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SOFTWARE REFERENCE

Tektronix provides a host of software packages to meet your needs.

The following pages provide a quick reference to match software and workstations, terminals, or instruments to your needs.

Workstation and terminal software is on page 15.

Communications Test and Measurement Instrument software is on pages 16-17.

HOW TO USE THE CHART:

By Software Package
Find the software package in the list on the left side of the chart. Follow across the row for the products supported, features provided, and languages supported.

By Workstation, Terminal, or Instrument
Find your product in the list at the top of the chart. Follow down the column to identify packages which support your product. Other workstations, terminals, or instruments supported by a particular software package, features provided, and languages supported are given in the row for each software package.

By Printer Support
Follow down the column for the printer to identify packages that support your product. Other products and features supported by a particular software package are given in the row for each software package.

By Features Provided
Follow down the column for the feature of interest to identify packages with this feature. Workstations, terminals, or instruments supported, other features, and languages supported are given in the row for this software package.

By Language Supported
Follow down the column for the programming language to identify packages that support this language. Workstations, terminals, or instruments supported, features provided, and other languages supported are given in the row for this software package.

INFORMATION DISPLAY

Software Package	Workstation/Terminal Support					Printer Support				
	4330/4230 Workstation	4320/4220 Workstation	4310 Workstation	4200 Terminals	VAX, MicroVAX, IBM	4693D	4695	4696	4510A	CX4510A
UTek™	•	•	•							
C Programming Language	•	•	•							
X Window System	•	•	•							
Small Talk 80			•							
Tek Common LISP			•							
Prologue			•							
Plot 10®				•	•					
TekniCAD	•	•	•	•	•				•	•
STI	•	•	•	•	•				•	•
GDI				•						
GKS	•	•	•	•	•				•	•
IGL	•	•	•	•	•				•	•
CADDPORT	•	•	•		•					
TekniCAP	•	•	•		•	•	•	•	•	•
TekPLOT	•	•	•		•				•	•
GSI					•					•
TekniLink				•						

COMMUNICATIONS, TEST AND MEASUREMENT

Instruments Supported

Software Package	2220/21/30 DSO—GPIB	2220/21/30 DSO—RS-232	2430/A/32A/40 DSO	2445A/B/65A/B/67B Scope	336/A DSO	370 Pgm. Curve Tracer	371 High-Power Pgm. Curve Tracer	390AD Waveform Digitizer	468 DSO	490P-/2750P-Series Pgm. Spectrum Analyzers	5223 DSO	7D20 Programmable Digitizer	7250 Transient Digitizer	7612D Pgm. Waveform Digitizer	7854 Waveform Processing Scope	7912 AD/HB Pgm. Digitizer	11301/A/302/A Pgm. Analog Scope	11401/402 Pgm. Digitizing Scope	AA 5001/SG 5010 Pgm. Analyzer/Oscillator	CG 5001 Pgm. Scope Cal. Gen.	DCS01/MUX Digital Camera System	MI 5010 Pgm. Multifunc. Interface	RTD 710/A Digitizer	TM 5000 Pgm. Test Instr.	TSI 8150 Test System Interface	Instruments From Other Vendors
EZ-TEST PC S45F030	•		•	•		•	•	•		•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•
GURU II S3FG100/110	•		•	•	•	•	•	•	•	•	•	•		•	•	•		•	•	•		•	•	•	•	•
GPIB Interface Software S3FG120/121/122																										
Signal Processing & Display (SPD) Software S3FG130	•	•	•								•	•			•	•		•					•			
ASYST Ver 2.0 S42P301																										
Digitizer Drivers for ASYST S42P302	•		•									•	•		•	•							•			
7854 Communications and Control Software S42P101															•											
7D20 Time and Amplitude Software S42P201												•														
7854 Time and Amplitude Software S42P202															•											
11400 Utility Software S47P102																		•								
11300 Utility Software S47P103																	•									
11400 Driver for ASYST S47P303																		•								
EMI Prequalification Software S26EM00										•																
General RF Applications Software (GRASP) S26RF00										•																
Remote Site Monitoring Software (RSM) S26RM00/01										•																
EZ-TEK 2400 S38A101			•	•																•		•		•		
370 Utility Software S48P104						•																				
370 Device Test Software S48P401						•																				
2220/2221/2230 Instrument Utilities S49Z201		•																								
2220/2230 Instrument Utilities S49Z202	•																									
2220/2221/2230 Instrument Utilities S49Z203	•																									
DCS Menu Software (Available only with DCS01 or MUX System)				•												•	•				•					•
DCS01 Functional Library S58DC01				•													•				•					•
DCS/GPIB Driver for 2467 S58DC02				•																	•					•
DCS/GPIB Driver for 11302 S58DC04																	•				•					•
24x5/2467/IBM PC Tutorial S49Z204				•																						
RTD 710 Digitizer S45D010																							•			

COMMUNICATIONS, TEST AND MEASUREMENT

Software Package	Printer Support										Features										Programming Language Support						
	IBM/EPSON	HC100	4693D	4695	4696						Front Panel Control	GPIB Communication	RS-232 Communication	Pulse Parameters	Waveform Analysis	Extended GRaphics	Test Procedure Generator	Test Program Generator	Data Logging	ADIF Format	Interpretive BASIC	IBM BASIC Compiler	Microsoft QuickBASIC	C Language	Borland Turbo Pascal	Fortran
EZ-TEST PC S45F030	•										•	•		•		•	•	•	•				•			
GURU II S3FG100/110	•										•	•		•			•		•	•	•	•	•			
GPIB Interface Software S3FG120/121/122												•									•	•	•	•		
Signal Processing & Display (SPD) Software S3FG130	•	•	•	•	•							•	•	•	•	•			•	•			•	•		
ASYST Ver 2.0 S42P301	•										•	•	•	•	•	•			•							
Digitizer Drivers for ASYST S42P302	•										•	•		•	•	•										
7854 Communications and Control Software S42P101	•											•										•				
7D20 Time and Amplitude Software S42P201	•										•	•		•	•	•										
7854 Time and Amplitude Software S42P202	•											•		•	•	•			•							
11400 Utility Software S47P102	•	•									•	•	•	•	•				•				•			
11300 Utility Software S47P103	•										•	•	•	•	•				•				•			
11400 Driver for ASYST S47P303	•										•	•	•	•	•	•			•							
EMI Prequalification Software S26EM00	•											•							•			•				
General RF Applications Software (GRASP) S26RF00	•										•	•			•				•		•	•				
Remote Site Monitoring Software (RSM) S26RM00/01	•										•	•			•				•		•					
EZ-TEK 2400 S38A101	•										•	•		•			•		•							
307 Utility Software S48P104	•										•	•				•	•		•				•			
370 Device Test Software S48P401											•	•				•			•							
2220/2221/2230 Instrument Utilities S49Z201													•			•					•		•			
2220/2230 Instrument Utilities S49Z202																									•	
2220/2221/2230 Instrument Utilities S49Z203												•				•					•		•			
DCS Menu Software (Available only with DCS01 or MUX System)	•	•												•		•	•		•	•						
DCS01 Functional Library S58DC01																							•	•	•	•
DCS/GPIB Driver for 2467 S58DC02	•	•									•	•		•			•		•							
DCS/GPIB Driver for 11302 S59DC04	•	•									•	•		•			•		•							
24x5/2467/IBM PC Tutorial S49Z204												•			•						•				•	
RTD 710/A Digitizer S45D010	•	•		•	•						•	•		•	•	•		•	•	•						

AnthroArm® PC

- **Holds up to 30 and 60 lbs.**
- **Easily Adjusts Up and Down**
- **Safely Tilts and Swivels**
- **Simple to Clamp on**

The AnthroArm PC frees your work space. It lifts your monitor screen up off your desk and keeps it within easy reach. Move it up, down, and swivel it around so you're perfectly comfortable.

The AnthroArm PC positions your monitor exactly where you want it:

- Raise your screen 7¾ to 12 inches above your desk for eye level viewing.
- Swing the AnthroArm 360 degrees and easily tilt your screen ±10 degrees so it is at the best angle for viewing.
- Extend the AnthroArm 16½ inches to bring it near you, or retract the arm to move it out of the way.

The AnthroArm clamps onto any surface from 1 — 2 inches thick and 2 inches deep simply by turning a knob. A desk clamp for surfaces without a lip will also be available.

Made of 16-gauge steel tube and glass filled polycarbonate plastic, the Arm moves up and down with an easy-to-turn hand crank. The AnthroArm has a 13×13 inch platform made of laminated high density fiber board with molded non-skid polyurethane foam skin. The platform is also available with a 17×17 inch platform. The arm has a durable baked-on liquid platinum gray finish.

For more information on the AnthroArm PC call:
Outside Oregon:**1-800-325-3841**
In Oregon: (503) 241-7113

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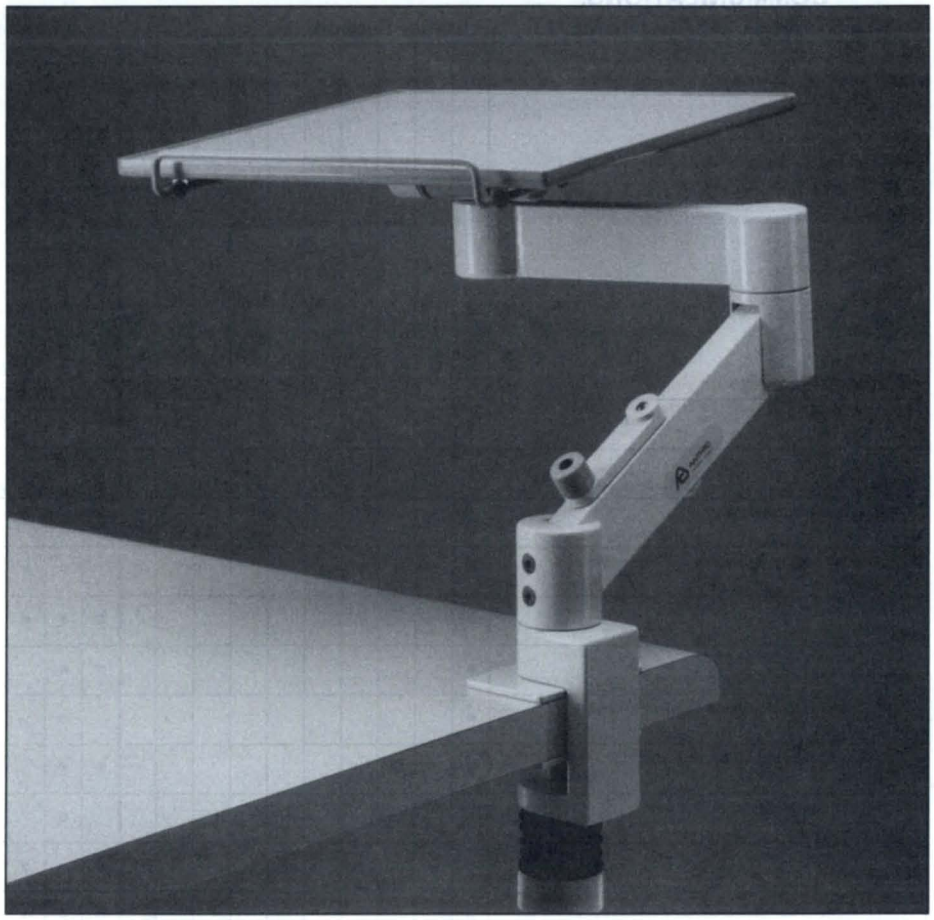
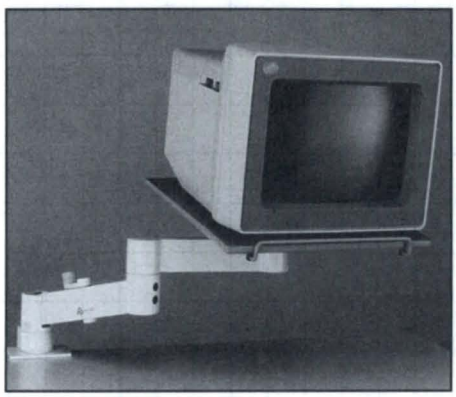
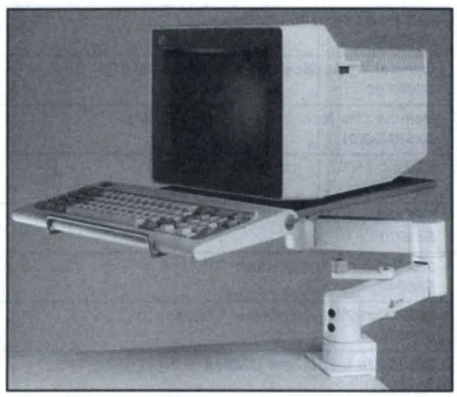
FAX 503-241-1619



AnthroArm PC keyboard holder optional. AnthroArm also available with 17×17" platform.



The AnthroArm PC extends or retracts for convenient use.



The AnthroArm PC moves up or down with the simple turn of a handle.

AnthroArm® GT

- **Holds up to 200 lbs.**
- **Rotates 360°**
- **Cast Aluminum Construction**
- **Five Year Warranty**

The AnthroArm GT is the space saving armature designed to hold substantial loads—up to 200 lbs. Float your heavy 19 inch terminal above your workspace and have plenty of room to spread out underneath.

Now you can easily move your terminal around. Push the AnthroArm back to store your monitor out of the way. Pull it towards you for better viewing. Swivel it 360° to get rid of screen glare or to share with others. Move it exactly where you want it.

Choose between three different models, depending on the reach you want (how much depth you have on your work surface) and how much flexibility you want the arm to have.

The AnthroArm is also available for OEM applications. The arms, mounting plates and platform can be ordered separately or in different combinations for specific use.

The AnthroArm GT. The only arm strong enough to give you back your workspace.

CHARACTERISTICS

- Arm, base plate and mounting plate are thick-wall aviation grade casted aluminum, hardened to T6. The parts have a baked-on liquid smoke tan finish.
- The main pivots are 1 inch ID brass bushings. Other pivots are oil light brass bushings.
- The AnthroArm's 17 ×17 inch platform is made of laminated high density fiber board with molded non-skid polyurethane foam skin.
- Two stacking lugs ($^{7}/_{8}$ inch each) are included for height adjustment.

For more information on AnthroArm GT call:
Outside Oregon: **1-800-325-3841**
In Oregon: (503) 241-7113

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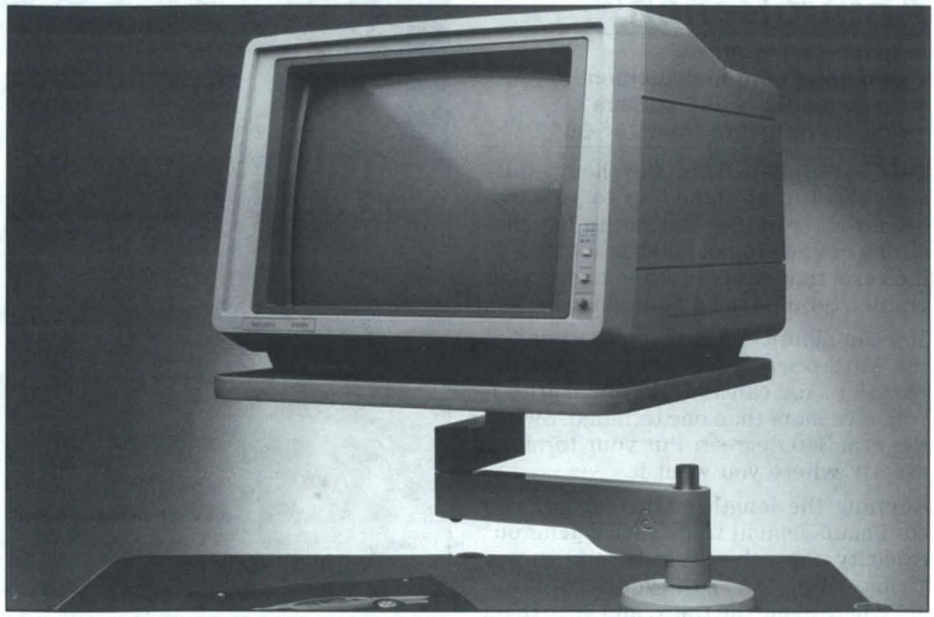
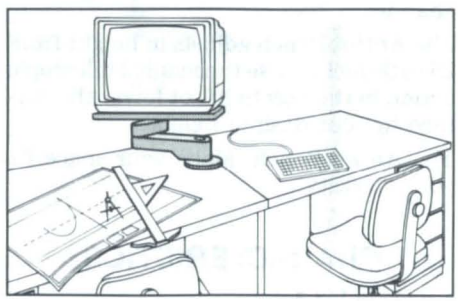
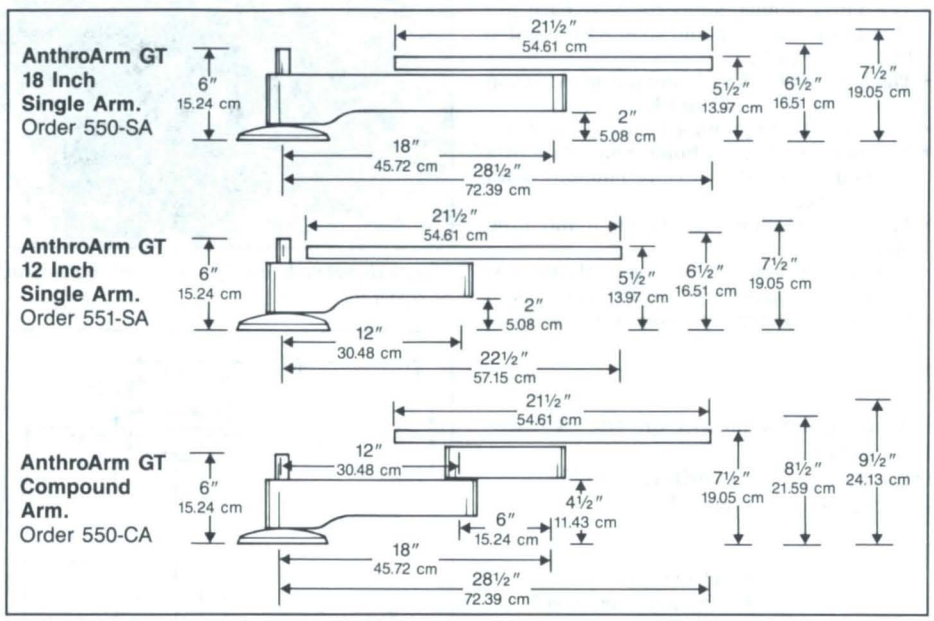


AnthroArm GT is also available with 13×13 inch platform.

The AnthroArm clears your work surface so you have more space.



With the AnthroArm, you can share equipment between stations.



AnthroBench™

- **Space saving arm**
- **Generous cord management**
- **Spacious 60″ × 36″ surface**
- **Adjusts in height from 25″-30″**

The AnthroBench is the heavy-duty workbench that stands up to your rigorous daily routine. The AnthroBench is strong enough to hold 600 lbs., with a 12 inch arm that easily lifts and moves your graphic terminal over your worksurface.

You can mount the Arm at either end of the AnthroBench depending on your application. You can add additional arms if you have more than one terminal. Swivel the arm 360 degrees. Put your terminal exactly where you want it.

Running the length of the surface is a cord management track with a generous capacity for cables, cords, and power strips. You can run your cords in anywhere along the track, and keep them out of your way in the 2′.5″ w. × 3′.75″ d. channel.

The AnthroBench adjusts in height from 25 to 30 inches. Use the manual telescopic action in the legs to lift or lower the surface to your desired height.

The AnthroBench. Make your space fit your workstyle.

CHARACTERISTICS

- Made in U.S.A.
- Base and track are smoke tan color. Surface is platinum gray.
- The cross beams, supports, and base are aluminum extrusion and steel with durable baked on finish.
- The legs are 3 × 6 inch aluminum extrusion with powder coated finish.
- The connecting joints are cast aluminum.
- The work surface is honeycomb structure covered with high pressure laminate with rolled edges.
- The AnthroArm is cast aluminum mounted on a steel post.
- The AnthroArm's 17×17 inch platform is made of laminated high-density fiber board with molded non-skid polyurethane foam skin.
- Patents pending.

For more information on the AnthroBench call:
Outside Oregon: **1-800-325-3841**
In Oregon: (503) 241-7113

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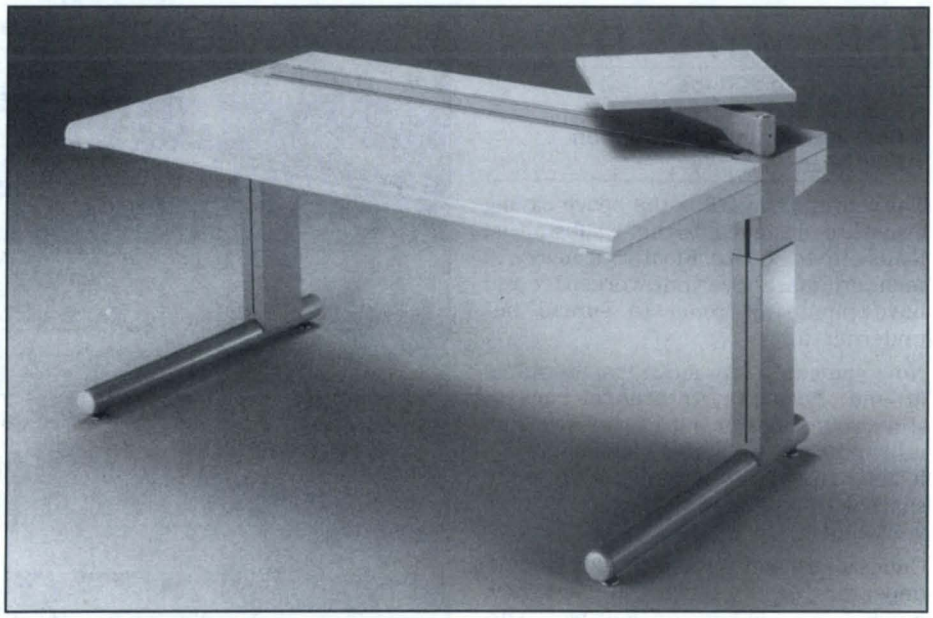
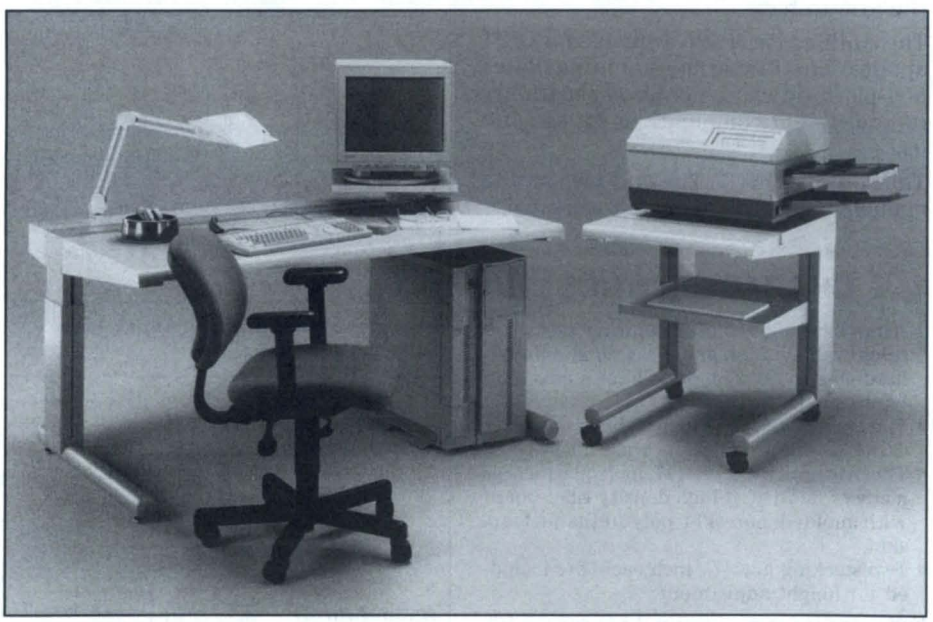
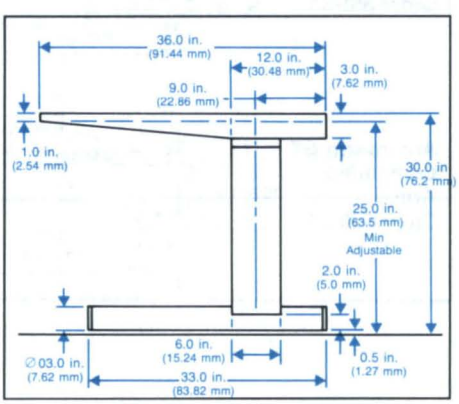


The AnthroBench comes standard with a 12 inch arm that supports 200 lbs.



The AnthroBench family includes the AnthroBench PrinterStand and other options which will be available soon.



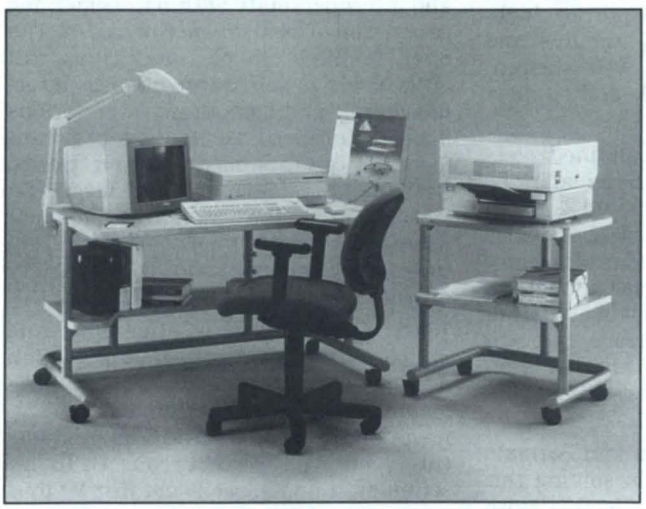
AnthroCart®

The Original AnthroCart. Mobile. Incredibly strong. So many ways to solve your space and equipment problems. Choose different sizes. Move shelves around. Add space saving options. AnthroCart. Well-designed technology furniture.

Original AnthroCart with sidecar option for large printers.

Original AnthroCart with PrinterBasket option for small printers.

Original AntyhroCart with Extension Shelf Kit for more shelf space.



KingSize AnthroCart with Anthro PrinterCart.

KingSize AnthroCart with SideRack option for vertical CPU's.

KingSize AnthroCart with Extension Shelf Kit option.

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FAX 503-241-1619
For more information on the AnthroCart call:
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Tektronix Means. . . Measurement Capability, GPIB Compatibility, VXI Innovation

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Tektronix Systems Experience

Long before publication of IEEE Standard 488-1975, Tektronix had entered the measurement systems business with the development premises of system flexibility, automation, and standarization firmly in place.

System flexibility through modular design goes back to the introduction of modular lab oscilloscopes, which utilized plug-in modules to provide a broad range of automated features and enhanced capabilities. With the introduction of the TM 500 family of instruments, modular flexibility was extended to a full line of test and measurement equipment.

The measurement speed and capabilities of the Tektronix automated oscilloscope and semiconductor test systems highlighted the benefits of measurement automation. The obvious next step was to combine automation and modularity—an interfacing standard was needed. But what standard?

A Leading Supplier

Tektronix recognized the benefits of the proposed IEEE 488 Standard. By the time it became reality, Tek had already integrated GPIB compatibility into product planning and engineering. As a result, Tektronix is now a leading supplier of a full line of GPIB system components—a supplier that puts more than a decade of systems planning, design, and implementation into each product.

GPIB systems come in many sizes, from small PC-based systems (such as the PEP family) to larger minicomputer-based systems. Effective test and measurement systems utilize specialized instrument control and signal processing software. Examples such as Tek EX-BUS, SPD, or Tek GPIB, along with smart, easy-to-program instruments and a variety of control hardware and software make tailoring an automated test system relatively easy and cost effective.

GPIB compatible system components make it possible to realize the benefits of automated testing without paying the price of a unique system design effort for each new test configuration. With Tek's TM 5000 family of GPIB compatible system components, complete test and measurement systems can be built by simply selecting the required off-the-shelf modular products, cabling them together, and adding the necessary software.

More Than Modular Products

But Tektronix offers more than just modular products. . .Tektronix has an entire staff of hardware, software, and systems specialists whose sole purpose is to provide total, integrated measurement systems solutions.

Whether the application calls for a manual, in-circuit test system or a totally automated system requiring high-speed, multiple channel stimulus and data acquisition, Tek will design, manufacture, test, install, and support your total solution.

While IEEE 488 initially defined electrical, mechanical, and functional interface standards (see Tables 1 and 2), it did not specify the syntax or coding of device dependent messages that control the programmable features of an instrument. As a result, some instruments will electrically and mechanically interface, but will not communicate within another vendor's system without expensive customized software drivers.

Tektronix Standard Codes and Formats

Tektronix took the lead in solving this systems communication dilemma with the implementation of the Tektronix Standard Codes and Formats for GPIB-compatible equipment. This set of standards defines message coding in simple, unambiguous, English-like terms. Initially designed for our own instruments, Tek Standard Codes and Formats have served as the basis for industry-wide standards.

Obviously, most users prefer the ease and safety of single vendor solutions, but getting the optimum price and performance for all test requirements from a single vendor is difficult. Consequently, many GPIB systems are quiltworks of instruments from different vendors. . .with the resulting software problems.

Tektronix solves this problem by providing the best combination of products for your requirements, even if other vendors' instruments are needed. These solutions are available in a wide range of choices, from individual system instruments to complete test and measurement systems. And Tek will integrate all of the products with the combined knowledge of our systems experts to provide you with a total system solution.

VMEbus Extensions

Moreover, Tek has been instrumental in taking a long-term approach to solving the instrument compatibility problem through its contribution in establishing a new industry-wide standard: the VMEbus Extensions for Instruments—VXIbus Standard. The new VXIbus standard ensures flexibility, multivendor selection and interoperability within the emerging generation of *instruments on a card*. The open architecture of the VXIbus will allow users to select instruments, interface cards, and computers from various manufacturers to develop the best card modular test systems for their needs. Both military and industrial users can look forward to the benefits of equipment downsizing, tighter time coordination between instruments, and a wider variety of solutions from which to choose.

Tektronix, as one of the founding members of the consortium which developed the VXIbus standard, is at the leading edge of VXI technology and innovation, offering its first VXI products this year. And, as with our GPIB instrumentation, Tek sells not just VXIbus products. . .but total systems solutions.

As VXIbus technologies and products emerge and find their place in the market, GPIB-based systems will still have their niche. Moreover, as a result of standarization activities sponsored by Tektronix and other vendors, GPIB-based systems can be easily integrated with VXI systems.

TABLE 1. INTERFACE FUNCTIONS DEFINED BY IEEE STANDARD 488.1-1987

Function	Description
Source Handshake (SH)	Synchronizes message transmission
Acceptor Handshake (AH)	Synchronizes message reception
Talker (T)	Allows instrument to send data
Listener (L)	Allows instrument to receive data
Service Request (SR)	Requests service from controller
Remote-Local (RL)	Allows instrument to select between GPIB interface & front-panel programming
Parallel Poll (PP)	Allows up to eight instruments to simultaneously return a status bit to the controller
Device Clear (DC)	Clears communication channel or puts instrument in known state
Device Trigger (DT)	Starts some basic operation of the instrument
Controller (C)	Sends device addresses and other interface messages

Going Beyond the Basics—Tek Standard Codes and Formats

Tek has recognized the need for additional standardization in GPIB interfacing since the late 1970s and has applied rigid internal standards to the design of its GPIB interfaces which go above and beyond the requirements of IEEE 488. Our guiding document is known as Tektronix *Standard Codes and Formats*. Tek pioneered the concepts of human-readable code, forgiving listening, and standardized data types. Over the years, these features were copied and adapted by several other companies for their own products. Now a new standard has been completed—IEEE Std. 488.2-1987. This document combines the best features of Tektronix *Standard Codes and Formats* plus ideas from other companies. IEEE Std. 488.1-1978 was polished (but kept basically unchanged and backwards compatible) and renamed 488.1-1987. These new standards—488.1-1987 and 488.2-1987—will further enhance compatibility for GPIB systems throughout the industry.

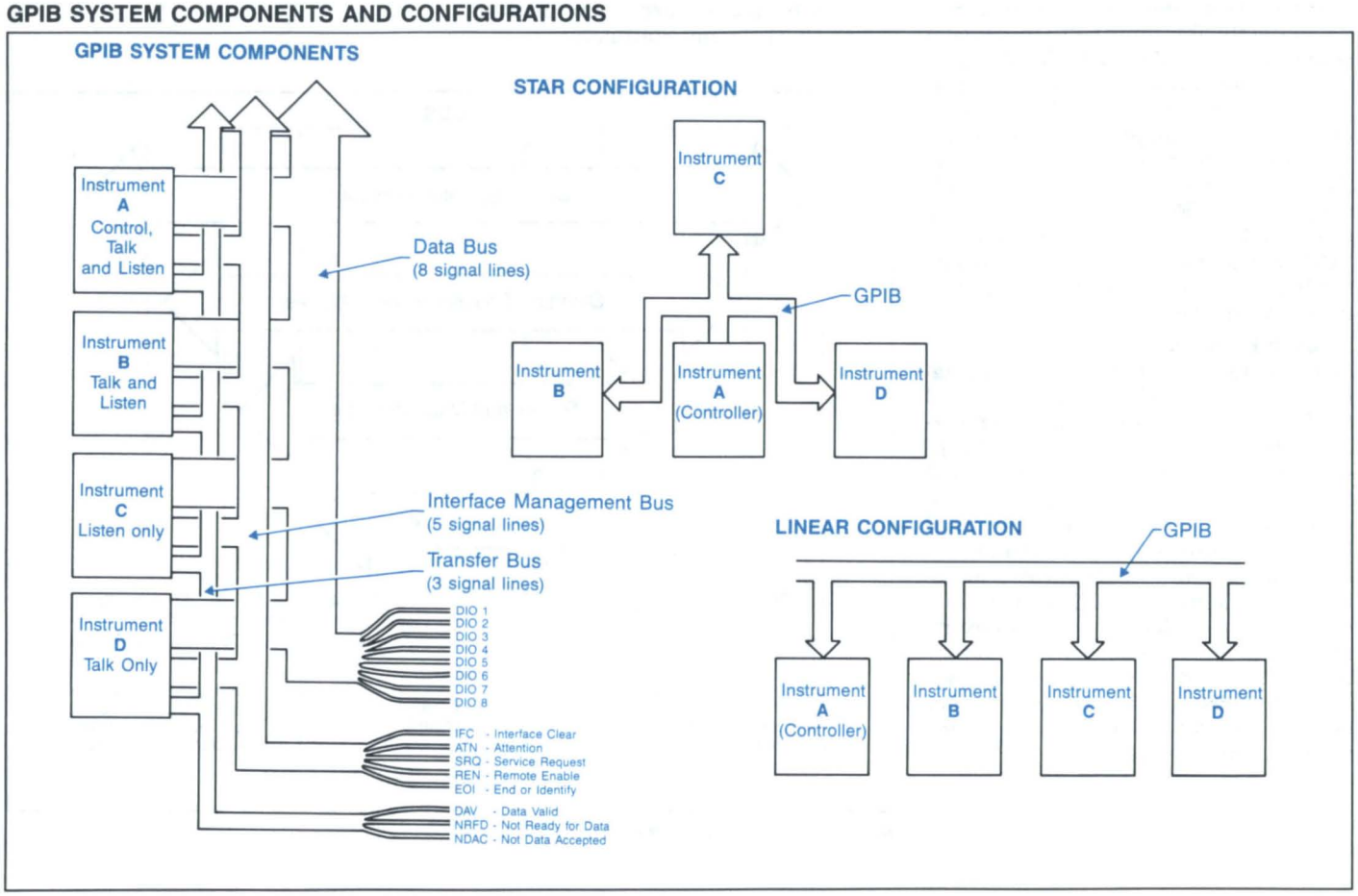
As a market for 488.2 devices matures, Tektronix will offer 488.2 compatibility on its new products, as appropriate. IEEE 488.2 was carefully designed to work with a wide variety of existing GPIB products. Instruments designed to the Tektronix *Standard Codes and Formats* will fully function in systems that employ 488.2 instruments.

Tek Standard Codes and Formats Means Programming Ease

IEEE Standard 488.1-1987 specifies the hardware interface and its basic functional protocol. It also specifies a set of codes called *interface messages* that control interface functions. 488.1 leaves the remaining higher level protocols—messages that control the programmable features of the instrument—up to the instrument manufacturer.

Since the device-dependent messages are not specified by GPIB, instruments that conform only to the basic GPIB standard may use inconvenient or even incompatible message formats.

GPIB SYSTEM COMPONENTS AND CONFIGURATIONS



The situation is analogous to an international telephone system—the hardware link is well defined, but unless both parties speak the same language, effective communication is not possible. That's why Tektronix developed a codes and formats standard in 1979, and why these same principles have been incorporated into the new 488.2 standard.

The benefits of the standards are numerous. Because of a natural English-like structure, instrument control commands and messages are easy to use. The result is a GPIB implementation that is specifically designed to overcome the programming rigidity and cumbersome procedures of other GPIB systems.

Both standards address the needs of users to develop test and measurement systems quickly and easily. The spirit of these standards is to provide message coding that is:

- Simple and unambiguous
- Uses commands common to other similar devices
- Uses simple and easy-to-remember mnemonics

ASCII Data Standard

Because most controllers accept ASCII data directly, Tektronix GPIB instrument commands are coded in ASCII. This procedure eliminates the need for error-prone data conversions or byte-by-byte encoding. For example, to set the center frequency of the 492BP Spectrum Analyzer to 1.75 MHz, the command is simply written FREQ 1.75 MHz—no more calculated percentages of full-scale or BCD equivalents. Settings for Tektronix GPIB instruments are sent as ASCII data in human-readable form.

Flexible Formats

Many minor format items that are aggravations in other systems are covered by Tektronix *Standard Codes and Formats*. For example, Tektronix GPIB instruments accept negative zeros and leading and trailing spaces; they also overlook inconsistent use of upper- and lower-case letters. Because truncated numbers can drastically affect measurements, Tektronix GPIB instruments round off rather than truncate: for example, a value of 2.49 becomes 2.5 rather than 2.4. In short, the built-in intelligence is used to make intelligent decisions. That makes your programming job much less rigid and much easier.

Common Messages

To make your job even easier, Tektronix *Standard Codes and Formats* also specifies messages that are to be common to all Tektronix programmable instruments. For example, you can program your system to learn the current settings of any Tektronix GPIB instrument by sending the instrument the SET? message. Any GPIB-compatible instrument from Tektronix—whether it is a waveform digitizer, a programmable power supply, or a function generator—interprets SET? the same way. The instrument firmware assembles the instrument's settings into a human-readable message to be sent over the bus to the controlling software. If you know how to operate a function generator, then you already know how to read a settings message from a Tektronix GPIB-compatible function generator.

Language Support

While BASIC remains the most established programming language used for instrument control, C and Pascal are growing rapidly in acceptance. Open systems that allow the user to choose either C, BASIC, or Pascal give programmers a choice of their preferred language without having to learn a new language just for instrument control.

Software—A Key Factor

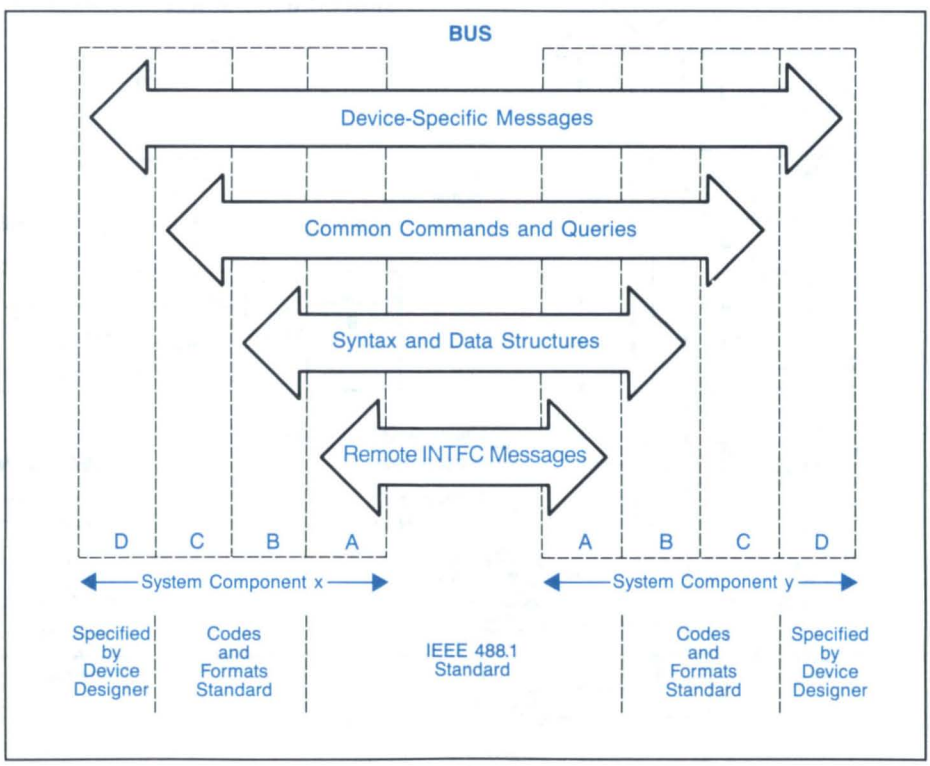
Software is more than an essential system ingredient; it gives the system its characteristics:

- Measurements performed
- Data analysis, data logging, and reporting
- Operator access and interface

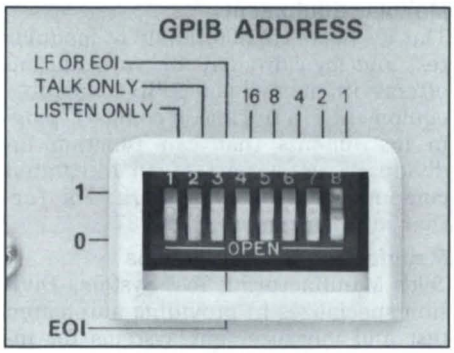
Software gives the system the *personality* its users see. Most systems involve two levels of software:

- The operating system software
- Applications software that the user applies to a particular measurement or task.

The operating system software provides basic functions such as file and directory access. Many operating system functions can also be accessed by applications. This enables the applications software to easily perform tasks for measurements without re-inventing features found in the operating system. The operating system provides a layer of functions and a system environment that may also give access to a wide variety of software products; MS-DOS is the prevalent operating system used in Test and Measurement applications.



Functional layers in GPIB systems.



Each GPIB instrument or peripheral, called a device, must be assigned a different system address. You can do so by simply setting switches, usually located on the back panel of the device.

Dedicated controllers have their own languages, such as BASIC or C. Open system controllers like the Tektronix PEP 301 host a variety of languages to choose from, such as BASIC, C, or Pascal. Languages provide the context through which users express control of instruments, data storage and analysis.

Controllers and Software to Match Your Needs

Tektronix offers controller-software packages to meet varying GPIB system needs.

The PEP family of Instrument Controllers are complete GPIB controller packages based on the Intel 80386 microprocessor. GURU II software and a GPIB interface card are standard.

Software Packages

- GURU II software, an interface package for the IBM PC (or IBM-compatible PC), uses National's GPIB card. This package contains a TEST PROGRAM GENERATOR, programming examples, and an excellent manual to help the novice user get started or the familiar user be more productive.
- The TekMAP (Tektronix Measurement Applications Programs) library of software products supports the Tektronix 7000 Series GPIB-programmable digitizers and extends the capabilities of these digitizers by integrating them with Tektronix controllers, IBM personal computers, or HP Series 200 technical computers.
- EZ-TEST PC is a test program generator that automates generating GPIB test and measurement software. Automatic code generation often cuts development time by 60 to 80%. EZ-TEST PC works with Tektronix and other manufacturer's instruments. Code generation is Microsoft QuickBASIC source files that the user can use as is, or optimize into standalone programs.
- SPD (Signal Processing and Display) is both a library of 196 functions and an application level program. From the menu application, the user can perform FFT, IFT, windowing, graphical display, and plotting on a variety of hard-copy devices. Using the library level of SPD, users can develop their own applications in compiled BASIC or C.
- EZ-BUS is a software program developed for the PEP 301, PEP 303, and PEP 303R that adds instrument control functions to widely accepted compilers for Microsoft C, QuickC, or QuickBasic. EZ-BUS simplifies programming and enhances the programmers' ability to handle service requests (SRQ).
- TDMS—the Test Development Management System—is a set of tools and operating system extensions available only on the PEP 301, PEP 303, PEP 303R. It provides word processing, terminal mode, graphics drawing, software revision control, and multitasking capability. TDMS allows the user to run more than one application at a time, and eases moving the results of one program to another.

SPD Software

Signal Processing and Display (SPD) Software supports 196 processing, analysis, and data-to-display functions using Tek digitizers in conjunction with an IBM PC, PC/XT, or PC/AT. Designed for scientific and engineering applications, this package includes complete mathematical functions plus waveform data, I/O utilities, analysis, processing, and graphic display functions. Access is via disk or GPIB port using popular waveform digitizers.

GURU II Software

GURU II is a simple but powerful package that provides control of GPIB (IEEE Standard 488.1) electronic instruments from an IBM PC (or compatible). It offers the menu-driven Test Procedure Generator to speed applications programming.

GURU II's Test Procedure Generator (TPG.BAS), written in BASIC, is a self-explanatory menu-driven program. It is the right tool for instrument system users who want fast results or who don't want to learn to program their system in BASIC. It allows you to generate a program that runs a specific test sequence—without writing a single line of code. You need to know only the details of the test to be performed and the equipment used.

The TPG is most suited to nondigitizer applications where testing of devices is required using programmable power supplies, digital voltmeters, signal sources, and counters.

For users who want to write their own application programs, GURU II provides SUBS.BAS, a set of canned subroutines.

These subroutines perform functions common to many test and measurement applications, complementing the IBM PC compatible Microsoft BASICA language (an advanced form of BASIC).

TekMAP Software

The Tektronix Measurement Application Programs (TekMAP) library of software products supports the Tektronix 7000 Series GPIB programmable digitizers in automated engineering or research environments. It extends the versatility of Tektronix digitizers by integrating them with Tektronix controllers, IBM personal computers, or HP Series 200 technical computers.

Basic communication utilities, accessible through friendly menu-driven user interfaces, are available through Communication and Control Utility Software.

Extended measurement capabilities (such as automated pulse parameter analysis, fast Fourier transformation, and propagation delay measurements) are provided by the Time and Amplitude Measurement Software products.

Tektronix Support for Your GPIB System

With GPIB products and systems from Tektronix, you're not left on your own after the product is purchased. Tektronix offers complete support and training for the operation and maintenance of its GPIB products and systems.

Every product is shipped with a complete and comprehensive operating manual. In addition, a variety of training services are available. Training classes are available both at our home office and at selected sites around the world.

As part of the long-term support for GPIB products and systems, Tektronix offers a variety of application literature and support.

HANDSHAKE is an applications newsletter published quarterly by Tektronix that contains application and technical articles about instrumentation and instrument systems.

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. Information is in the Customer Training Section. For further information, or to enroll, call us at 1-800-835-9433 ext. 430. In Oregon call collect 1-629-1017.

TEKWARE and TAS Service Support

The Tektronix Instrumentation Software Library provides software and application information for Tektronix programmable measurement instruments and systems. Two types of software are available:

- Measurement Software
- Instrument Utility Software

The TEKWARE Instrumentation Software Library includes development tools for creating and modifying software as well as drivers, processing modules, display modules, and a variety of ready to use applications software for general purpose control, measurement, and display. In addition, Tek will provide the Technical Assistance Service (TAS) support to write custom software, to generate test procedures for your application, to train your staff, or to provide whatever level of technical service support that you need. See page 470.

The Tektronix Instrumentation Software Library catalog provides program abstracts and ordering information.

Application notes and magazine article reprints are another source of information offered by Tektronix. Our Sales Offices and Sales Representatives maintain a list of current literature and will be glad to supply you with items in your areas of interest.

Warranties and service are part of the support you get from Tektronix. Tektronix maintains a network of service centers for your maintenance needs at strategic locations throughout the world.

For more information see Customer Services and Information Section of this catalog.

Guide for Selecting GPIB Instruments

When selecting GPIB instruments for a specific application, be sure to check several key specifications for suitability in the configuration. Make sure that:

- The instrument can make the desired measurements
- The interface functions are compatible with the proposed usage and with other instruments in the GPIB configuration

You and your sales representative can use the following items as a checklist for selecting GPIB instruments:

- ☐ What is the application: Interactive measurement analysis or automated measurement? (Are all necessary instrument functions remotely programmable, or will an operator be available to adjust settings?)
- ☐ Does the instrument's GPIB interface have the necessary set of functions implemented at the desired level? (For example, AH1 is needed for any useful interaction and SH1 is required for instruments supplying measurements to the controller.)
- ☐ Are diagnostics available to check out the instrument from the front panel or over the GPIB interface?
- ☐ Does the instrument use standard codes and formats conventions for terminators, numeric formats, and other software features?
- ☐ Can the instrument's front-panel setting be read from the controller and saved for later automated set up?
- ☐ Can the front panel be "locked out" via the GPIB?

Tektronix Provides Systems Solutions

As the explosion of micro-electronic technology has driven the evolution toward smaller, faster, more powerful, and more automated test and measurement systems, Tektronix has remained at the leading edge of development, providing a full range of products and services to ensure total system solutions to test and measurement problems.

Once, Tektronix provided only measurement equipment. Now, users also need completely automated and integrated test systems that are affordable, flexible, expandable, and simple to use. Whether the system requires modular TM 500 instruments for a fully manual controlled application, fully automated Manufacturing Test Systems using TM 5000 Series instruments controlled with the PEP 301 system controller, specialized equipment for high speed multi-channel stimulation and acquisition, or VXIbus instrumentation, Tektronix can provide the solution.

Furthermore, Tek's systems are *not just hardware packages.* With each system, Tek provides complete design services, a fully documented system proposal, manufacturing and integration, software development, on-site installation, maintenance and repair services, and technical support. For further information on complete measurement systems see the following catalog sections:

Modular Equipment

The TM 5000/TM 500 family of modular test and measurement instrumentation offers both manual and GPIB compatible equipment in a full line of compact, plug-in instruments that can function individually or as part of an integrated computer-controlled network. For further information, see page 371.

Manufacturing Test Systems

Tek's Manufacturing Test Systems Division specializes in providing automated test and measurement systems for industry. Whether you need to monitor vibrations on a piece of heavy machinery, perform at-speed testing of critical military circuit boards, or functionally test thousands of boards on a fully automated bed-of-nails test system, this group can provide a solution. See page 476.

Integrated Measurement Systems

Measurement systems solutions requiring high-speed, multiple channel data acquisition, data logging, and diagnostic testing; time domain measurement systems; and automated test systems for low-run manufacturing environments, are the forte of Tek's Integrated Measurement System Group. There's no application too fast or too complex for our unique systems solutions. See page 474.

VXIbus Systems Instrument

Tektronix is at the forefront in the development of "instrument on a card" systems conforming to the new VXIbus standard. The short and well-matched propagation delays and tight time coordination possible within this controlled backplane structure promise users new, high levels of performance. For details about Tek's newest approach to systems development see page 482.

Customized Systems Products

Selected products can be modified with off-the-shelf plug-ins, options, or other customized modifications to meet specialized requirements.

Tektronix Systems Affiliates (TSA) Services

Through the Tektronix TSA program, Tek secures the services of qualified system vendors who know your application best, working in conjunction with Tektronix to provide assured customer satisfaction and continuing support.

Semiconductor Test Systems

Tektronix test systems have kept up with the ever increasing complexity and higher speed requirements of semiconductor testing. The LT-1000 offers a cost-performance breakthrough in the testing of high-speed, high pin-count, CMOS VLSI. See page 471.

ACCESSORIES

Recommended GPIB Cables

Part Number	Description
012-1015-00	0.5 meter, single shield
012-0991-01	1 meter, double shield, low EMI
012-0991-00	2 meters, double shield, low EMI
012-0991-02	4 meters, double shield, low EMI

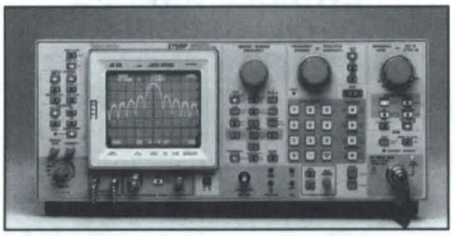
GRAPHICS WORKSTATIONS

4300 Graphics Workstation Support
GPIB is supported as an option on the following:

4330 3D Series
4320 2D Series
4319 2D X Window
4301 Computer Module

See page 47 for additional information.

LABORATORY SPECTRUM ANALYZERS



2756P 10 kHz to 325 GHz Programmable Spectrum Analyzer
This benchtop analyzer combines laboratory performance with ease of use and advanced signal processing intelligence. Full control of the front panel, waveform processing, and storage are accessible via the standard GPIB. See page 106 for additional information.

2755AP 10 kHz to 325 GHz Programmable Spectrum Analyzer
The 2755AP laboratory performance spectrum analyzer offers built-in signal-processing intelligence. Marker intelligence provides hands-off convenience for measuring the bandwidth of filters, amplifiers, and other networks. Menu-selectable signal processing provides measurements at the touch of a button. These features and many more are controllable via the standard GPIB for measurement repeatability. See page 108 for additional information.

2754P 50 kHz to 21 GHz Programmable Spectrum Analyzer
This benchtop analyzer is fully programmable via the GPIB for increased measurement speed and repeatability. It combines built-in signal processing intelligence and marker intelligence for easy use. See page 110 for additional information.

2753P 100 Hz to 1800 MHz Programmable Spectrum Analyzer
The 2753P laboratory performance spectrum analyzer features a built-in frequency counter and macro recall menus. Advanced intelligent markers and signal-processing capabilities are controllable via the standard GPIB for measurement repeatability. See page 112 for additional information.

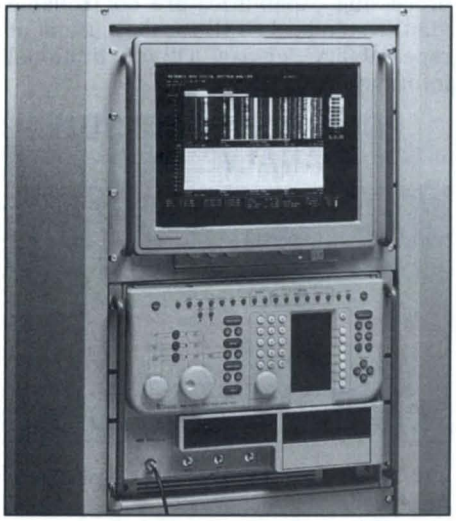
PORTABLE SPECTRUM ANALYZERS

494AP 10 kHz to 325 GHz Spectrum Analyzer
The 494P provides lab precision measurement capability in hostile field environments. Full control of the front panel, waveform processing, and storage are accessible via the standard GPIB. See page 116 for additional information.

492BP 10 kHz to 325 GHz Programmable Spectrum Analyzer
This portable spectrum analyzer offers built-in signal-processing intelligence. Marker intelligence provides hands-off convenience for measuring the bandwidth of filters, amplifiers, and other networks. Menu-selectable signal processing provides measurements at the touch of a button. These features and many more are all controllable via the standard GPIB for measurement repeatability. See page 118 for additional information.

495P 100 Hz to 1800 MHz Programmable Spectrum Analyzer
The 495P offers features essential for lab-grade spectrum analysis in a light-weight portable package. This spectrum analyzer incorporates advanced intelligent markers and signal-processing capabilities all controllable via the GPIB. See page 120 for additional information.

DIGITAL SPECTRUM ANALYZER



3052 DC to 10 MHz Programmable Digital Spectrum Analyzer

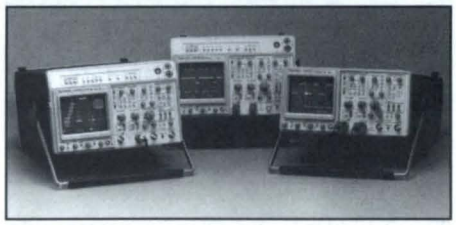
The new 3052 has exceptional processing speed for demanding signal processing applications. The 3052 performs a 1024 point complex frequency conversion every 200 microseconds with an unparalleled real time bandwidth of 2 MHz. The RS232 terminal provides full access to the 68020-based CPU and its C-compiler to develop specialized measurement programs for data analysis routines in the instrument itself. With the GPIB option, the 3052 is remotely controllable, and waveforms can be transferred to the host controller. The GPIB permits programming of virtually all of the 3052's capabilities. Compatible with IEEE 488.2, the instrument can function as a LISTENER or TALKER/LISTENER. The recommended controller is the Tektronix PEP 301. See page 94 for additional information.

2630 Fourier Analyzer

The new 2630 high performance, multichannel signal analysis instrument is ideal for testing and monitoring applications involving mechanical, electrical, or electrical/mechanical systems and components. See page 96 for information.

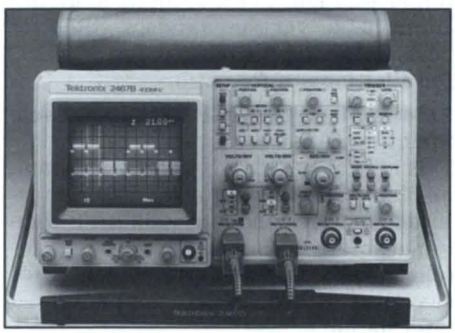
ANALOG OSCILLOSCOPES

PORTABLE ANALOG OSCILLOSCOPES



2465B, 2455B, 2445B Option 10

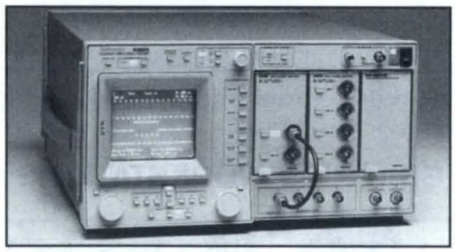
These three portable scopes can be easily programmed to assist the scope operator complete a sequence of measurements. Front-panel settings can be remotely set/changed with display prompting of messages, providing operator guidance. The results of voltage, time, fre- quency, phase, and ratio can be both displayed on the CRT and read back over the bus. CT versions are ideal for automatic frequency, period, pulse-width, and time-between-events measurements; the DM for automatic counter and digital tests and measurements; and the DV for high-resolution video applications. See page 156 for additional information.



2467B Option 10

The 2467B has the fastest visual writing rate available in a portable oscilloscope due to the microchannel plate CRT, which amplifies the brightness of transient events. The 2467B Option 10 can be easily programmed to assist the scope operator perform a complete sequence of measurements. Front-panel settings can be remotely set or changed via the GPIB. Measurement results can be both displayed on the CRT and read back over the bus. See page 156 for additional information.

LABORATORY ANALOG OSCILLOSCOPES



11301A and 11302A

These oscilloscopes offer a new degree of measurement versatility up to 500-MHz bandwidth. Full programmability via either the GPIB or RS-232C plus a touch-screen operator interface make these plug-in scopes ideal for both automatic test systems and benchtop applications. A built-in 500-MHz counter/timer and peak detecting make measurements that normally require a digitizer. The results of all measurements are displayed numerically on the CRT and are available over either bus. See page 194 for additional information.

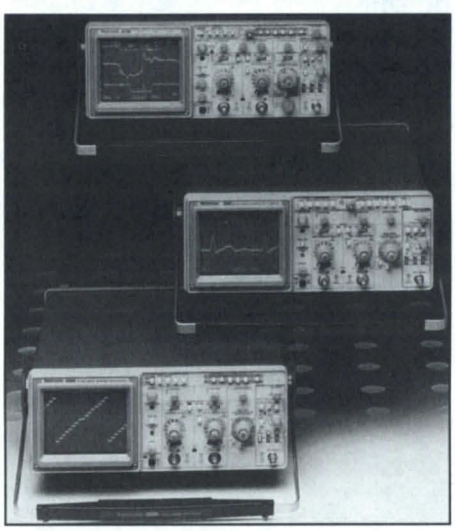
DIGITAL STORAGE OSCILLOSCOPES

Tektronix is always improving digitizing oscilloscope performance. Call your local sales representative for the latest offerings.

PORTABLE DIGITAL OSCILLOSCOPES

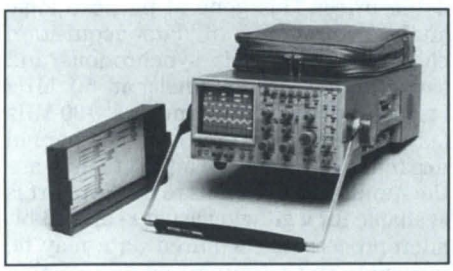
2440, 2440M, 2432A, 2432M, 2430A, 2430M

Our 2400 Series Digital Oscilloscopes set the industry standard for measurement and automation performance in portable, compact oscilloscopes. At the top of the line, the 2440 offers 500 MS/s sampling, 300 MHz bandwidth, dual-channel simultaneous acquisition, 8-bit vertical resolution, and 2 ns maximum sweep speed. The Tek patented Save on Delta makes pass/fail testing decisions automatically. The scope is fully programmable over the GPIB. It sends and receives waveforms, front-panel settings, custom menus, and operator prompts. It provides direct printer/plotter output—without a controller. The M version of each scope offers all features of the standard scopes, plus CIIL capability for operation in Modular Automatic Test Equipment used in testing military avionics and weapons systems. See page 220 for information.



2200 Digital Storage Oscilloscopes

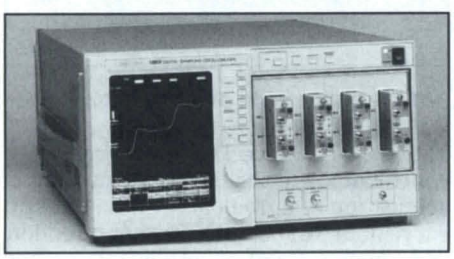
The 2200 family of portable scopes offer both analog and digital capability to 100-MHz (2230) and to 60-MHz (2221, 2220). All scopes offer "Peak Detect Mode", allowing glitch capture to 100 ns at any sweep speed. The 2230, 2220, and 2221 also feature unlimited storage time, pre/post trigger viewing, roll/scan modes, and standard X-Y plotter output. Options include RS-232C or GPIB interface capabilities. In addition, the 2230 includes battery-backed memory with other options to allow saving up to 26 waveform sets. See page 27 for more information.



336A Digital Storage Oscilloscope

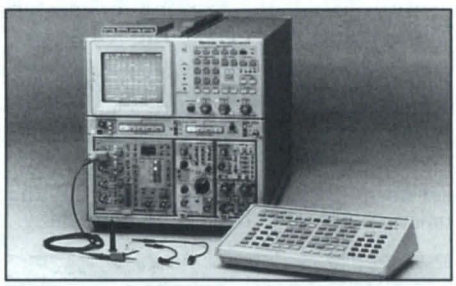
This compact scope can simultaneously display analog and digital waveforms, and can store up to 16 for recall and display. Nonstorage bandwidth is 50 MHz; storage bandwidth is 140 kHz. Vertical and horizontal scale factors, delay time position, and voltage and time readouts of cursor positions are displayed on the CRT, as is a menu of many of the features and modes. An Auto mode for both vertical volts/division and horizontal time/division allows "hands-off" operation in many applications. See page 236.

LABORATORY DIGITAL OSCILLOSCOPES



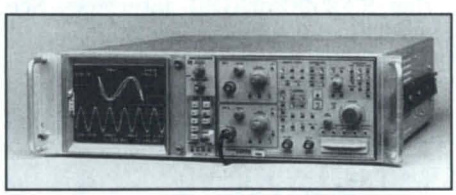
11000 Series Digitizing Oscilloscopes

The 11000 Series oscilloscopes are equally at home in a system or on a designer's bench. Full programmability through both the GPIB and RS-232C, direct memory access option for fast waveform transfer through the GPIB, extensive waveform processing along with pulse parameter analysis, automatic window placement, and other automatic measurements combine to make these scopes ideal for automated environments. These scopes are easily adapted to rackmounting and can be equipped with cable feedthroughs that make it possible to connect signals to the rear of the instruments. Accurate, automatic measurements of voltage, timing, and area/energy can easily be set up and read out over either standard bus. See page 241 for more information.



7854 Waveform Processing Oscilloscope

This two-channel, digital storage oscilloscope has 400-MHz equivalent-time bandwidth. Keystroke programming of local keyboard and remote waveform calculator allows user-designed waveform measurement routines. Signal averaging capability recovers signals buried in noise and improve measurement accuracy. All mainframe keystroke functions and operating modes remotely controlled via the GPIB. (Plug-in functions are controllable only with custom interface. Contact your local Sales Engineer.) The 7854 is supported by TekMAP 7854/IBM PC Communication software. See page 258.



7D20 Plug-in Programmable Digitizer

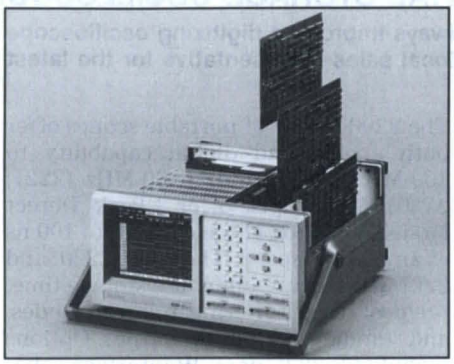
Converts any 7000 Series mainframe into a fully programmable, digital scope with 70-MHz equivalent time bandwidth. Operating modes include: Envelope, Average, and Roll. Optimized for interactive and automated applications from biomedical research to radio modulation and is remotely controllable over the GPIB. It is shown with R7603 mainframe. See page 260.

LOGIC ANALYZERS

DAS 9100 Series Digital Analysis System
All functions that can be accessed from the keyboard of the color DAS 9100 may be controlled via GPIB. The I/O interface, Option 06, supports GPIB data rates to 200K bytes per second. In addition this interface has a RS-232C port for remote control, serial line printing, or master/slave operations. A composite video output is also standard. All of the functions that can be accessed from the keyboard may be controlled via GPIB. The I/O Option 06 supports GPIB data rates up to 200K bytes per second as well as RS-232C, serial line printers, hard copy units and master/slave operation. See page 343.

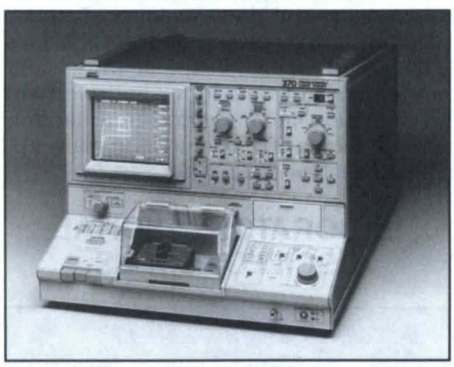
DAS 9200 Series Digital Analysis System Options 1C and 2C
The DAS 9200 expands on all the best - features of the DAS 9100 Series. All operations are menu controlled via a high-resolution color display. The DAS 9200 can be set up and controlled over either RS-232C or GPIB interfaces. See page 336.

1240/1241 Logic Analyzers
The 1240/1241 support all aspects of the design task, including hardware analysis, software analysis, and integration. For hardware analysis, they offer up to 36 channels of 100-MHz acquisition with 6-ns glitch detection. Software analysis is supported by up to 72 data channels at sampling rates of 50 MHz synchronous or asynchronous. See page 346.



1230 Logic Analyzer
The 1230 is a modular, expandable tool that allows you to identify digital hardware and software problems at an affordable price. This general purpose logic analyzer provides 16 data acquisition channels at 25 MHz synchronous and asynchronous, 8 channels at 50 MHz (asynchronous), or 4 channels at 100 MHz (asynchronous). Up to three 16-channel expander cards may be added to increase the number of channels to 64. Support is available for a growing list of 8- and 16-bit microprocessors. Acquired data may be viewed in state, timing, and disassembly formats. Optional GPIB and RS-232 interfaces allow complete remote control from an appropriate controller, keyboard emulation, and up/down loading of setups or memories. See page 351.

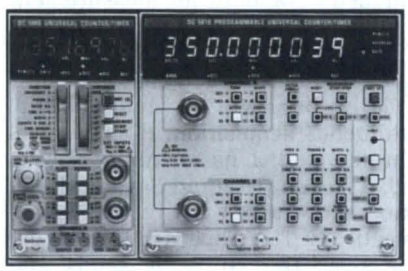
CURVE TRACERS



370 Programmable and 371 High Power Curve Tracers
The 370/371 Curve Tracers are remotely controllable via the GPIB for automated acquisition of curve data. Characteristic curve data can be sent in either direction over the bus. Front panel controls, except for those intended for local use only (such as Intensity), can be remotely set with a controller (like the Tek 4041) or with an IBM PC or compatible. See page 359.

GENERAL PURPOSE INSTRUMENTS

AA 5001/SG 5010
Programmable Audio Test System
This system automatically performs industry-standard tests, i.e., harmonic distortion, intermodulation distortion, frequency response, and noise/signal-to-noise ratio. Option 02 adds noise measurements. The SG 5010 also generates the burst signal for dynamic headroom tests. See pages 374, 376.



DC 5009
Programmable Universal Counter/Timer
This dual-channel, microprocessor-based plug-in provides frequency/period measurement to 135 MHz. It features push-button automatic trigger-level setting and eight measurement functions. Front-panel settings and features are remotely controllable via GPIB. See page 380.

DC 5010
Programmable Universal Counter/Timer
This dual-channel plug-in provides frequency measurement to 350 MHz, period, ratio, and event B during A. Trigger levels are automatically set to optimum. Trigger voltage setting is displayable. The DC 5010 has an automatic self-test feature, and is remotely controllable over and fully programmable via GPIB. See page 379.

GENERAL PURPOSE INSTRUMENTS

DM 5010
Programmable Digital Multimeter

This remotely controllable plug-in measures dc and true rms ac voltages/resistances. A diode-test function tests semiconductor junctions while a low-voltage/ohms function allows in-circuit measurements without turning on diode or transistor junctions. Math functions include averaging (up to 19,999 readings), dB (ref to 1 mW or to user-supplied constant), comparison, offset, and scaling, or any combination of these functions. See page 388.

DM 5120/DM 5520 Digital Multimeter

The DM 5120/5520 Programmable Digital Multimeter provides autoranging voltage, current and resistance measurements at up to 6½ digits resolution. DC voltage measurements with 100 nanovolt resolution can be performed to the full range of the multimeter. True rms ac voltage and current, and a crest factor of 3:1 provide the reliability required for all ac measurements, regardless of the waveshape. Standard 4-wire ohms measurement eliminates the errors caused by cable resistance, and the offset compensated ohms automatically subtracts thermal contact potentials. See page 386.

FG 5010
Programmable Function Generator

This plug-in outputs sine, square, and triangle waveforms. Pulses and ramps are provided with variable symmetry in 1% steps. Phase-lock mode automatically locks to any input signal, 20 Hz to 20 MHz. DC offset voltage is programmable from 20 mV to 7.5 V. The FG 5010 can store ten front-panel setups to reduce programming time. Fully programmable via GPIB. See page 401.

PS 5004
Programmable Precision Power Supply

This TM 5000 Series plug-in provides the high-resolution voltages and currents necessary for characterization of transistor, IC, and other semiconductor/hybrid circuits and in operation of high-performance strain gauges and other transdducer systems. Its entire 0 to 20 V output is covered with a coarse and fine adjustment to provide rapid setability and ±0.5 mV resolution without changing ranges. Output is available at the rear as well as from the front-panel. Overall accuracy is ±0.01% ±2 mV. See page 410.

PS 5010
Programmable Triple Power Supply

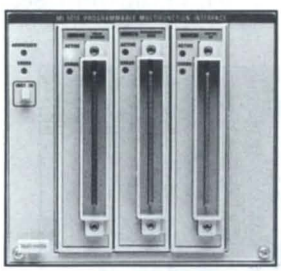
This supply provides 3 concurrent outputs: two floating (0 to +32 V and 0 to −32 V dc) and a logic level supply (4.5 to 5.5 V dc). Operation includes autocrossover with bus interrupt on continuous-voltage or continuous-current mode change. All three supplies may be remotely controlled over the GPIB (front-panel settings locked out). Overall accuracy is ±(0.5% +20 mV). See page 410.

AFG 5101/AFG 5501

Tek's GPIB Compatible AFG 5101/5501 Arbitrary/Function Generator lets you accurately simulate real-world events by combining the capabilities of an analog Function generator with arbitrary waveform generation and the ability to generate a variety of sweep shapes. You actually get three generators in one. See page 397.

PFG 5105/PFG 5505

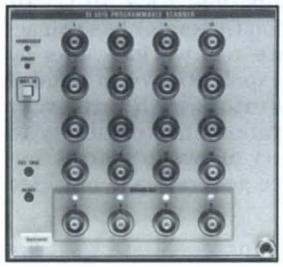
The PFG 5105/5505 Programmable Pulse/Function Generator combines the advantages of pulse generation, with the versatility of full featured function generation and complete programmability. Its waveform generation capabilities include pulse, double pulse, sine, triangle, square, and dc outputs from 0.012 Hz to 12 MHz in continuous, triggered, gated, burst, swept, and AM/FM modes. See page 399.



MI 5010/MX 5010

The MI 5010/MX 5010 Multifunction Interface System consists of the three card MI 5010 Multifunction Interface chassis, the three card MX 5010 Multifunction Interface Extender, and seven different types of cards. These cards provide a variety of functions typically required in automated test system interfacing, data acquisition and generation, and process control at one GPIB address. See page 415.

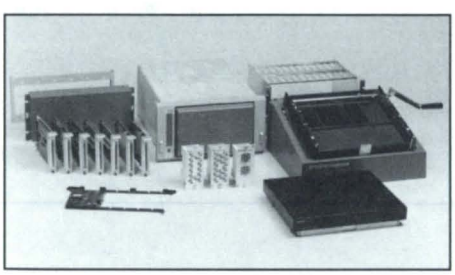
GENERAL PURPOSE INSTRUMENTS



SI 5010
Programmable RF Scanner
This TM 5000 Series plug-in uses 16 RF reed relays to interconnect 20 front-panel BNC connectors in three possible combinations: four groups of four channels, two groups of eight, or one group of 16. Rise time for groups of four channels is approximately 1 ns. Used for scanning and channel switching, this device is remotely controllable over the GPIB. See page 418.

CG 5001
Programmable Calibration Generator
This microprocessor-based plug-in is used to calibrate/verify major scope parameters. Learn mode allows front-panel control settings to be assimilated as program data by the controller. All front-panel settings are remotely controllable via the GPIB. See page 406.

SIGNAL ROUTING/DUT INTERFACING

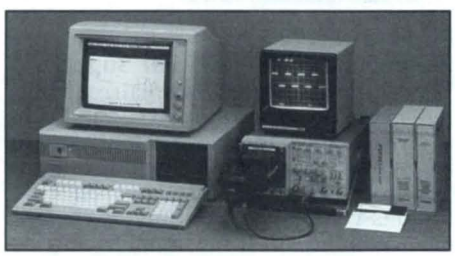


The Test System Interface (TSI) Family of off-the-shelf components can be easily configured to fit a majority of signal switching and DUT interfacing needs. The TSI can range in complexity from a mainframe and a single switching assembly to DUT interfacing and multiple card/module switching configurations for up to 720 channels. Rackmounting and GPIB operation are both standard features. See page 423.

SYSTEM CONTROLLERS

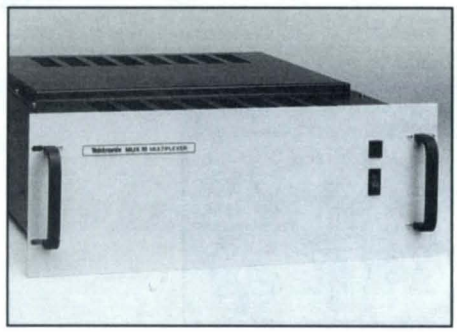
PEP 300 Series
The PEP 300 Series Systems Controllers provides 32-bit data acquisition/processing power to instrument systems control. Processing power is essential to acquire data and convert it to engineering units. Up to 3 additional standard GPIB interface cards can be installed allowing control of up to 60 standard GPIB devices. See page 437.

DIGITIZING CAMERA SYSTEMS



DCS P11
The DCS P11 system includes everything you need to digitize and analyze analog waveforms: PEP301 System Controller, 2467B 350 MHz Oscilloscope, DCS01 Digitizing Camera and Frame Store board, DX05 Display Monitor, S58DC02 Operating System Software, and all cables needed to link the scope and camera to the controller. See page 453.

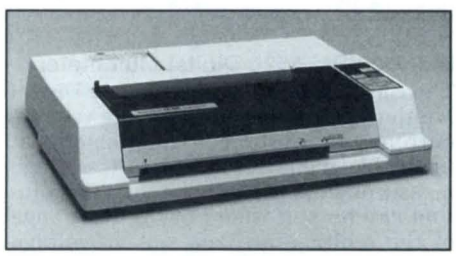
DCSP13
The DCSP13 Digitizing Camera System is simular but includes a different oscilloscope (the 11302 aith two 11A71 plug-in amplifiers) and a different software package (S58DC04). See page 453.



MULTIPLE-CHANNEL DIGITIZING CAMERA MAINFRAME

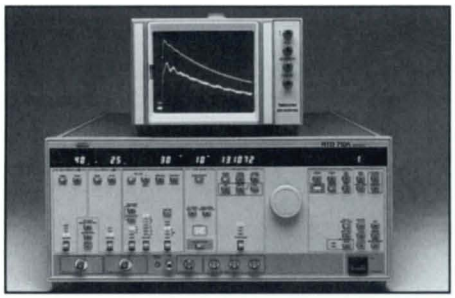
MUX 04/MUX 16
The MUX permits one host controller—PEP 301, IBM PC, VAX, or MICROVAX—to control up to 256 DCS frame store boards. The host controller can also control GPIB-based oscilloscopes via the MUX chassis. See page 456.

HC100 FOUR-COLOR PLOTTER



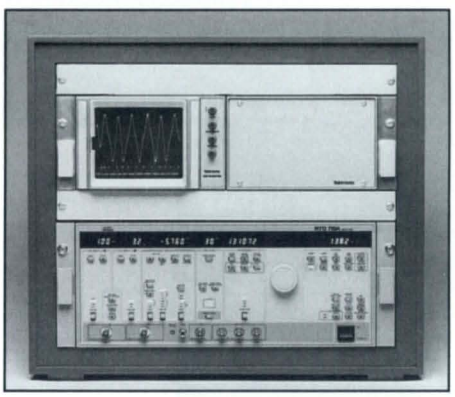
HC100 Four-Color Plotter
The Tektronix HC100 Color Plotter is a low-cost, four-color plotter designed to make waveform plots directly from a variety of Tektronix digitizing instruments without using an external controller. The HC100 connects directly to a compatible instrument via the GPIB or Centronics interface. HC100 operations is supported by HP-GL command set. See page 502.

DIGITIZERS



RTD 710A Programmable Digitizers
This 2-channel, 10-bit digitizer achieves excellent dynamic accuracy with a 2-stage flash-conversion process.

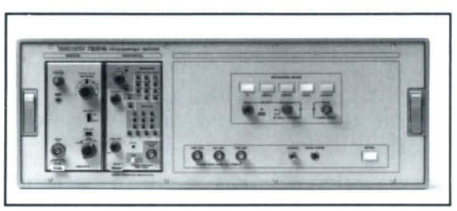
Single-channel operation can provide 200 megasamples per second. It features built-in self-calibration and self-test and is remotely controllable over the GPIB. Applications vary from ultrasonic testing to video. See page 443.



TD1301 Acquisition and Viewing Package

TK2301 Acquisition and Analysis System

The TD1301 and TD2301 provide an integrated package or system for waveform acquisition, processing, analysis and display. See page 446.

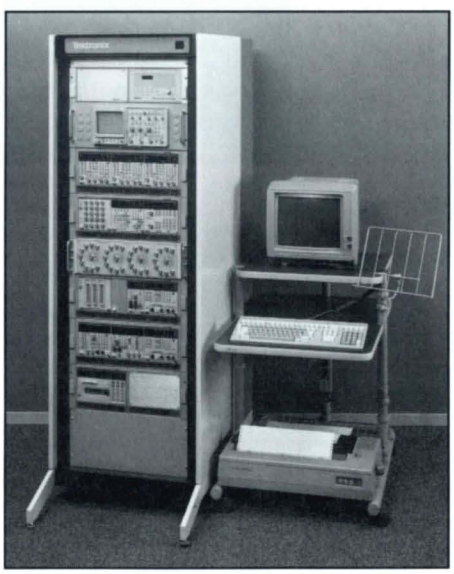


7912HB Programmable Digitizer
The 7912HB is designed for interactive and automated applications. It digitizes and stores single-shot or repetitive signals from millisecond to subnanosecond duration. Single-shot BW is 750 MHz. See page 448.

TEST AND MEASUREMENT SYSTEMS

Tek's line of GPIB-compatible system components make it possible to build a unique automated test system (at a reasonable price) that can easily be adapted to other applications. The result is a totally integrated system solution built to fit your test application. See page 476.

MEASUREMENT INSTRUMENT SYSTEMS



The Tek Measurement Instrument systems team provides total, integrated measurement solutions. We blend the best of technologies and provide a team of experienced system integration specialilsts that will work with you from the initial system definition through installation and support. We specialize in measurement system solutions requiring high speed, multiple channel data acquisition, data logging, and diagnostic testing; time domain measurement systems; and automated test systems for low-run manufacturing environments. See page 474.

DESKTOP CONTROLLER-BASED PACKAGES

MP 1101
Based on the Tektronix 7912HB Programmable Digitizer, this compatible signal acquisition and display package can be front-panel controlled or completely programmed via the GPIB Interface from any suitable controller. Single-shot BW is 750 MHz. See page 486.

PTS101
The new Tektronix PTS101 Personal Test System is an integrated hardware and software package that provides dynamic testing and characterization of analog-to-digital converters. System control is provided by a Tektronix Controller that includes a GPIB interface. See page 480.

TEKTRONIX SOLUTIONS

Tek is "one of the world's most technologically blessed companies. We have an uncommon range and depth of creative talent. . . Strong leadership position in major businesses, excellent reputation for products and services and also high business ethics."
Dave Friedley, President

Today, Tek designs, manufactures, and markets a broad range of Communications, Computer Graphics, and Test and Measurement products/systems for use in education, research, design, production, testing, and service of electronics-based products/systems.

Tek's product offerings have broadened significantly in response to advances in technology and to our changing and expanding customer needs.

Total Solution
Once Tek provided only measurement equipment. Now, users also need completely automated and integrated test systems that are affordable, flexible, expandable, and simple to use. Tek has remained at the leading edge of development, providing a full range of products and services to ensure total system solutions.

Meeting Expanding Customer Needs
We develop products and systems to fill your needs. Tek continues as an industry leader for product-line breadth, range of price/performance options, and service and support. As a high technology company, Tek realizes the importance of pushing the threshold of discovery in existing and related technologies.

Tek continues to set standards around the world—Tek innovation, reliability, and flexibility are built in to all our products.

The following pages provide a glimpse of the newest solutions from Tek.

Communications
Our communications products and systems focus on applications in the television and data communications industries. Tek provides the expertise for the growing TV broadcast industry and is at the forefront of network analysis for voice and computer networks.

Computer Graphics
Computer Graphics provide a window to the computing environment, enabling the brain to absorb information far faster than by interpreting words and numbers. Tek produces hardware and software computer graphic products for workstation applications ranging from molecular modeling, medical imaging, mapping to stress analysis and scientific animation. We also provide products for presentation graphics used throughout the business community to the fast-growing arena of desktop publishing.

Test and Measurement
As design and test become more specialized and complicated, instruments are adapting to keep up and meet the challenge. Markets span the range from application specific integrated circuits, to nuclear test and national defense.

Tek supplies test and measurement instruments to customers engaged in education, research, design, manufacturing, operation, and electronic equipment service. We provide individual instruments plus instrument system solutions.

Tek features a broad range of portable and laboratory spectrum analyzers used extensively in satellite and microwave communications to analyze signals.

Technical Assistance Services

- **Installation Assistance**
- **Familiarization Training**
- **Custom Training**
- **Problem Definition and Debugging Assistance**
- **Interfacing Assistance**
- **Applications Assistance**

When your systems development program calls for informed, on-site assistance, Tektronix can keep you in touch with some of the best in the world. With Tek Application Engineers, you enjoy a resource that you can draw on to help you derive maximum benefit from Tektronix system components.

When you need assistance to supplement your own resources, Tek can arrange the consultive services of an Application Engineer skilled in meeting your needs. Not only are our A.E.'s skilled professionals in their own right, they are backed by the resources and collective experience of Tektronix—itself an experienced user of automated test and measurement systems.

Tektronix A.E. consultation is intended specifically for optimizing the operation of Tek instruments and software. We suggest that customers may first want to avail themselves of Tek's excellent documentation and regular customer training programs prior to requesting our Technical Assistance Services.

Typical consulting services include:

Installation assistance. This may include pre-installation counseling, assistance in installing hardware or software, and installation validation.

Familiarization training. This usually takes the form of a brief introduction (individuals or groups), of hardware basics, system interaction, and software utilization. Other training modules may present specific operational aspects of a product.

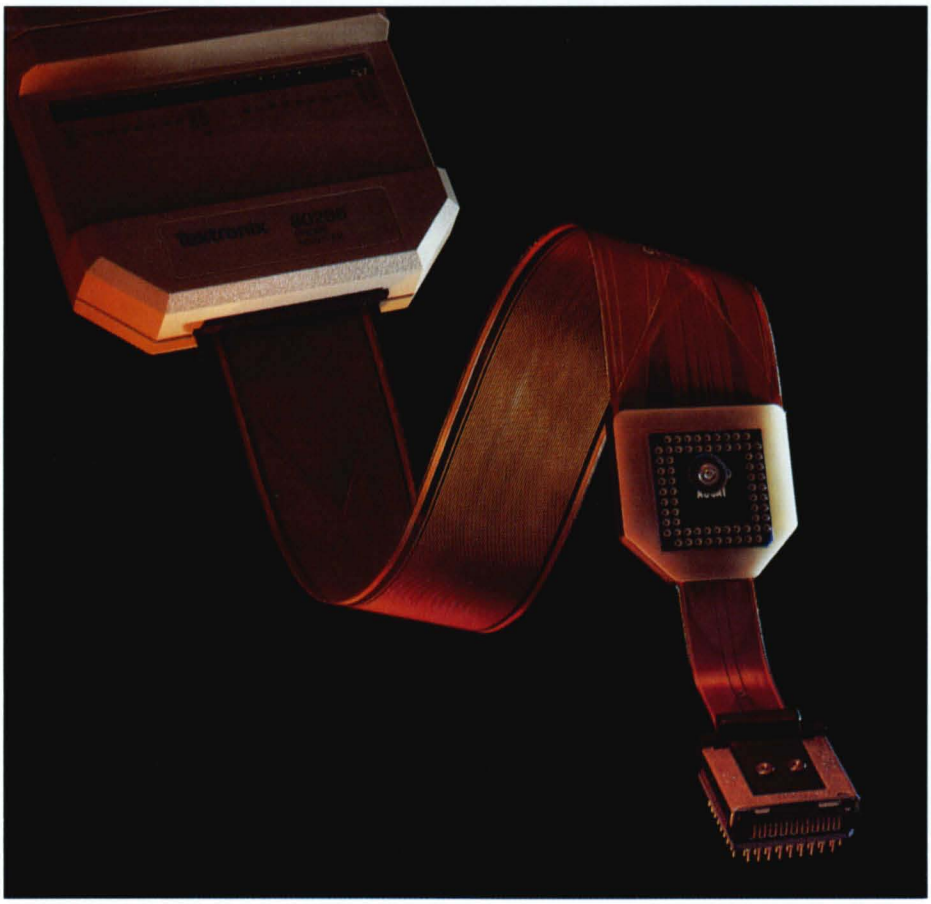
Custom training. You may require that unique training modules be designed and presented to meet an unusual application, environmental or personnel need.

Problem definition and debugging assistance. Application Engineers can help you trace and debug problems within a hardware/software system.

Interfacing assistance. We can assist you with unusual interfacing challenges requiring intimate knowledge of Tek hardware and software.

Applications assistance. You can obtain expert consultation in signal acquisition, in specific test and measurement tasks, in integrating Tek hardware and software within an existing process, and in other application-specific areas. Technical Assistance service is available in one hour increments. Order part number 068-9080-00.

If you'd like to know more about these Tek consulting services, please call your Tektronix Sales Engineer.



Flexible Circuits

- **High Density**
- **High Reliability**
- **Versatility**

Flexible circuits are solving increasingly complex packaging needs required by todays high-density, compact instruments in the areas of digital interconnects, wire-harness replacement, and specialty applications.

Patented design techniques are used by Tektronix to achieve controlled impedance, low-capacitance electrical performance. Flexible circuits simplify the interconnection without sacrificing high circuit density or reliability. UL recognition available for flexible circuits and multi-layer flexible circuits with a flammability classification of 94 V-O.

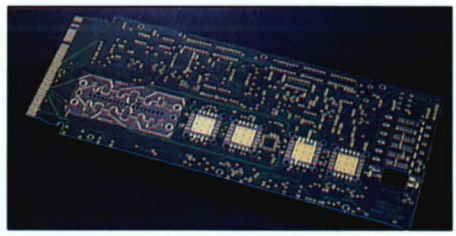
Advantages of Tektronix Flexible Circuit Manufacturing Processes

- Production fine-line capabilities
- Use of thin dielectrics
- Proprietary strain relief for improved mechanical reliability
- Use of Teflon coversheets for increased flexibility and ruggedness

We offer a full-service package from design support through prototypes, to production. We prefer to participate early in the new product introduction to achieve a product that meets or exceeds the desired electromechanical properties, and is economically manufacturable.

TYPICAL SPECIFICATIONS

Front to Back Registration—± 0.0005 in.
Smallest Line Width and Spacing—0.004 in.
Line Width Tolerance—0.0005 in.
Hole-to-Hole Distance—0.050 in.



Teflon Circuit Boards & Hypcon Connectors

- **Low Dielectric Constant**
- **Dimensional Stability**
- **Controlled Impedance Lines**
- **Close Tolerances**

The utilization of higher frequencies (>1 GHz) in the field of communications and data transmission has accented the need for accurately-tuned transmission lines and high-performance Hybrid Circuit Connectors.

The low dielectric constant, dimensional stability and close tolerance requirements of these circuit designs make Teflon-based substrates an essential material for circuit board applications. Certified by UL for recognized Teflon printed wiring boards, flammability classification is 94 V-O.

TYPICAL SPECIFICATIONS

Operating Frequencies—>10 GHz.
Dielectric Constant—2.17-10.6
Std. Dielectric Thickness—0.002-0.062 in.
Production Process Dimensions—
Multilayers Registered to: ±0.0004 in.
Line Widths and Spacing to: 0.0004 in.
Line Width Tolerance to: ±0.0005.
Line Width Tolerance to: ±0.0005 in.
Front-to-Back Registration to: 0.0005.

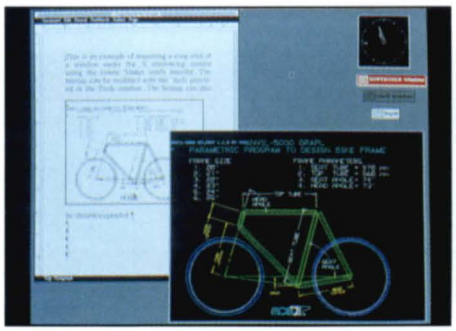
Hypcon™ Connector

Hypcon is the trademark for a metalized elastomer connector used by Tektronix to mate hybrid circuits to PWB's. Hypcon connectors perform at frequencies greater than 10 GHz. Contact spacing is from 0.01 inch on 0.03 inch centers.

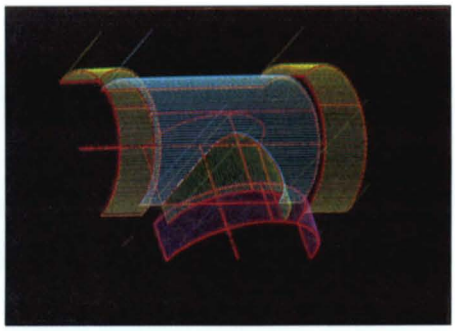
Customer Support

Flexible Circuits, Teflon
CBs and Hypcon Connectors
Tektronix, Inc. P.O. Box 500, D.S. 38-330
Beaverton, OR 97077
(503) 627-2000

Graphics Workstations, Terminals and Printers



Ideal Choice For Conceptualization and Drafting
The 4319 excels as a general-purpose UNIX bit-mapped graphics workstation and is compatible with the higher performance 4320 and 4330 series. Quality graphics presentation and a host of system software make this workstation the solution to your needs. See page 47.



Fastest in the Low Cost Color Graphics Arena—Advanced, Intelligent Graphics Capability
The 4211 combines the best of all the 4200 Series terminals. Features include higher display resolution, networking capability and dual display support for separating graphics and alphanumeric displays. See page 55.

Rapidly and Accurately Translate Data to CAD Formats
The 4991S3 provides scanning and editing processes locally, so valuable CAD system resources are not tied up with time-consuming input tasks. This multi-tasking UNIX-based workstation provides scanning, vectorizing, editing and computer-aided drafting tools for many applications in mapping, architecture, and mechanical and electrical engineering. See page 58.

Less than Four-Second Screen Capture Plus Image Sizing to Media Print Boundaries
The superior performance of the 4693RGB increases your productivity. This video-interfaced, color screen printer is based on thermal-wax print technology and provides less than 4-second screen capture and image sizing to the boundaries of the media print area. Additional features include automatic calibration, image queueing, and multi-user capability plus enhanced image quality with 4096 color palette, 300 dpi. See page 57.

Low Cost, Compact, General Purpose NTSC Video Monitor
The DX05 is a 9-inch diagonal desktop, black and white display for general-purpose video applications requiring NTSC format. The low-cost, makes it an easily affordable accessory plus, the small size is especially suitable for limited space applications. See page 62.

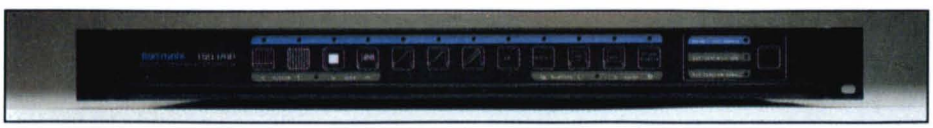
Television, Telecommunications Testing

Simple, Yet Functional Test Signal Complement
The low-cost TSG-100 NTSC test signal generator is ideally suited for maintenance and alignment of video equipment. See page 77.

TSG-100 Test Signal Generator

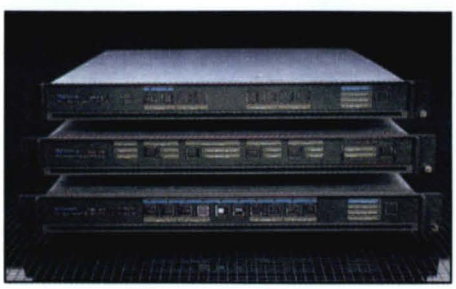
Complete Digital Monitoring and Measurement at Your Finger Tips
The VM700 makes all standard television measurement automatically. All functions are controlled by a few simple, front-panel pushbuttons. Results are accurate and repeatable. See page 74.

VM700 Video Measurement Set



NTSC Operation and Maintenance Support
The TSG-170D provides test signals and audio tone in both digital and analog form plus an analog black burst for equipment synchronization. See page 77.

Provides All the Test signals You Need
The TSG-422 provides all the necessary test signals to operate, maintain and evaluate 4:2:2 digital equipment. See page 77.



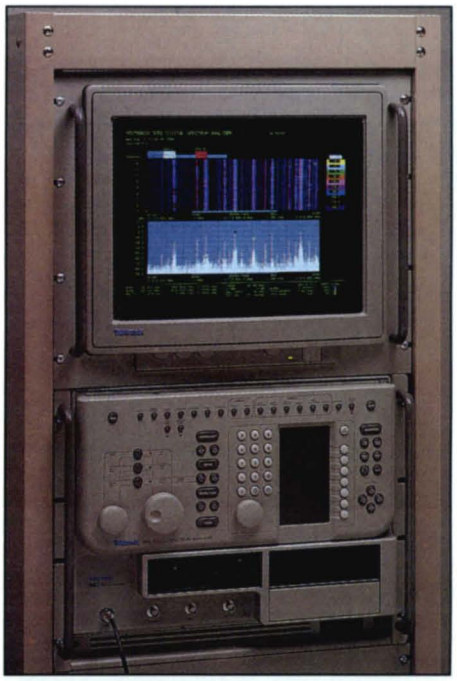
Complete PAL Sync System
Tek now combines the popular SPG-271, ECO-170A, and TSG-271 for a complete PAL Sync System.

Ensures Accurate SCH Phasing
The SPG-271 uses digital signal generation and a precision 12-bit DAC to ensure accuracy and long term stability. See page 78.

High Definition Television Production and Transmissions System Support
The 1730 HD monitor was expanded from the 1730 Series and allows full High Definition waveform monitoring capabilities. See page 86.

Modular Test System Allows Multiple Configurations with One or a Number of Test Functions
The TC-2000 is a software-based, modular test system that provides multiple configurations with one or more of the following test functions: T1/PCM/BERT, Protocol analyzer, LAN Protocol Analyzer, Enhanced Macros, TIMS, Signaling, Voice Band Spectrum Analyzer, Remote Operation, and ISDN. See page 72.

Digital, Signal Analysis



3052 Digital Spectrum Analyzer

User is analyzing a downconverted RF signal in the desktop 3052 configuration.

Capture the Real World in Real Time
The new 3052 Digital Spectrum Analyzer captures elusive spectral transients and quickly transfers the data. Both rack and desktop instrument configurations are available and include a 19-inch color display and instrument console. The 3052 performs real time spectrum analysis at much wider frequency. Spans, which opens the way to solve difficult measurement and analysis problems. At 2 MHz, its widest real time span, the 3052 updates its spectral output every 200 μs. See page 94.

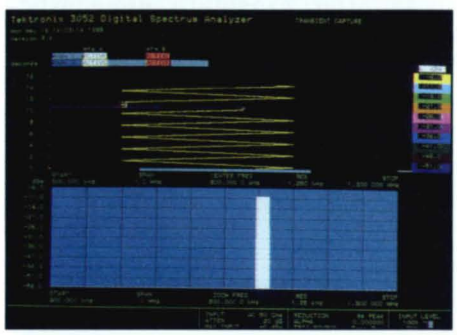


Fig. A. *In this case, a synthesizer is monitored as it sweeps from low to high frequency and back again. As this synthesizer sweeps, there is a transient glitch that occurs. The line of the spectragram that shows the transient appears at the bottom of the spectragram then moves upward. At 10.5 seconds after the transient occur, the instrument is paused and the red triangular cursor appears at 0 seconds on the spectragram time scale.*

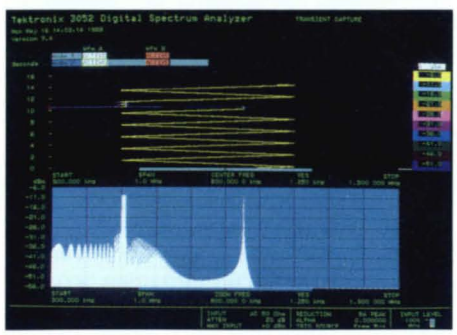


Fig. B. *Spectragram cursor scrolled upward to the transient spectrum. When the cursor is pointed there, then we have a display of the transient spectrum for detailed analysis.*

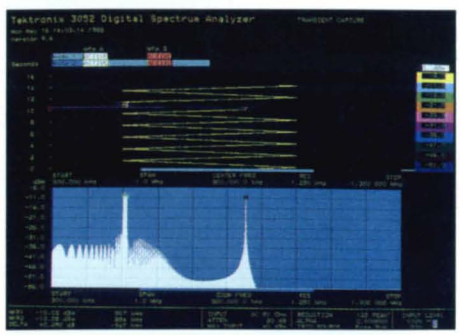
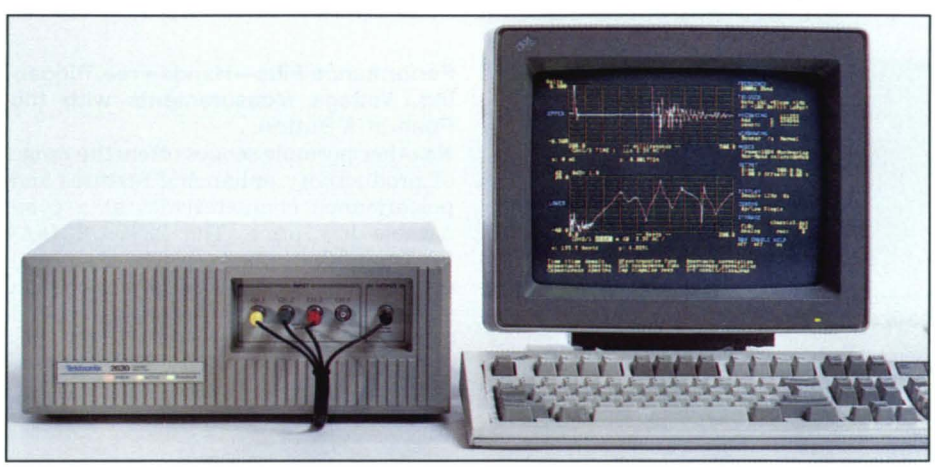
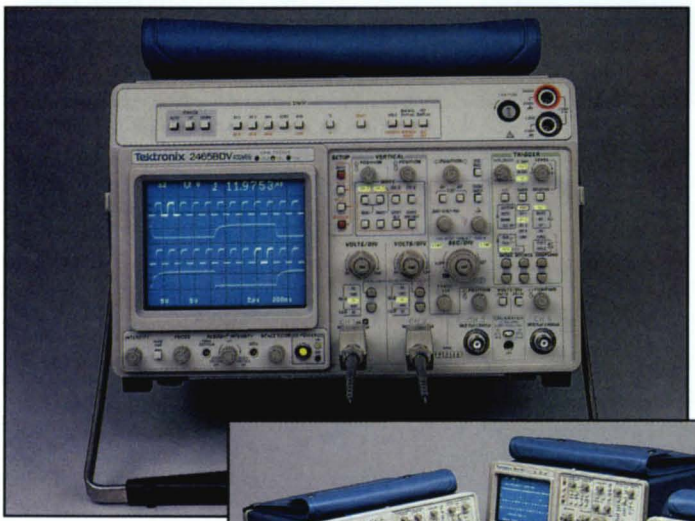


Fig. C. *Then dual markers are positioned, one at each peak. Readout for marker #1 is at −10.03 dBM and at 507 kHz and marker #2 is at −10.28 dBM and at 854 kHz. Delta (marker #2 minus marker #1 values) is at +0.250 dB and at −3.47 kHz.*

Flexible, Low Cost, Easy to Use Signal Analysis Measurement Solution
A few menu-driven keystrokes is all it takes to apply any of the 2630's powerful built-in features. The 2630 high performance, multichannel signal analysis instrument is ideal for testing and monitoring applications involving mechanical, electrical, or electrical/mechanical systems and components. See page 96.



Analog Scopes



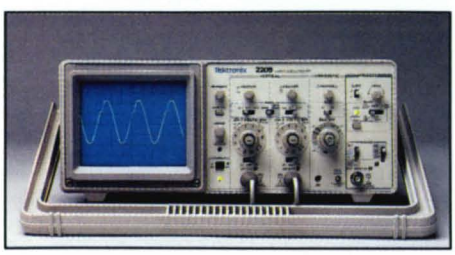
Three 2465B Special Edition Preconfigured Packages Offer Specific Solutions and Significant Savings

2465B special packages provide multi-instrument capabilities while reducing rack space, equipment costs, and programming complexity. All three are packaged with a GPIB interface—making each a perfect systems choice. See pages 156–171.

2467B, 2445B, 2465BCT Portable Analog Oscilloscopes

The 2400B Series Brings Unprecendented Efficiency to Your Design Lab, Production Line or Field Service Site

These scopes combine new convenience and leading-edge performance—up to 400 MHz. The 2400B Series pushbutton smarts offer capability previously available only with a digital storage scope or high performance counter.



2205 Portable Analog Oscilloscope

Perfect Measure of Economy Plus Performance in a True Industrial-Quality Instrument

Whether your needs are industrial or education, the 2205 provides a cost-effective solution to your needs. Featuring performance that you'd expect to find only in more expensive instruments, the 2205 features a well-organized, easily-learned front panel, full size CRT, hands-off triggering, and low-noise vertical system. See page 185.

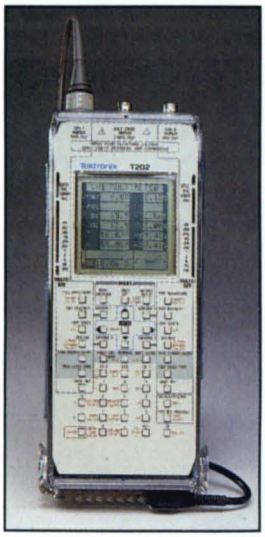
2246A/2245A Portable Analog Oscilloscopes

Performance Plus—Hands-Free Triggering, Voltage Measurements with the Push of a Button

No other portable scopes offers the range of productivity enhancing features and performance characteristics at a comparable low price. The 2245A/2246A/2247A produce sharp, bright trace and displays that bring out the details on high speed signals. Hands-free triggering and pushbutton voltage measurements enhance your productivity. See page 180.

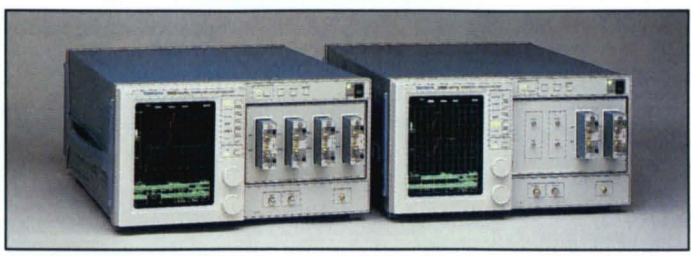
The World's Most Versatile Counter/Timer Analog Oscilloscopes

The 11301A and 11302A are equally at home in the most complex automated production-test system or in a smaller scale computer-assisted testing and data-logging applications in the engineering environment. The menu-driven touch-screen operator interface places the 11301A/11302A a step beyond anything presently available in convience of use. See page 193.



Sophisticated Capabilities Made Ultra-Portable and Easy to Use
Only Tek packs so much in so little and makes it easy enough for even a new user. The T200 Series offers your choice of logical manipulation or traditional oscilloscope interface. Light and compact, the T200 Series scopes will fit easily in a tool box, briefcase, glove compartment and in the palm of your hand. Time base and trigger functions can be set automatically—just press the autoset button and the scope does the rest. See page 238.

T202 Hand-Held Digital Storage Oscilloscope



The New Standard in High Performance Oscilloscopes
The 11000 Series offer the widest selection of performance and features: high bandwidth, full programmability, highest accuracy. The large, high resolution display provides easy viewing and convenient screen menus and touch screen to eliminate front-panel clutter and confusion. See pages 241–256 for complete details on the full line of 11000 Series Digitizing Oscilloscopes.

Digital Scopes

Quickstart Training—In a Group or at Your Own Pace
The *NEW* 2400 Series Quickstart Operator's Training Package takes you through the various 2400 series digital scope functions step by step. The training package is complete and portable. You can proceed at your own pace or service several users, even at different locations.

Fully Programmable, Proven Scopes—Unmatched Ease of Use
The 2432A/2440 are powerful and versatile scopes that speed measurements, simple setups and automate test procedures—all from the front panel. Time-saving innovations plus high standards of technical performance make these scopes unmatched in performance and ease of use. See page 220.

2201 Digital Storage Oscilloscope

Familiar Analog Operation With Powerful Digital Capabilities
The 20 MHz 2201 Digital Storage Oscilloscope is Tek's newest member of the 2200 series of oscilloscopes, combining the familiar analog operation of the 2205 with powerful new digital capabilities. These include 10 MS/s maximum sampling rate and 2K record length, both per channel, for high resolution. See page 234.

Low Cost, Portable Self-Contained Test System—More Power For Your Portable Digital Scope
The 2402 provides advantages of computer-based test systems without the size and costly programming constraints. Its rugged, compact construction and portability make the 2402 an excellent choice for remote test or data logging sites of multiple-station, distributed-intelligence test systems. See page 225.

Documentation from Digitally-Based Instruments, General Purpose Plotter for Hard Copies or Transparencies
The HC100 is a low-cost, four-pen, color plotter that is used for direct output of waveform plots and setup information from various Tek digitally-based instruments. See page 502.

Digitizers, Controllers, Logic Analyzers

High Resolution, Accuracy, and Speed
Ten-bit vertical resolution digitizer (rates up to 200 megasamples per second with long record lengths), the RTD710A provides excellent resolution of fine signal details. See page 443.

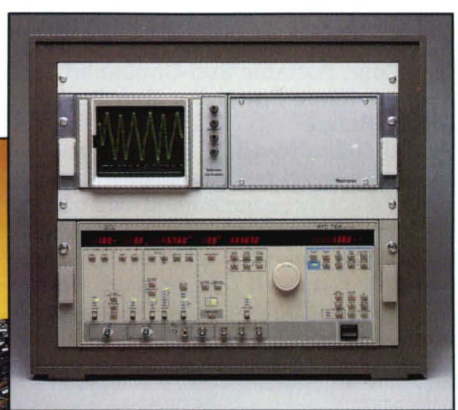
1230 Logic Analyzer

DAS 9200 Support of 88100

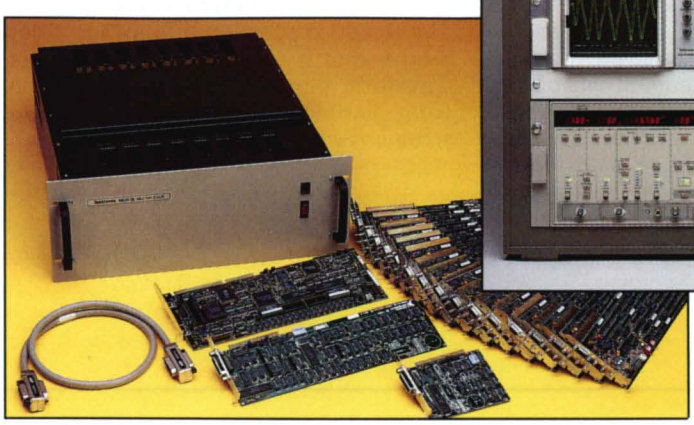
1241 Support of 68030

Power to Handle Your Growing Test and Measurement Needs
The PEP 30X Series provides state-of-the-art microprocessor technology without compromising your current or future software investments. These IBM PC/AT, PC/XT compatible instrument controllers provide unparalleled power to analyze and plot data and plenty of processor power to support a true windowed environment. See page 437.

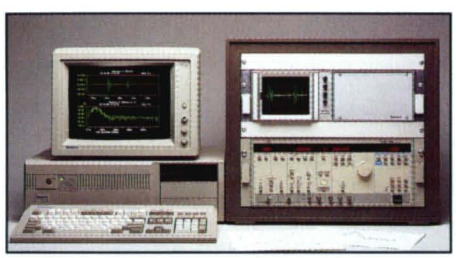
TSD20 Digital Input/Output, TSM20 Memory, and TST20 Timer/Counter



TD1301 Acquisition and Viewing Package



Cost Effective Multiple-Channel Digitizer System
The MUX04 and MUX16, along with the Digitizing Camera System and a host controller make up a multiple-channel digitizer system. Up to 256 DCS's and scopes can be controlled by one host computer. See page 456.

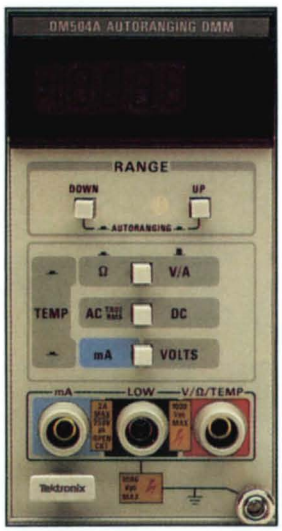


TD2301 Acquisition and Analysis System

Acquisition, Processing and Analysis, and Display—Your Choice of High Performance Digitizer Systems
TD1301 provides an integrated viewing package with digitizer and monitor enclosed in a standard instrument rack. The TD2301 system adds a PEP 300 Series Controller to provide waveform capture, processing analysis, display and storage. See page 446.

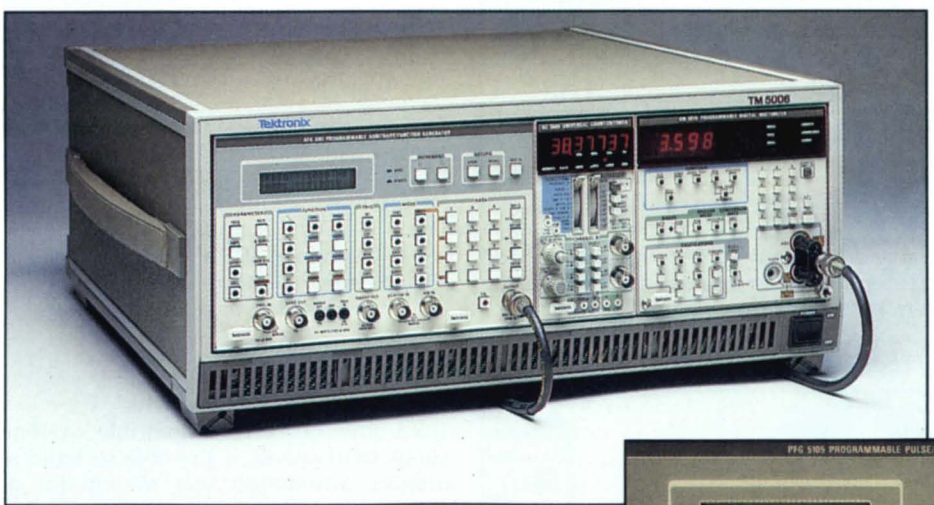
Modular Instruments

Configure the Most Economical Solution to Meet Your Needs
The TM 5000/TM 500 family of modular test and measurement instrumentation offers both manual and GPIB compatible equipment in a full line of compact, plug-in instruments that can function individually or as part of an integrated computer-controlled network. Configure your solution, or choose from our preconfigured EBS Series packages. See pages 371–433.



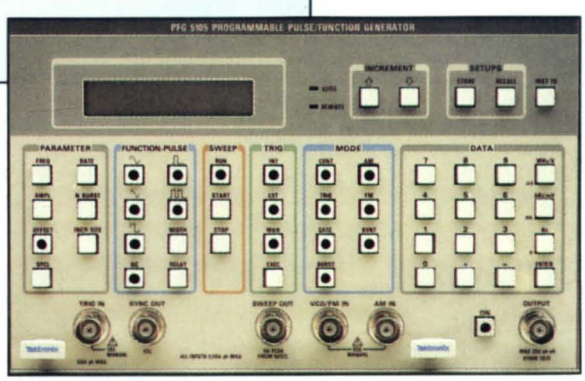
DM504A Autoranging Digital Multimeter

AFG5101 Function Generators



EBS5002 Product Configuration

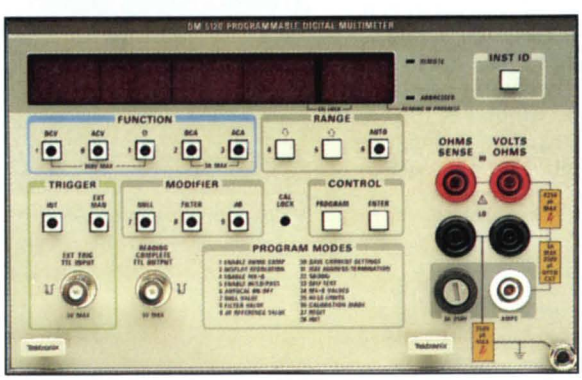
EBS5002 Package
Engineering bench systems package complementary instrument components and a mainframe into a ready to go system. The EBS packages let you save 10% of the component catalog prices.



PFG5105 Pulse/Function Generators

TS18155 Test System Interface shown with TSA8140 Test System adapter, TSS44 Coax Scanner, TSS45 RF Scanner, and TSS46 Microwave Scanner

Easily Configured Signal Switching/DUT Interfacing Solutions
The TSI family offers a host of off-the-shelf components to meet your needs. Each interface increases your productivity and easily configures to fit your signal switching and DUT interfacing requirements. See page 423 for the new additions to the TSI family.



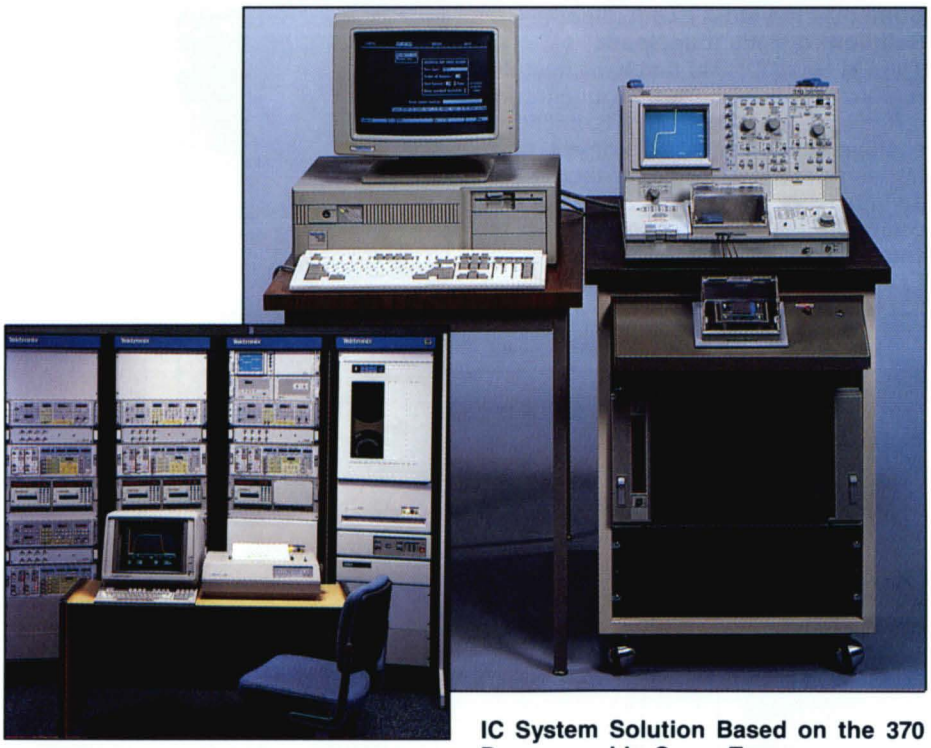
DM5120 Programmable Digital Multimeter

Systems—Device Test, Custom, VXI bus

Tektronix Provides Systems Solutions

Tek's systems are not just hardware packages. With each system Tek provides complete design services, a fully documented system proposal, manufacturing and integrations, software development, on-site installation, maintenance and repair services and technical support.

There's no application too fast or too complex for our unique systems solutions.



Typical Measurement Instrument System

Measurement Instrument Systems

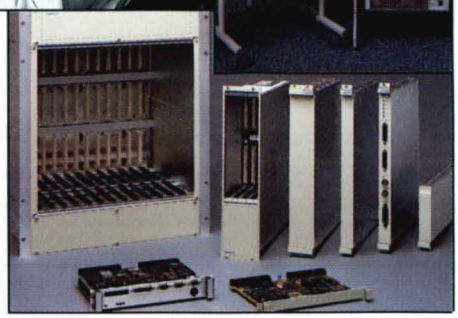
The Tek Measurement Instrument systems team provides total, integrated measurement solutions. we blend the best of technologies and provide a team of experienced system integration specialists that will work with you from the initial system definition through installation and support.

We specialize in measurement system solutions requiring high speed, multiple channel data acquisition, data logging, and diagnostic testing; time domain measurement systems; and automated test systems for low-run manufacturing environments. See page 474.

IC System Solution Based on the 370 Programmable Curve Tracer

The S370FA IC Failure Analysis System reveals common IC failure mechanisms such as leakage, shorts, opens, and bonding problems. See page 364.

PTS101 Personal Test System is an integrated hardware and software package that provides dynamic testing and characterization of analog to digital converters. The highly interactive mouse-based interface allows fast parameter changes and instantly displays results in color graphics on a windowed display. The system is easily expanded when more functions are needed. See page 480.



VXIbus Instrumentation

Manufacturing Test Systems

Tek's line of GPIB-compatible system components make it possible to build a unique, automated test system (at a reasonable price) that can easily be adapted to other applications. The result is a totally integrated system solution built to fit your test applications. See page 476.

High-Speed A/D Functional Test System

Tek's VXIbus Systems

The VXIbus standard establishes the basis for the next generation of automated test systems, and is the most important new standard since IEEE-488. VXIbus (VMEbus Extensions for Instrumentation) is a completely open, nonproprietary architecture for modular electronic test instruments that fully incorporates the open VMEbus standard, and is completely compatible with Eurocard standards. See page 482.

Opto-Electronics, Measurement Accessory Products

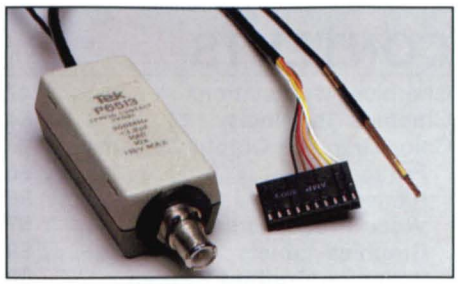
7F10A/11F10 Optical-Electrical Converters

Optical-Electrical Converters
The 7F10A and 11F10 are single-wide plug-in modules for use with either single-mode or multimode fibers. See page 490.

Optical Sampling Head
The S42 allows researchers to display and measure optical waveforms from dc to 6.4 GHz in the 1000 nm to 1700 nm wavelength range. See page 491.

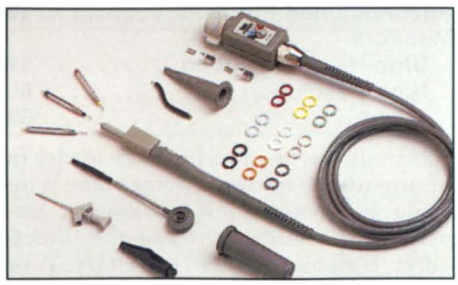
Probes—The Strongest Link Between Your Tek Instrument and Results
Tek offers several new probes to optimize your system's performance. The P6511 and P6513 Spring Contact Probes enable acquistion (at functional board speeds) of AC parametric waveform information from high-impedance test points. In a bed-of-nails fixture, automated tests can be performed with low circuit loading and high bandwidth.

The P6150/P6156 high bandwidth, low impedance probes are designed for use with the 11000 Series, including the 11800 Sampling Systems. See pages 518–548 for our complete line of signal acquisition probes.



P6513 Spring Contact Probe

Complete Opto-Electronics Field Service Tool
The 2815 OPTO-Scope offers unprecedented capability for testing and maintaining optical communication systems. This portable, self-contained, lightweight package is both easy to use and handle. See page 492.

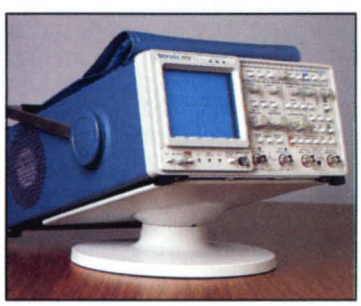


P6156 Probe

SMT Probing Measurements
Tek introduces a family of five adapters for Small Outline Integrated Circuits (SOIC) devices and another family of five adapters for Plastic Leaded Chip Carriers (PLCC) devices, and a SMT grabber clip. See page 544.

Very High Density Probe Card for VLSI Testing

The VHD probe card is used for AC/DC die-sorting at wafer probe to guarantee performance prior to packaging. See page 518.

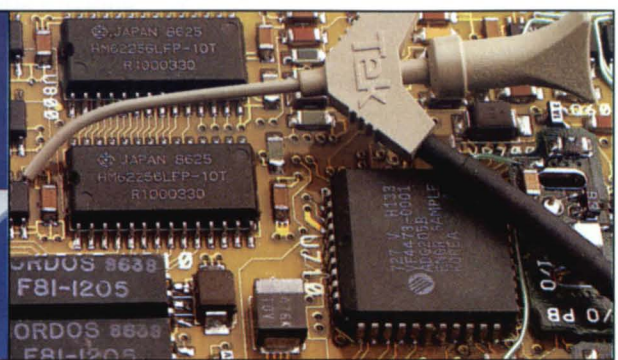


K501 Tilt Swivel Base

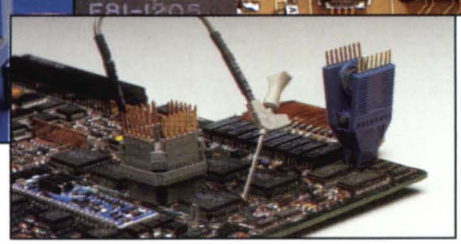
The K501 compact swivel base, is designed for portable type instruments used in a bench top environment. See page 550.

K318 Utility Cart

The K318 is a general purpose utility cart used to provide onsite mobility, store equipment, plus provide a platform for PC-type instrument controllers. See page 550. The K217S is a rugged version of the K217 and designed to support the 11000 Series instrument and other rack width instruments.See page 552.



SMT Grabber Clip



SMT Grabber Clips shown with PLCC and SOIC Adapters

INFORMATION DISPLAY SOLUTIONS

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Tektronix has been an industry leader in information display products since it introduced the age of low cost graphics displays with the discovery of the direct-view, bistable storage tube (DVST or Anderson Tube) in 1962. Today, the breadth of the Tektronix product line, its family compatibility, peripheral support, leadership in meeting industry standards, and range of price/performance options, make Tek information display products the best-equipped to meet research, engineering, business and manufacturing needs.

Tektronix has designed its information display products to offer a wide range of price/performance. Customers can select from a variety of entry-level and high-performance graphics workstations, color terminals, and color output systems. All information display products, at all price/performance levels, provide Tektronix-quality display and power.

Tek's new products in 1988 are designed to increase selection and choice so that customers can get just the power and performance they need. Product adaptability and access to applications are broadened with IBM and DEC compatibility with most information display products. Together, Tek's current and new information display products meet the need for performance, targeted application and increased economy in graphics products.

Color Graphics Terminals

The 4200 Series of Color Graphics Terminals expands its versatile offering, bringing advanced features like an optionsl networking capability with the new 4211 terminal.

3D/2D Color Graphics Workstations and Terminals

Families of 3D and 2D Color Graphics Workstations and Terminals present users with the ultimate in choice for high-performance graphics systems. Both graphics workstations and terminals are offered in 3D and 2D with a selection of features that truly reflects the specific needs of graphics users. Tek anticipates growth paths by offering easy upgrade from terminal to workstation. And while introducting new graphics systems, Tek also protects investment in current Tek products by offering local computing resources for 4100, 4120, and 4200 Series terminals.

Applications Software

PLOT 10® Applications Software and Standard Tools expand Tek's standard-setting family of graphics software with enhanced design and presentation softwre, increased portability from other applications, and the NEW PHIGS library of subroutines to aid development of interactive graphics applications.

Color Output Systems

The 4693 Color Output Systems introduce a new technology: thermal wax printing. Offering quality printing, full color, and fast processing, thermal wax technology is available in a standalone color printer and, for highest quality, in a rasterizer system. All Tek color output products combine to offer a range of price/performance, and now include compatibility with IBM PC and Apple Macintosh II systems.

As always, Tektronix provides a complete offering of graphics supplies.

Monitors

Tek offers a variety of monitors for your viewing needs. Monitor selections include ultra-high resolution, high resolution and general-purpose video monitors.

RECONDITIONED TEKTRONIX INFORMATION DISPLAY PRODUCTS

- **Quick Delivery**
- **Low Prices**
- **New Product Warranties**
- **Quantity Discounts**

With Tek's quick delivery, you can be using Information Display products at substantial savings in just two weeks. Tektronix remanufactures demo and lease returns to latest specifications and offers them with new product warranties. Quantity discounts apply to current as well as discontinued products.

In the U.S., contact your local Tektronix Field Office for IDG Reconditioned Product availability and prices. Overseas customers call your Tektronix Sales Office.

TEKTRONIX 4300 SERIES GRAPHICS WORKSTATIONS

Tektronix Visualization ...Setting the Pace to See the Future

Continuing the Lead

Tektronix continues to provide the graphics world with the best in price performance value in its new series of graphics workstations and terminals. Offering the serious graphics user a selection of 3D and 2D workstations and terminals and an ability to upgrade terminals to workstations, Tek meets the need for performance, value and versatility in the graphics environment.

Graphics Workstations and Graphics Nodes

Tek's Graphics Workstations perform as completely integrated solutions to graphics intensive applications. Additionally, they can be used separately as graphics terminals or as standalone compute platforms.

For example, the graphics subsystems of Tek's high end workstations can be used as a terminal connected to a VAX or other host via RS-232, DMA or LAN connections as an intelligent graphics node in a network. The compute engine can stand alone as a file server, compute server or engineering workstation.

Flexibility of Implementation

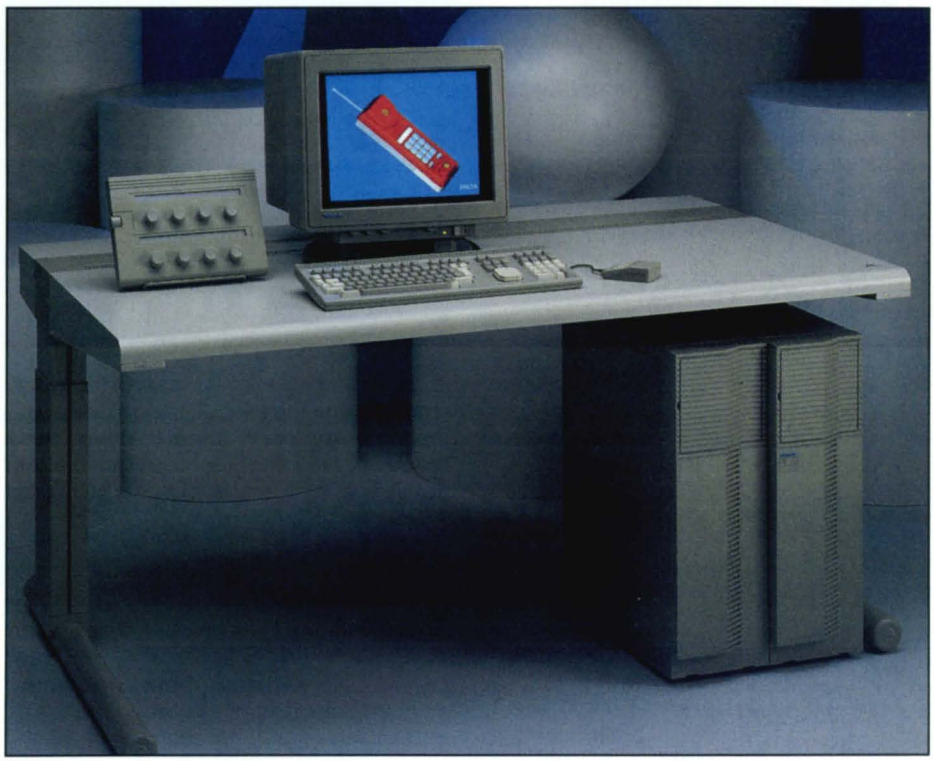
The Tek 4300 family can be deployed in multiple computer environments. For example, the Tek terminal subsystem can be connected to a host computer, then, as the application requires a more dedicated resource, the terminal can be removed from the host and attached directly to a Tek compute engine via a high speed bus connection, forming an integrated workstation.

Compatibility

Tektronix has been the graphics leader for over twenty years. Insuring a protected investment for our large installed base, our new workstations are compatible with the thousands of Tek graphics terminals already in use. Out PLOT 10® graphics kernels include the latest GKS and PHIGS as well as Tek's popular STI, TCS, and IGL graphics drivers.

Applications

A large number of applications currently run on Tek terminals in the fields of mechanical CAD, earth resources, design, drafting and research. Many of these same applications also run on Tek's new integrated workstations, providing standalone solutions to the design marketplace.



Tektronix 4300 Series Workstations Family.

Common System Software

The UTek operating system continues to be a Tek strength as one of the leading implementations of bsd 4.2 with System V extensions. A rich set of utilities and system administration functions have positioned UTek as a solid, high performance, easy to use UNIX implementation, well suited to graphics applications.

Wide Family Range

The design process consists of Defining and Conceptualization, Construction and Detailed Design, Rendering and Displaying objects. Tek provides the perfect match for each stage: From personal graphics drafting stations, to visualization systems and real time animation systems. And, all from one family of products with compatibility, common operating systems and graphics libraries as well as a wide range of options to match any graphics computing environment.

Every workstation on the market was designed for a primary task such as software development, realtime control, math computations or general purpose use. Tek's specialty is graphics, and in the graphics intensive applications areas, Tek workstations excel at meeting the market's needs.

So, if your applications is graphics, and your focus is on Graphics Power, then Tektronix is the logical choice.

Tek Graphics Workstations depicted on the following pages consist of three families of the 4300 Series:

- 4330 3D High Performance System
- 4320 2D Medium Performance System
- 4319 Bit-Mapped X Window System

Each of these systems can be expanded and optioned for most any graphics applications.

Tektronix 4330 Graphics Workstation for 3D and shaded surface design visualization, realtime rotation and viewing.

4330 Graphics Workstation

TYPICAL APPLICATIONS

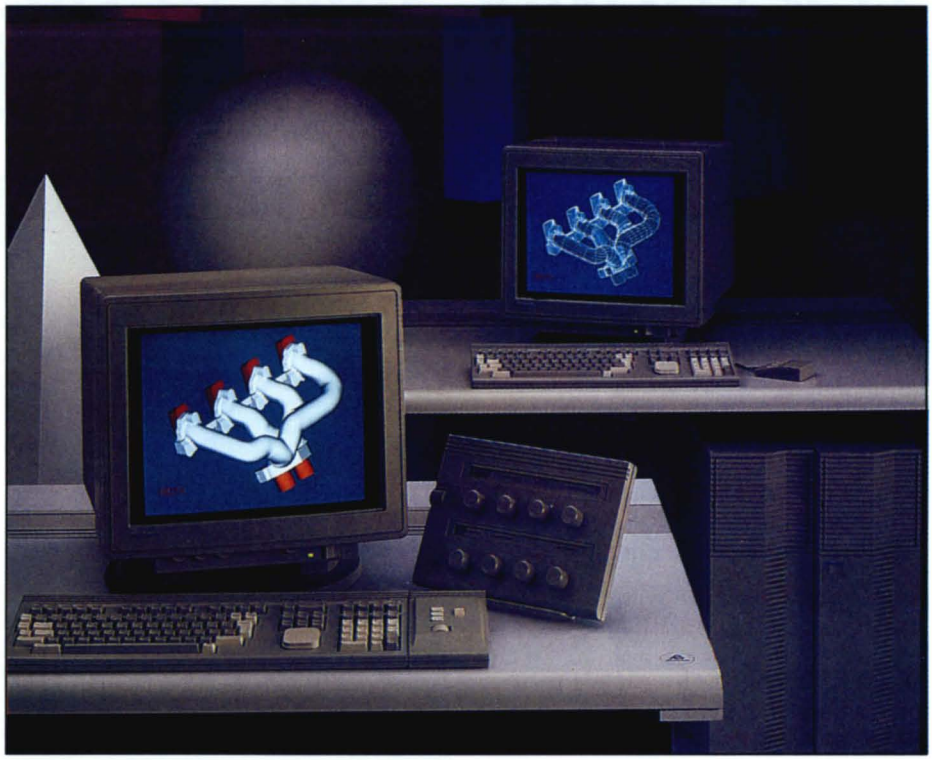
- **3D Mechanical Design/Modeling**
- **Simulation Animation**
- **Earth Resources**
- **Cartography**
- **Molecular Modeling**
- **Finite Element Analysis**
- **Visualization**

FEATURES

Graphics Power
- 68020 Graphics Processor (16 MHz)
- 4 to 52 MB Display List Memory
- Pipelined Parallel Architecture
- Transform Engine
- Tiling Engine
- 4 to 24 Bit Plane Frame Buffer
- 16 to 16.7 Million Colors
- 340,000 3D Vectors/Second
- 450,000 2D Vectors/Second
- 20,000 Shaded Polygons/Second
- 1280×1024 Pixel Addressability
- 16 and 19-Inch Monitors
- Three-Button Mouse
- Optional 16-bit Z Buffer
- Optional Valuator Dials
- Printer Output Port
- Tektronix Terminal Compatibility

Compute Power
- 20 MHz Motorola 68000 CPU
- 68881 Floating Point Co-Processor
- Optional High Speed Floating Point
- VME Bus Expansion
- 4 to 12 MBytes Main Memory
- 86 MB to 300 MB Disk Storage
- 1.2 MB Flexible Disk Drive
- Ethernet TCP/IP
- SCSI Controller
- Serial, Parallel and Optional GPIB Ports
- VT200 Compatible Keyboard
- Optional Mass Storage
- Optional 60 MB Streamer Tape

System Software
- **UTek™ (bsd 4.2) System**
- System V Extensions
- C Programming Language
- X Window System
- NFS Network File System
- System Utilities
- IBM PC Emulation
- Optional Languages—Fortran, Pascal
- Unify and Ingres Database
- High Performance Third-Party Software Applications Packages
- PLOT 10® Graphics Compatibility



Tektronix High Performance 3D Graphics Workstation

The 4330 is the system for visualization of product concepts, allowing three-dimensional interaction with creative designs. Before parts are actually built, designs on the 4330 can be viewed, simulated, modified and perfected without requiring old fashioned time consuming and expensive prototype and model processes.

The Tek 4330 is the ideal workstation for design processes requiring visualization and manipulation of 3D images at very high speeds.

Dual Processors

One 68020 processor is used for the operating system and applications processing. Another 68020 processor is used to drive the graphics subsystem, ensuring maximum graphics and compute throughput, with a dedicated processor for each of these functions.

Workstation Performance

The 4330 is a high performance workstation designed 3D for graphics-intensive applications. The display processor includes a 16 MHz 68020 which communicates with the application process, manages the graphics peripherals and loads the display memory. A 6.5 MIPS bit slice engine traverses the display list and speeds coordinate geometry into a 13 MFLOP Transform Engine which performs real time scaling, clipping and rotations. A 52 MOPS Tiling Address Generator calculates the pixel values between the end point coordinates and produces Gourand or smooth shaded surfaces. Additional custom gate arrays load the frame buffer in parallel and the results are displayed on a high resolution 1280×1024 display at a flicker free 60 Hz refresh rate.

Up to 16 light sources and 64 possible views allow objects to be viewed in parallel or perspective projection, sectioned, clipped, rolled and rotated. Graphics segments and a 32-bit virtual graphics coordinate space support true zoom and pan. Segment editing and subroutining and the powerful Draw Facets command, provide high-level programming entities. With the optional liquid crystal stereo display, images come to life in real time.

Tektronix 4320 Graphics Workstation for detailed design and construction with high speed 2D vector graphics.

4320 Graphics Workstation

TYPICAL APPLICATIONS

- **2D Mechanical and Electrical Design**
- **Earth Resources**
- **Cartography**
- **Finite Element Analysis**
- **Visualization**

FEATURES

Graphics Power
- 68020 Graphics Processor (16 MHz)
- 4 to 8 MB Display List Memory
- Bit Slice Graphics Engine
- 8 Bit Planes
- 256 Colors
- 16.7 Million Color Lookup Table
- 100,000 2D Vectors/Second
- 1024×768 Pixel Addressability
- Optional 1280×1024 Pixel Addressability
- 16 and 19-Inch Monitors
- Printer Output Port
- Tektronix Terminal Compatibility

Compute Power
- 20 MHz Motorola 68000 CPU
- 68881 Floating Point Co-Processor
- Optional High Speed Floating Point
- VME Bus Expansion
- 4 to 12 MBytes Main Memory
- 86 MB to 300 MB Disk Storage
- 1.2 MB Flexible Disk Drive
- Ethernet TCP/IP
- SCSI Controller
- Serial, Parallel and Optional GPIB Ports
- VT200 Compatible Keyboard
- Optional Mass Storage
- Optional 60 MB Streamer Tape

System Software
- UTek™ (bsd 4.2) System
- System V Extensions
- C Programming Language
- X Window System
- NFS Network File System
- System Utilities
- IBM PC Emulation
- Optional Languages—Fortran, Pascal
- Unify and Ingres Database
- High Performance Third-Party Software Applications Packages
- PLOT 10® Graphics Compatibility

Tektronix High Performance 2D Graphics Workstation

The 4320 is the recommended system for the detailed design and construction stage of product concepts, allowing fast two dimensional panning, zooming and vector drawing. Drawings are completed and viewed at high speeds, increasing productivity.

Dual Processors

One 68020 processor is used for the operating system and applications processing. Another 68020 processor is used to drive the graphics subsystem, ensuring maximum graphics and compute throughput, with a dedicated processor for each of these functions.

Workstation Performance

The 4320 is a high-performance workstation designed for 2D graphics-intensive applications. The 68020 Graphics processor communicates with the applications process, manages graphics peripherals and loads the display memory. A high-speed bit slice engine converts coordinate geometry into full color results which are displayed on a 1024 ×768 or a high-resolution 1280×1024 display at a flicker free 60 Hz refresh rate.

Graphics segments, combined with 32-bit graphics coordinate space, allow full detail viewing.

Tektronix 4319 Graphics Workstation for design/drafting and general-purpose UNIX-based x window graphics.

NEW 4319 Graphics Workstation

TYPICAL APPLICATIONS

- **2D Mechanical and Electrical Design/Drafting**
- **Cartography/Mapping**
- **Software Development**
- **Artificial Intelligence**
- **Personal Workstation**

FEATURES

Graphics Power
- 8 Bit Planes
- 256 Million Colors
- 16.7 Million Color Pallette
- Color×Cache Graphics Accelerator
- 1280×1024 Pixel Addressability
- 16 and 19-Inch Monitors

Compute Power
- 20 MHz Motorola 68000 CPU
- 4 to 20 MBytes Main Memory
- 86 MB to 300 MB Disk Storage
- 1.2 MB Flexible Disk Drive
- Ethernet TCP/IP
- SCSI Controller
- 2 Serial Ports
- 1 Parallel Port
- VT200 Compatible Keyboard
- Optional GPIB Controller
- Optional Mass Storage
- Optional 60 MB Streamer Tape
- Output to Tek Color Printers
- Attractive Design, Compact Size

System Software
- UTek™ (bsd 4.2) System
- System V Extensions
- C Programming Language
- X Window System
- NFS Network File System
- System Utilities
- IBM PC Emulation
- Optional Languages—Fortran, Pascal
- Optional Smalltalk, Lisp, Prologue
- Unify and Ingres Database
- High Performance Third Party Software Applications Packages
- PLOT 10® Graphics Compatibility

Tektronix X Windows System Graphics Workstation

Most graphics workstation applications require varying levels of price/performance and the Tek 4319 is the ideal choice for the conceptualization and drafting functions of the design process. As a member of Tek's workstation family, the 4319 is compatible with the higher performance 4320 and 4330 Series.

Workstation Performance

The Tek 4319 is well suited to the drafting portion of the design process and excels as a general purpose UNIX bitmapped graphics workstation. The 4319 compute power and system throughput are high, matching its quality graphics presentation and display speed.

Color≠Cache™, Tek's proprietary custom gate array graphics accelerator, increases graphics pixel drawing speed by up to a factor of eight over standard bitmapped workstations.

High speed X window system performance was a key design criteria for the 4319 and as a result, user interaction is excellent, with very fast pop-up menus, multiple X windows, client and server tasks and on-line system utilities.

A Tek 4107 graphics emulator is supplied with the system to provide compatibility with Tek vector graphics applications. The 4107 emulator runs in an X window concurrently with other X tasks.

The Tektronix 4301 is also used to form the compute platform for integrated Tek graphics workstations.

4301 Compute Engine

FEATURES

Compute Power

- **Motorola 68020 20 MHz CPU**
- **68881 Floating Point Processor**
- **Optional Floating Point FPU**
- **256 MB Virtual Memory**

Bus

- VME Bus Architecture
- High Speed Graphics Bus
- High Speed Internal Bus

Communications

- Ethernet TCP/IP
- 2 RS-232 Ports
- Parallel Printer Port
- Optional RS-232 Ports
- Optional Centronics Parallel Ports
- Optional GPIB

Mass Storage

- 86, 156, and 300 MB Disks
- 60 MB Streamer Tape
- 1.2 MB Flexible Disk

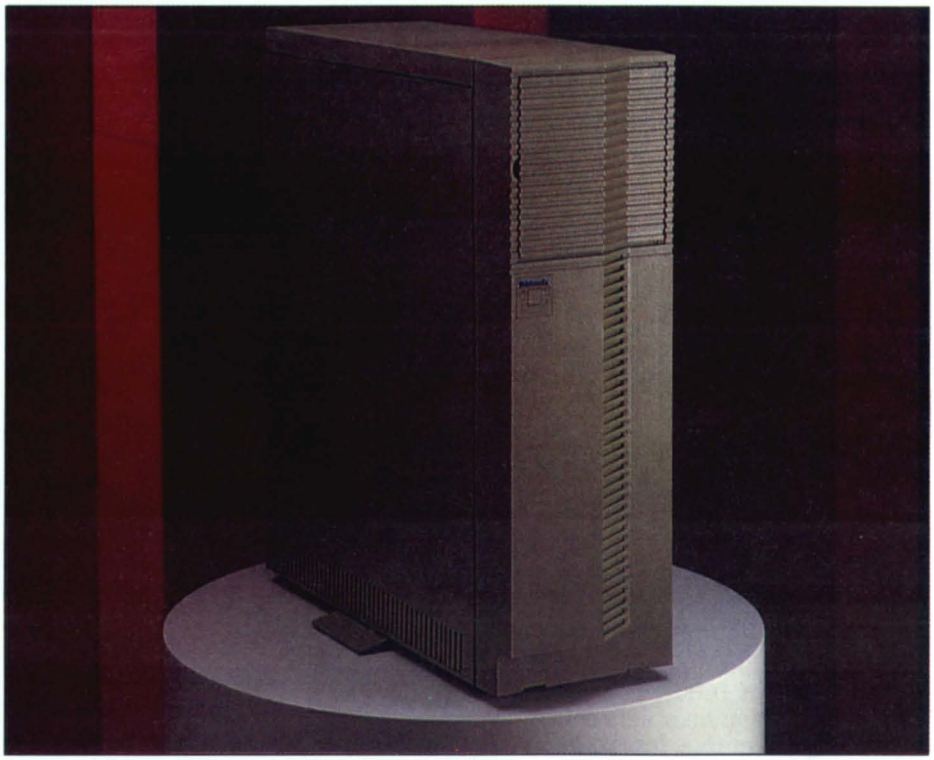
Input/Output

- VT200 Compatible Keyboard
- Three-Button Mouse
- GIN Devices

Major graphics applications have traditionally required large mainframe hosts to provide the necessary computing power to generate the complex geometry required to feed graphics processors. Now, in one compact unit, the power of a mainframe is available in a single workstation, closely coupled to the graphics subsystem, without the communications overhead of traditional systems. Lower costs, higher performance and user interactivity are the key benefits of the 4301 compute engine.

The 4301 compute engine provides 2.5 MIPS (million instructions per second) of computing power and 0.7 MFLOPS (million floating point instructions per second) to address medium range performance requirements.

The 4301 fits well into a heterogeneous computer networking environment. Standard communications ports are provided.



4301 Compute Engine Application Processor

The cabinet can contain one 5-inch disk drive, streamer tape and flexible drive. Additional peripherals may be added up to a total of 1.2 gigabytes of disk drive. A high speed imbedded SCSI controller insures quick response time and rapid disk access.

A variety of Tektronix input devices and high resolution color output printers are available as peripherals to the 4301 compute engine. Plotters and printers connect through standard output ports.

Graphics

The 4301 is fully compatible with Tek's high performance 2D and 3D Graphics subsystems and can be connected via RS-232, DMA or Bus with Tektronix 4220 and 4230 terminals.

Software

The 4301 Compute Engine runs UTek (bsd 4.2) ensuring access to a wide range of available software.

Virtual memory of 256 Gigabytes is supported and services are provided for all major peripherals.

System V extensions provide a wide range of utilities, and Network File System (NFS) and X Window System ensure access to industry standards.

High Performance

The Motorola 68000 processor provides powerful industry-standard computer performance. Producing 2.5 MIPS and 0.7 MFLOPS, the 68000 is ideally suited for graphics programs. The 4301 compute engine can be coupled with Tektronix high performance graphics display processors to form integrated workstations with 'twin engine' horsepower for the most demanding applications.

Terminal to Workstation Upgrade

Existing Tek 4220 and 4230 terminals can be upgraded in the field to graphics workstations by the addition of the 4301 compute engine. A 4301 can also drive a number of graphics terminals over an Ethernet LAN using TCP/IP, or via RS-232.

The 4310 can be used as a file server or compute service in a network of graphics workstations.

In addition to forming the graphics subsystem of Tek's 4300 Graphics Workstations, the following Tektronix terminals can also be used as graphics terminals connected to host computers.

4200 Terminal Subsystems

These terminals maintain compatibility with Tek's 4100 and 4200 terminal families and provide a logical upgrade path to increase the performance of host based graphics terminals for high speed 2D and 3D applications.

Segment Memory

4 to 52 MBytes of display list memory are supported for quick access to large drawings.

Compatibility

Connections to host computers, minicomputers or to other workstations can be accomplished by four different methods:

- RS-232 high speed ports
- DMA to a VAX DR11-C connection
- LAN connection on a network
- Bus connection to a Tek workstation

The LAN connection provides a diskless, Graphics Node, forming an ideal solution in a networking environment. DMA provides the highest speed link to a VAX. RS-232 connection allows flexibility in deployment of several terminals with the widest range of host options.

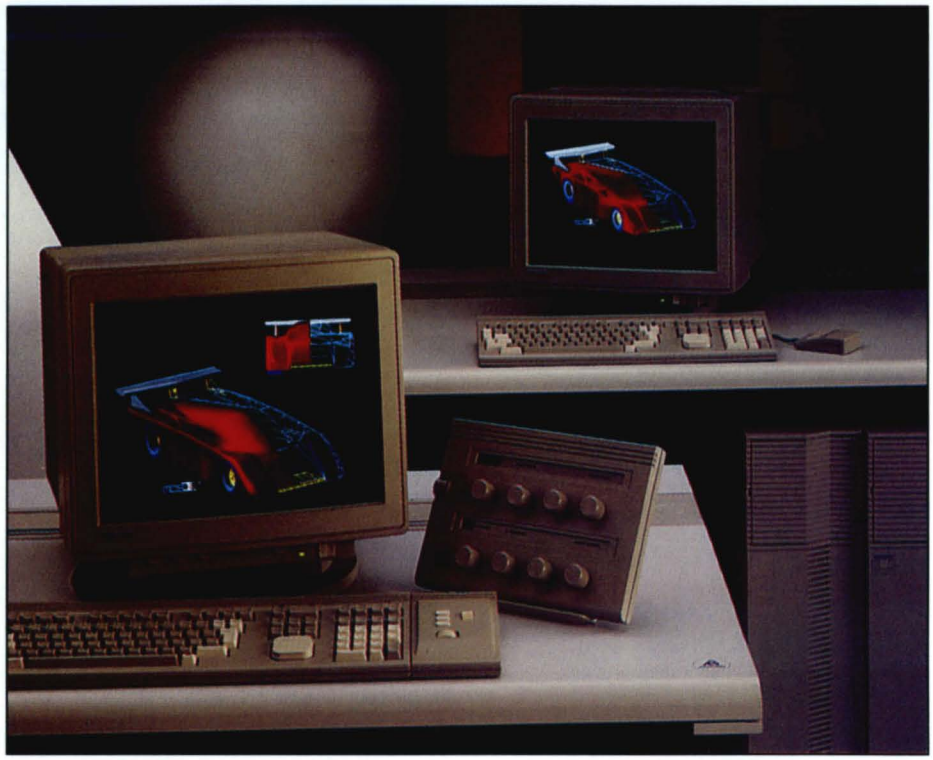
The most efficient and highest speed connection is to a Tek workstation, integrating the compute and graphics functions together into a closely coupled system as described in the 4320 and 4330 Graphics Workstation section.

Printer Output

A high speed printer port provides very fast output to the Tek 4693D color printer for full color printed images. Other Tek printers such as the 4692 and 4696 are also supported.

Stereo

Optional Stereo displays show 3D images with true depth perception.



4200 Terminal Subsystems

3D Terminals

The 4230 Series feature very high speed graphics with true color representation.

FEATURES

- 68020 Graphics processor (16 MHz)
- 4 to 52 MB Display List memory
- Pipelined Parallel Architecture
- Transform Engine
- Tiling Engine
- 4 to 24 Bit Plane Frame Buffer
- 16 to 16.7 million colors
- 340,000 3D Vectors Second
- 450,000 2D Vectors/Second
- 20,000 Shaded Polygons/Second
- 1280×1024 Pixel Addressability
- 16 and 19 inch Monitors
- Three Button Mouse
- Optional 16 bit Z buffer
- Optional Valuator Dials
- Tektronix terminal compatibility

4235
- 4 bit planes
- 4 MBytes display list memory

4236
- 8 bit planes
- 4 MByte display list memory

4237
- 12 bit planes
- Z buffer with 16 planes
- 4 MByte display list memory

2D Terminals

The 4220 Series feature high speed 2D graphics for detailed design.

FEATURES

- 68020 graphics processor (16 MHz)
- 4 to 8 MB Display List memory
- Bit slice graphics engine
- 8 bit planes
- 256 colors
- 16.7 million color lookup table
- 100,000 2D Vectors/Sec
- 1024×768 pixel addressibility
- Optional 1280×1024 pixel addressability
- 16 and 19 inch Monitors
- Tektronix terminal compatibility

4224
- 1024×768 pixel addressibility
- 4 MBytes display list memory

4225
- 1280×1024 pixel addressibility
- 4 MByte display list memory

ORDERING INFORMATION

4335 3D Graphics Workstation. **37,500**
4336 3D/2D Graphics Workstation. **$47,500**
4337 3D/2D Graphics Workstation. **$51,500**
4235 3D Graphics Terminal. **$23,500**
4236 3D Graphics Terminal. **$33,500**
4237 3D Graphics Terminal. **$37,500**
4324 2D Graphics Workstation. **$26,950**
4325 2D Graphics Workstation. **$29,950**
4224 2D Graphics Terminal. **$12,950**
4225 2D Graphics Terminal. **$15,950**
4301 Compute Engine. **$14,950**

STANDARD ACCESSORIES

Includes: Color display, tilt/swivel base, graphics module, compute module, VT200-type keyboard, mouse, power cords, keyboard overlays, RGB cables, and manuals.

OPTIONS

Option 1A—Floating Point Accelerator (4301, 4330/4320 Series). **+$4,900**
Option 1B—4 MByte Additional Memory (8 MBytes total) (4301, 4330/4320 Series). **+$3,000**
Option 1C—8 MByte Additional Memory (12 MBytes total) (4301, 4330/4320 Series). **+$6,000**
Option 2A—Additional 4 Bit Planes (8 total) (4235/4335). **+$4,000**
Option 2E—12 Bit Planes Double Buffered (4237/4337). **+$12,000**
Option 3A—Dual RS-232C DMA (4301, 4330/4320 Series). **+$700**
Option 3B—Dual Centronics Interface (4301, 4330/4320 Series). **+$700**
Option 3E—Network Adapter (4301, 4330/4320 Series). **+$500**
Option 3F—Interactive DMA for DEC DRV-11WA Interface. **+$1,500**
Option 3G—Local Bus Adapter (4301, 4330/4320 Series). **+$500**
Option 3W—Interactive DMA for DEC DR-11W Interface.*1
Option 10—Additional 360 Kbyte Flexible Disk (4301, 4330/4320 Series). **+$500**
Option 11—Additional 360 Kbyte Flexible Disk and Streamer Tape (4301, 4330/4320 Series). **+$2,000**
Option 12—Additional Streamer Tape (4301, 4330/4320 Series). **+$2,000**
Option 16—156 MByte Hard Disk (4301, 4330/4320 Series). **+$2,300**
Option 17—300 MByte Hard Disk (4301, 4330/4320 Series). **+$5,500**
Option 32—19-inch 1280×1024 Color Display. **+$1,500**
Option 33—Stereoscopic Display. **+$12,000**
Option 49—Rental Tag. **NC**

WARRANTY-PLUS SERVICE PLANS

See Service Support on page 559.

OPTIONAL ACCESSORIES

Includes: Service manual, display calibration graticules, and software porting guide.

4319 2D Graphic Workstation **$11,950**

OPTIONS

Option 1B—Add 4MB Memory (8MB total) **+$3,000**
Option 1C—Add 8MB Memory (12MB total) **+$6,000**
Option 1D—Add 12MB Memory (16MB total) **+$9,000**
Option 1E—Add 16MB Memory (20MB total) **+$12,000**
Option 10—Add 360KB flexible disk **+$500**
Option 11—360KB flexible disk and 60MB streamer tape (replaces 1.2 MB flexible disk) **+$2,000**
Option 12—Add 60MB streamer tape **+$2,000**
Option 13—Removable hard disk **−$2,500**
Option 16—156 MB hard disk (replaces 86MB) **+$2,300**
Option 17—300MB hard disk (replaces 86MB) **+$5,500**
Option 3J—GPIB interface **+$300**
Option 32—19" color display **+$1,500**
Option 49—Rental Tag **NC**

FIELD KITS

4319F1B—Add 4MB Memory **$3,000**
4319F1C—Add 8MB Memory **$6,000**
4319F3J—GPIB interface **$300**

WARRANTY-PLUS SERVICE PLANS

See Service Support on page 559.

Option S0—Onsite installation and setup **+$323**
Option E1—E/U +1 year onsite service **+$1,872**
Option S1—OEM +1 year onsite service*1
Option E2—E/U +2 year onsite service **+$3,975**
Option S2—OEM +2 year onsite service*1
Option E3—E/U +3 year onsite service **+5,289**
Option S3—OEM +3 year onsite service*1
Option S4—OEM 90 day onsite service*1
Option S9—1 year S/W update and phone support*1

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4*2—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

SOFTWARE

This is a partial list of the software available for 4300 Series workstations. Please refer to the software catalog for a complete list of software.

4319P01—UTek O/S Backup Media
Option S9—Warranty Plus
Option 01—Streamer Tape
Option 02—1.2MB Flexible Disk
4300P34—Color Smalltalk
Option S9—Warranty Plus
Option 01—Streamer Tape
Option 02—1.2MB Flexible Disk
4300P21—Data Base Manager
4300P22—Interactive Database Development Env.
4300P32—EMACS Editor
4300P33—Tek Common Lisp Programming Language
4300P36—Quintus Prolog Programming Language
4300P37—Fortran 77
4300P38—Pascal

RECONDITIONED TEKTRONIX INFORMATION DISPLAY PRODUCTS

- **Quick Delivery**
- **Low Prices**
- **New Product Warranties**
- **Quantity discounts**

With Tek's quick delivery, you can be using Information Display products at substantial savings in just two weeks. Tektronix remanufactures demo and lease returns to latest specifications and offers them with new product warranties. Quantity discounts apply to current as well as discontinued products.

In the U.S., contact your local Tektronix Field Office for IDG Reconditioned Product availability and prices. Overseas customers call your Tektronix Sales Office.

*1 *Contact your local sales office.*
*2 *Unavailable for 4319.*

4200 Series Graphics Terminals

TYPICAL APPLICATIONS

- **CAD/CAM/CIM**
- **Automated Mapping and Facilities Management**
- **Presentation Graphics/Data Analysis**
- **Process Control**

BENEFITS

- **Investment Protection**
- **User Productivity**
- **User Confidence**
- **Matches Users Needs**

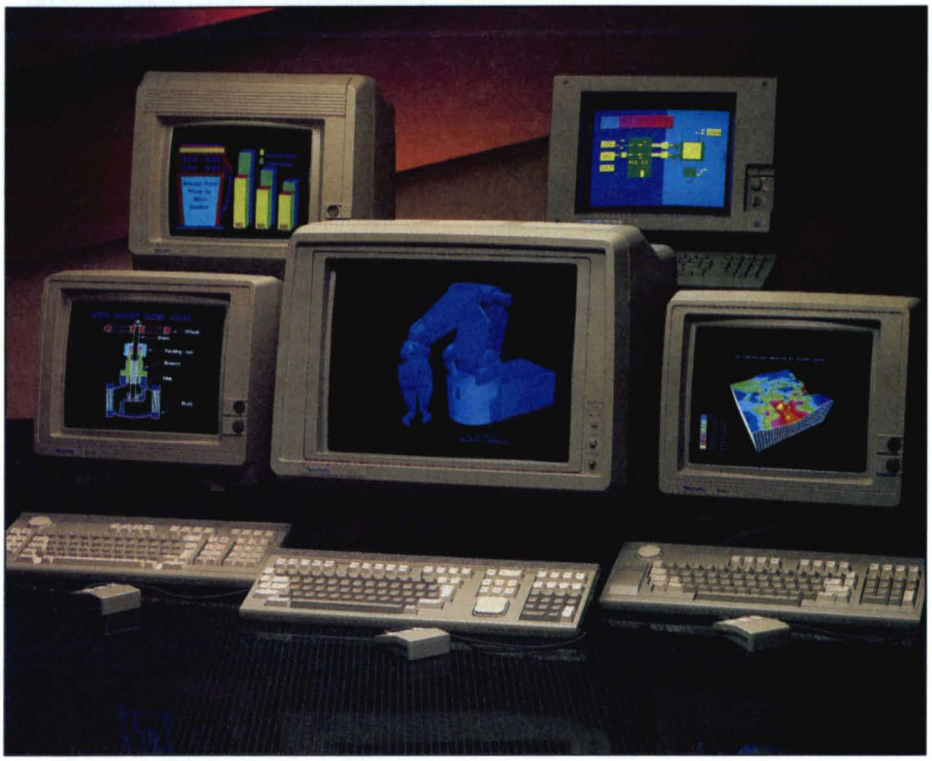
FEATURES

- **Compatibility with Thousands of S/W Applications and Host Platforms (DEC & IBM)**
- **Sophisticated Graphics Capabilities**
- **Excellent Reliability**
- **Product Flexibility/Modularity**

Tektronix color graphics terminals provide advanced features at affordable prices, with a full range of fully compatible terminals to select from.

The 4205 is our lowest cost terminal; the 4207 and 4208 offer more advanced features and higher resolution. The SF4208 is adapted specifically for shop floor, rough and dirty environments. The 4209 is a large-screen version (19-inch) of the 4207 and, in addition, offers video out.

The 4211 Networked Graphics Terminal is the newest addition to our family of fully compatible graphics display products. It combines the best of all the 4200 Series terminals with a higher resolution (1024×768) display. It achieves the fastest speeds yet in the low-cost color arena, and offers optional networking capability.



4200 Series Graphics Terminals

4200 SERIES TERMINAL SELECTION GUIDE

Features	4205	4207	4208	SF4208	4209	*NEW* 4211
Display size	13-inch	13-inch	13-inch	13-inch	19-inch	15 or 19-inch
Displayable colors:						
Graphics	16	16	16	16	16	16 or 256
Alphanumeric	8	8	8	8	8	8
Palette size	64	64	64	64	64	4096 or 16.7 million
Addressable points	480×360	640×480	640×480	640×480	640×480	1024×768
Virtual graphics coordinate space	4096×4096	4096×4096	4096×4096	4096×4096	4096×4096	4 billion×4 billion
Segment operations	Yes	Yes	Yes	Yes	Yes	Yes
Local zoom andpan	Yes	Yes	Yes	Yes	Yes	Yes
Arc and circle commands	Yes	Yes	Yes	Yes	Yes	Yes
Pixel operations	Yes	Yes	Yes	Yes	Yes	Yes
Two-port peripheral interface	No	Yes	Yes	Yes	Yes	Yes
Color & monochrome copier support	Yes	Yes	Yes	Yes	Yes	Yes
4957/4958 Tablet support	No	Yes	Yes	Yes	Yes	Yes
4510A support	No	Yes	Yes	Yes	Yes	Yes
System memory, standard (bytes)	256 K	256 K	512 K	512 K	512 K	2 MB
Optional additional megabytes of memory	1.0	1.0	1.0	1.0	1.0	2.0
Video out	No	No	Yes	Yes	Yes	Yes
Prices begin at (U.S. end user)	$2,495	$3,995	$4,995	$5,495	$6,995	$8,995

Contact your local Tektronix Sales representative.

Software Compatibility

The 4200 Series terminals incorporate specific features needed to meet the needs of applications in four specific areas: CAD/CAM/CIM, automated mapping/facilities management, presentation graphics and data analysis, and process control.

4200 Series users can run any program written for Tek 4100 Series terminals, including Tektronix' PLOT 10, TekniCAD, STI, GDI, GKS, and IGL. Other 4200 Series-compatible applications include packages from Computer Associates, SAS, MCS, SDRC, ESRI, and Sierra Geophysics.

Advanced Intelligent Graphics Capability

Performance and productivity are improved by enhanced segment operations, local zoom and pan, and multiple view functions. Local memory and graphics intelligence allow users to define objects at the host, save them in the terminal, and then manipulate and edit them locally with only minimum interaction with the host.

True local zoom and pan on the 4200 Series rescales images using the full addressability of the terminal's 4096-by-4096 coordinate space. Users can enlarge an image to view it in detail, then pan beyond the image displayed on the screen to zoom in on a portion. These powerful functions are handled locally by the terminal and do not require host interaction.

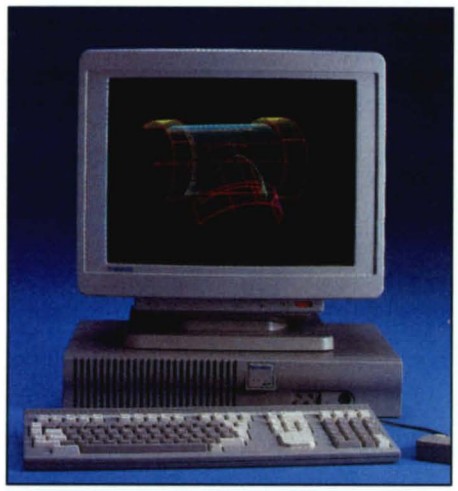
Users can display up to 64 views in independent viewports on the screen, allowing them to compare graphics information simultaneously, look at different views of one object, or display time-series data.

The 4200 Series is ANSI X3.64-compatible and supports standard industry alphanumerics. Users can download custom character fonts from the host computer to fit specific applications.

The 4200 Series supports Tek's 4690 Series Color Copiers, including the new, powerful 4693D, and popular low-cost printers such as the HP ThinkJet, HP LaserJet, Epson FX-80, and others. A background copy feature frees the computer for continued use while it makes hard copies. New to the 4200 Series is support for HPGL-compatible plotters.

TekniCAD is a trademark of Tektronix, Inc. PLOT 10 is a registered trademark of Tektronix, Inc.

Flexible leasing programs available in the continental U.S.



NEW 4211

In addition to the graphics input device on the keyboard, the 4200 Series supports an optional mouse, plugged directly into the keyboard. The 4200 Series, except for the 4205, also supports Tek's 4957 and 4958 Graphics Tablets.

VT200 Compatibility

DEC users have full access to high-performance Tek graphics and long-term support for an upward migration path. The 4200 Series provides complete alphanumeric compatibility with DEC's VT200 family. The Tek VT200 keyboard supports most Tektronix 4100 and 4200 Series applications and VT200 applications without modification.

GDDM Compatibility

Tek brings the performance advantages of Tek graphics to IBM users while maintaining compatibility with existing GDDM applications. Both high-performance Tek graphics and existing GDDM applications are supported, giving users the widest graphics choices available.

Shop Floor Features

The SF4208 Industrial Color Graphics Terminal offers the full graphics performance of the 4200 Series Color Graphics Terminals combined with the construction to withstand the rigors of the shop floor. The SF4208 is suitable for a wide range of manufacturing applications including mechanical drawing preview, numeric control tool path simulation, production assembly and process control.

GDDM compatibility offers access to a variety of exsiting applications. Users can access up to five IBM host sessions,changing sessions by pressing just one key. The 4200/CX Series terminals have dual-host connections, so they can be linked simultaneously to an IBM host and a DEC or other RS-232 host.

NEW 4211

Networked Graphics Terminal

ADDITIONAL FEATURES

- **Networking Capability**
- **15- or 19-inch Display**
- **Multiple Configuration Choices**

The *NEW* 4211 combines the best of all the 4200 Series terminals with higher display resolution (1024×768). It is the fastest terminal yet in the low-cost color graphics arena, and includes advanced features like optional networking capability and dual display support for separating graphics and alphanumeric displays.

Many Connections

The 4211 allows you to connect to any computer on an RS-232 line, a coax line, *or a network line.* In addition, it gives you VT200 and GDDM emulation for immediate compatibility with any package conforming to these popular standards. You can expect programs currently running on any 4200 Series terminal or on the 4111 to run on the 4211 *without modification.*

Modularly Configured

The 4211's modular design allows you to configure the terminal with only those advanced features needed for your application. You can outfit it with an optional extra four bit planes (four are standard), giving you a palette of 16.7 million colors with 256 displayable at one time. You can select a 15 or 19-inch screen and you can purchase an extra two megabytes of memory (two are standard).

Flexible Packaging

The 4211's physical design allows you to place the graphics engine module out of your way. And, for the first time, we are offering a tilt and swivel base as a standard part of the product and a floor stand as an option.

ORDERING INFORMATION

4205 Color Graphics Terminal	$2,495
4207 Color Graphics Terminal	$3,995
4208 Color Graphics Terminal	$4,995
SF4208 Industrial Graphics Terminal	$5,495
4209 Color Graphics Terminal	$6,995
4211 Networked Graphics Terminal	$8,995

STANDARD ACCESSORIES

Includes: Power cord, RS-232 cable and manuals.

OPTIONAL ACCESSORIES

Includes: Mouse, additional memory, sealed keyboards, programmers documentation and IBM coaxial interface.

International keyboard and power cords are also available.

WARRANTY-PLUS SERVICE PLANS

See Service Support on page 559.

4693D

Color Image Printer

TYPICAL APPLICATIONS

- **Presentaton Graphics**
- **2D and 3D CAD**
- **Computer-Generated Imagery**
- **Complex Business Graphics**
- **Desktop Publishing**

BENEFITS

- **Accepts All Full-Color Screen Graphics**
- **Handles Multiple Users and Applications Simultaneously**

FEATURES

- **Thermal Wax Print Technology**
- **High-Speed Digital Interface**
- **300-dpi**
- **16 Million Colors or 256 Shades of Gray**
- **2048 by 1536 Pixel Resolution**
- **Color or Monochrome Printing at 1 Minute/Page**

The 4693D Color Image Printer accepts and prints high-resolution graphic images on paper or transparencies in as little as 1.5 minutes. It features a high-speed digital interface, a Motorola 68020-based controller, and a 300-dpi color thermal wax print engine.

With a color palette of more than 16 million colors, the 4693D excels at high-quality printing of computer-generated color graphics from 2D line drawings and business graphics, to sophisticated computer imaging. It also can accept a color image and print it in black and white, using up to 256 shades of gray. With an optional 4-channel multiplexer and optional memory, the 4693D queues and processes multiple images simultaneously, providing optimal results to each user without delay.

The 4693D is compatible with all Tektronix color display systems and workstations, as well as those from Apollo, Sun, Silicon Graphics, Apple Macintosh II, IBM PC, PC Compatibles, Commodore Amiga, Masscomp, and others.

Ordering Information is on page 58.

4510A

Color Graphics Rasterizer

TYPICAL APPLICATIONS

- **Direct Host Connection to Tektronix 4691, 4692, 4693D, 4696 Color Output Systems**

BENEFITS/FEATURES

- **Shared System Resource**
- **More Than 130,000 Colors Available**
- **IBM 3287-Style Coax Interface (CX4510A)**
- **Compatible With Tektronix 4100,4110,4120,4200 Series Graphics Terminals (2D Vector Data)**

The 4510A Color Graphics Rasterizer enables a direct host connection to the 4691, 4692, 4693D, and 4696 color printer systems. This allows you to configure shareable color output systems, compatible with most computer systems or Tektronix terminals.

The 4510A accepts Tektronix-style graphics data serially to drive color graphics printers at maximum potential for quality color and high resolution.

When equipped with the optional IBM-style coaxial interface, the 4510A can be connected simultaneously to an IBM and a non-IBM host computer.

Ordering Information is on page 58.

NEW 4693RGB

Color Screen Printer

TYPICAL APPLICATIONS

- 2D/3D CAD Screen Copies
- Technical Data/Scientific Images

BENEFITS

- Video Interface
- Compatible With Most Non-Interlaced Color Display Systems
- Simple Installation and Calibration
- Small Fiber-Optic Cables

FEATURES

- Screen Copies in 43 Seconds
- Sheet-fed Paper and Transparency Film
- User Installable
- Small, Lightweight Fiber Optic Interconnect Cable
- Compatible With a Wide Variety of Display Systems
- Image Capture Within 4 Seconds Regardless of Display Size and Color Pallet
- Automatic Calibration
- Image Queueing and Sizing
- 4096 Colors or 16 Gray Shades
- Personal Control Unit

The 4693RGB adds superior performance as a video-interfaced, color screen printer based on thermal-wax print technology. Features such as less than 4-second screen capture, automatic calibration, image queueing, and multi-user capability are designed to increase user productivity. Image quality is enhanced with a 4096 color palette, 300 dpi, and image sizing to the boundries of the media print area. A Personal Control Unit located at the user work-site gives the individual user a three-button, 32-character LCD display to control quanity of prints, imaging functions, and printer status.

Ordering Information is on page 58.

4696

Color Ink-Jet Printer

TYPICAL APPLICATIONS

- Presentation Graphics
- PC CAD, Publishing
- Terminal Screen Copies

BENEFITS

- Low Cost
- Three Graphics Modes
- Easy Installation and Maintenance
- Roll, Sheet or Transparency Media
- Quiet, Compact Design
- Complete Supplies Start-up Kit

FEATURES

- 120 by 240 dpi
- 0.47 Square Inch-Per-Second Printing

The 4696 Color Ink-Jet Printer combines low cost and quiet operation in a compact design. It produces high quality color screen copies at the push of a single key, in vivid color with addressability of up to 120×240 dpi. Specially-formulated inks for the 4696 provide excellent color saturation and brilliance. A separate black cartridge ensures a true black that is unobtainable from other systems that mix dyes. Three graphics printing modes offer a variety of print qualities and speeds, including enhanced black at regular speed and enhancement of all colors at reduced speed.

Ordering Information is on page 58.

4521/4522

Color Video Processors

TYPICAL APPLICATION

- Interface for Tektronix 4692, 4693D and 4696 Color Printers to Tektronix Terminals, Workstations and Monitors

BENEFITS/FEATURES

- Color Screen Copy Capability for Terminals, Workstations, and Monitors with Color Video Outputs
- RGB Video Input
- Image Capture in 2 Seconds for Fast Display Off-load
- Multiple Image Queueing and Print Requests
- 8 or 64 Colors

The 4521 and 4522 Color Video Processors provide a simple method of interfacing Tektronix color ink-jet printers to a variety of terminals, workstations and monitors.

These processors quickly capture a copy of the display video signal, freeing the display for other tasks. The screen image is converted into data for use by Tek color printers to produce a copy of the screen image. The processors can also produce multiple copies of a single image, as well as multiple image capturing and queueing.

Ordering information is on page 58.

4957 Graphics Tablet

TYPICAL APPLICATION

- **Data Transfer From Paper to Computer Data Base**

BENEFITS/FEATURES

- **12×18 inch Active Area**
- **Easy to Use Four-button Cursor on Stylus**
- **Compatible With Tek 4100 and 4200 Series Terminals and Graphic Workstations**
- **RS-232C Compatible**
- **1000 Points/Inch Resolution**
- **0.010-inch Accuracy**

The 4957 Destop Graphics Tablet reads graphic coordinate data via a four-button cursor or stylus (optional). By touching either to the tablet's surface, X-Y coordinates are calculated and relayed to the host terminal or computer for further processing. The 4957 augments your terminal's keyboard as a menu selection or cursor control device.

The 4957 is compatible with the Tektronix 4106A, 4107A, 4109A, 4110A, 4120 and 4200 Series Color Graphics Terminals and Tektronix Graphics Workstations.

4958 Graphics Tablet

TYPICAL APPLICATION

- **Schematic Capture**

BENEFITS/FEATURES

- **18×24 to 44×60 inch Working Area**
- **Desktop or Pedestal Mount**

The 4958 Graphics Tablet reads graphic coordinate data via a multi-button cursor or a stylus (optional). When either is touched to the tablet surface, the tablet calculates the coordinates and relays them to the host computer/terminal for further processing.

The 4958 is available in either 18×24 inch desktop, 36×48 inch pedestal-compatible, or 44×60 inch pedestal-compatible configurations. The 4900H01 Tablet Pedestal is available for pedestal-compatible surfaces.

The tablet cursor is available with 4 or 16 buttons, and a cross-hair lens for accurate point selection. The cursor serves as a programmable hand-held keyboard from which the user can perform user-defined functions.

The 4958 offers up to 1,000 points-per-inch resolution with 0.010-inch accuracy.

NEW 4991S3

Scanning/Drafting System

TYPICAL APPLICATIONS

- **Mechanical/Electrical Engineering**
- **Architectural, Mapping**
- **Translates Hard Copy into CAD Databases**

BENEFITS/FEATURES

- **5-Fold Productivity Increase Over Manual Digitizing or On-Screen Redesign**
- **Simultaneous Scanning and Vectorizing**

The 4991S3 Scanning/Drafting System quickly transforms existing line-intensive documents into a useful, accurate database for CAD and mapping systems. It provides scanning, vectorizing, editing and computer-aided drafting tools for many applications in mapping, architecture, and mechanical and electrical engineering.

Because the system's 4991 Scanner/Vectorizer and 4324 2D Graphics Workstation perform scanning and editing processes locally, valuable CAD system resources are not tied up with time-consuming input tasks. The multi-tasking UNIX-based workstation allows concurrent editing of existing vector files during the scanning process.

Interactive TekScan scanning software gives the user maximum flexibility and control in preparing the most useable database for each application. Its straightforward user interface simplifies scanning and editing through on-screen menus.

The 4991S3's PLOT 10 TekniCAD editing/drafting software supports a powerful array of geometric entities, symbols, line attributes, editing functions, and user-definable macros, while its PLOT 10 CADDPort bidirectional data exchange utility software rapidly and accurately translates data to all leading CAD formats.

ORDERING INFORMATION

4692 Color Graphics Copier	**$7,795**
The 4692 must be ordered with on-site installation and setup.	
4693D Color Image Printer	**$8,495**
4510A Color Graphics Rasterizer	**$5,995**
4693RGB Color Image Printer	**$6,400**
The 4693RGB must be ordered with a video adapter with prices starting at $1,200.	
4696 Color Ink-Jet Printer	**$1,795**
4521 Color Video Processor	**$1,995**
4522 Color Video Processor	**$3,995**
4957 Graphics Tablet	**$995**
4958 Graphics Tablet	**$500**
4991S3 Scanning/Drafting System.	**$125,000**

OPTIONS

Contact your local Tektronix Sales Representative.

***WARRANTY-PLUS* SERVICE PLANS**

See Service Support on page 559.

GRAPHICS SUPPLIES

Paper, pens, transparencies, ink and maintenance cartridges, ribbons, toners, diskettes, data cartridges, manuals, cables for:

- Color Image Printers and Systems
- Graphics Tablets
- Graphics Terminals and Workstations

Complete *Computer Graphics Supplies Catalog* available through the toll-free number or your local Tektronix office.

Direct Order Desk toll-free number:

1-800-TEK-6100

Alaska & Oregon call collect:

1-503-642-8000

Open from 6:00 am to 5:00 pm PSST
VISA/MasterCard accepted

International customers call your local Tektronix office.

RECONDITIONED TEKTRONIX INFORMATION DISPLAY PRODUCTS

In the U.S., contact your local Tektronix Field Office for IDG Reconditioned Product availability and prices. Overseas customers call your Tektronix Sales Office.

GMA 201 19" Ultra-High Resolution Monochrome Analog Raster Display

TYPICAL APPLICATIONS

- Document Retrieval
- Architectural CAD
- Gray Scale Imaging
- Computer-Aided Publishing

BENEFITS

- Image Uniformity
- High Reliability

FEATURES

- Ultra-High Addressability and Visual Resolution
- Highly Stable Operation
- Precision Landscape-Format Display
- Over 3,000,000 Viewable Pixels

The GMA 201 features a bright, stable, flicker-free 60 Hz refresh rate, 2048 horizontal by 1536 vertical viewable pixels, and a crisp, well-focused beam at all points on the screen. A high-bandwidth 200-MHz amplifier affords maximum image fidelity while digitally-adjusted focus and astigmatism tracking provide crisp, stable displays, even in the corners.

ORDERING INFORMATION

GMA201 Monochrome Raster Display Monitor. **$3,950**

OPTIONS

Option 23*[1]—Cabinetry and CRT Bezel. **+$870**
Option 30—64 kHz Horizontal Sync. **NC**
Option 32—78 kHz Horizontal Sync. **NC**
Option 38—75 Hz Vertical Sync. **NC**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

*[1] *Option 23 includes a standard North American 115 V power plug. Option 23 is required to order A1-A5 power plugs.*

OPTIONAL ACCESSORY

Service Manual—Order 070-5079-00 **$130.**

GMA 202 19" Ultra-High Resolution Monochrome Analog Raster Display

TYPICAL APPLICATIONS

- Medical Imaging
- Reconnaissance
- Computer-Aided Publishing
- Document Retrieval

BENEFITS

- Small "Footprint"
- High Reliability

FEATURES

- Ultra-High Addressability
- Visual Resolution 1536×1536
- Highly Stable Operation
- Precision Page Format Display

The GMA 202 features a bright, stable, flicker-free display with 1536 horizontal by 2048 vertical viewable pixels and comes fully equipped with all required internal shielding.

Our modular concept provide customers a wide range of displays while minimizing costly modifications to incorporate additional displays with various limited performance ranges.

ORDERING INFORMATION

GMA202 Monochrome Raster Display Monitor. **$3,950**

OPTIONS

Option 01—WB (P45) Phosphor with 30% contrast enhancement filter. **+$100**
Option 10—Composite Video **+$85**
Option 41—80 kHz-120 Hz interlace **NC**
Option B1—Service Manual. **+$75**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

For further information, contact:
Tektronix, Inc.
P.O. Box 500, MS 46-943
Beaverton, Oregon 97077
or call: (503) 627-6868
(800) 835-9433, ext. 6868
TWX: 910-467-8708
TLX: 151754
FAX: 503-627-2670

GMA 251 19" Ultra-High Resolution Digital Image Display

TYPICAL APPLICATIONS

- Photogrammetry
- Picture Archiving and Communication Systems (PACS)
- Reconnaissance
- Gray-Scale Imaging
- Computer-Aided Publishing

BENEFITS

- Easy Interface
- Image Update Speed

FEATURES

- 2048×1536 Pixel Display
- 2048×2048 Pixel Frame Buffer
- Scroll and Window Functions
- 16-Bit Parallel Interface Operates at Up to 20 Mbyte/Sec
- 0.2 Sec Display Update Time
- 256 Levels of Gray-Scale

The GMA 251 makes the benefits of high-resolution video available to the system builder.

The frame buffer incorporates ultra fast circuits that allow the user to update the display as fast as 5 times a second. This frame buffer has a storage capacity of 2048×2048×8 and, by scrolling the entire image can be displayed on the screen.

ORDERING INFORMATION

GMA251 Monochrome Digital Image Display. **$16,250**

OPTIONS

Option 01—WB (P45) Phosphor with 30% contrast enhancement filter. **+$100**
Option B1—Service Manual. **+$150**
Interface Cards—Call for information on custom cards such as VME, AT, etc.

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switxzerland 220 V, 50 Hz.

600 Series Monitors

General-Purpose, Economical X-Y Displays to Very High-Resolution X-Y and Raster Displays for Critical Applications

606B Monitor

TYPICAL APPLICATIONS

- Ultrasound Multi-Imaging
- High Density Graphics
- Imaging For Scan conversion
- Scanning Electron Microscopy

BENEFITS

- Ultra Sharp Images
- Image Stability
- High Reliability

FEATURES

- Uniform Resolution
- Brightness Uniformity
- Multi-Imaging Capability

608 Monitor

TYPICAL APPLICATIONS

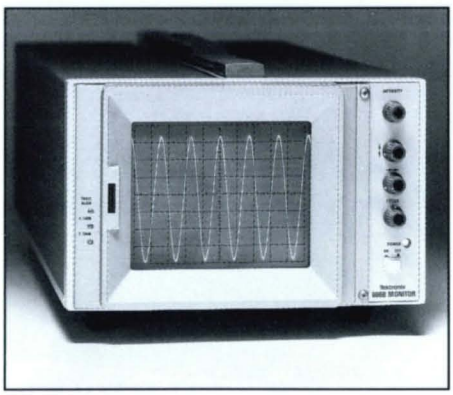
- Spectrum analysis
- IR Imaging
- Mass Spectrometry
- Ultrasound

BENEFITS

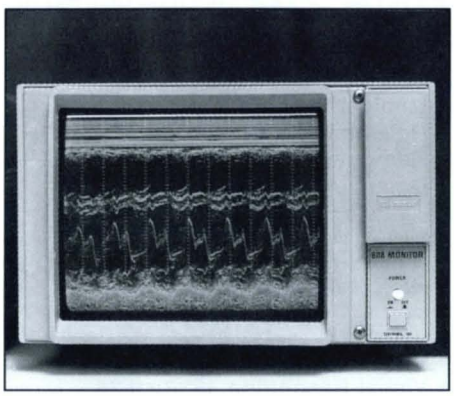
- Optimum Viewing Capability
- High Ambient Viewing
- Photographic Quality Images

FEATURES

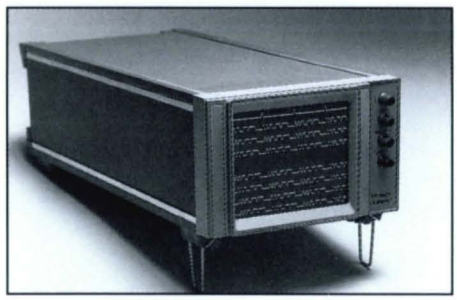
- 70 fL Useable Brightness
- High Clarity
- Excellent Gray Scale



606 Option 06



608 Option 23



620 Option 23

620 Monitor

TYPICAL APPLICATIONS

- Ultrasound
- Logic Analyzers
- Electronic Test Equpment
- Network Analyzers

BENEFITS

- Economical Display
- High Reliability

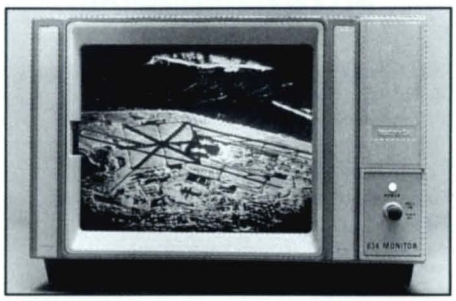
FEATURES

- Low Cost
- Modular Packaging
- Low Power Consumption

KEY SPECIFICATIONS FOR X-Y DISPLAYS

	606B	608	620
Spot Size*1	0.08 mm (3.1 mils)	0.26 mm (10 mils)	<15 mil <25 mil at max drive
Display Size	8×10 cm	9.8×12.2 cm	10×12 cm
Acceleration Potential	5.5 kV	22.5 kV	12.0 kV
Bandwidth, X-Y*2	>3 MHz	≥5 MHz	≥2 MHz
Bandwidth, Z*2	5 MHz	≥10 MHz	≥5 MHz
Rise Time	<35 ns	≤35 ns	
Input R and C, X-Y*3	1 MΩ ±1% or 50Ω <47 pF	1 MΩ≤ ≤60 pF	1 MΩ< ≤47 pF
Input R and C, Z*3	1 M or 5 MΩ	1 MΩ ≤60 pF	1 MΩ, <47 pF
X-Y Phase Difference	1° to ≥ 500 kHz	≤1° to 1.5 MHz	≤1° dc to 500 kHz
Recommended Source Impedance, X Y and Z	<10 kΩ in 1MΩ pos.	≤10 kΩ	≤10 kΩ
Temperature Range	0 to 50° C	0 to +50° C	0 to +50° C
Power Requirements*4	75 W	61 W	See footnote*4
Included Accessories		Lined external implosion shield (graticule) for adjustment purposes.	Lined external implosion shield (graticule) for adjustment purposes
Recommended Cameras	C-30BP, C-5C Opt.01, C-7 Opt. 01	C-5C Opt. 01, C-7 Opt. 01 C-59A	C-5C, C5-C Opt 01 C-7 Opt. 01

*1 *Measured at 0.5 μA, except for the 606A, measured at 0.1 μA.*
*2 *Full spec would read: "dc to . . ." appropriate figure.*
*3 *"<" means "paralleled by less than".*
*4 *Line-voltage selector allows operation from 100, 110, 120, 200, 220, and 240 V (±10% on each range). 48 to 440 Hz (except the 624 which excludes 220 V). Number given shows Watt max at nominal line voltage. The 620's power requirements are 90 to 132 V ac; 48 to 440 Hz, 22 W max, 0.2 A at 120 V ac, 60 Hz.*



634/634LC Monitors

KEY SPECIFICATIONS

Video Display	634*1 634LC	634 Option 01 634LC Option 01
Display Size (flat screen)	9 cm×12 cm	9×12 cm
Resolution* 1 At least	1100 line	650 line
Position Accuracy/Nonlinearity	≤0.5% within 9 cm circle. ≤1% in corners. For Option 01: 1% within 90 mm circle, 2% at corners	
Brightness	515 cd/m² (150 fL) max	
Brightness, Nonuniformity	Less than ±10%	
Bandwidth	1-10 MHz std. (20 MHz video bandwidth available as Option 14.)	

*1 *Merged raster lines.*
*2 *Standard 634 accepts the line/field rate of 625/50. Discrete line rates of 675/60 through 1083/60 can be accommodated using Option 15. Option 15 is factory calibrated at 1029/60.*

TYPICAL APPLICATIONS

- **Multi-Imaging Cameras**
- **Reconnaissance and Surveillance**
- **Electron Microscopy**

FEATURES

- **High Resolution**
- **Excellent Gray Scale**
- **Full Screen Brightness Uniformity**

BENEFITS

- **Picture Perfect Images**
- **Low Distortion Images**
- **High Stability**

ORDERING INFORMATION

606B Monitor*1	$4,925
608 Monitor*1	$3,080
620 Monitor*1	$1,710
634 Monitor*1	$3,610
634LC Monitor*1	$2,510

RECOMMENDED CAMERAS

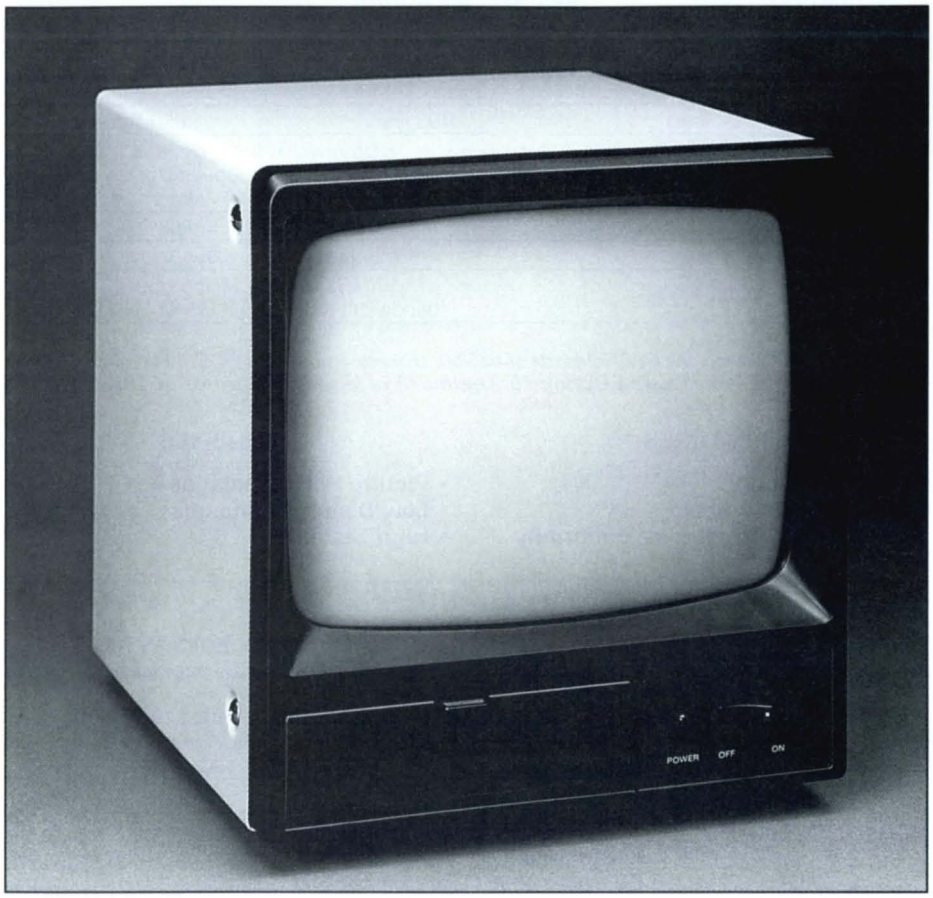
See Instrumentation Documentation Devices section.
C-5C Option 01, C-7 Option 01, C-59A.

*1 *Without handle feet or covers.*

	606B	608	620	634	634LC	Description	Price
Option 01		✓	✓			Internal Graticule	NC
Option 01				✓		Resolution of 800 Line Nominal, 650 Worst Case	−$150
Option 01					✓	Resolution of 800 Line Nominal, 650 Worst Case	−$150
Option 06			✓			UL 544 (Includes Handles, Feet and Covers)	+$135
Option 06				✓		UL 544 (Includes Handles, Feet and Covers)	+$135
Option 06	✓					UL 544 (Includes Handles, Feet and Covers)	+$135
Option 07	✓					Screwdriver Front Panel Controls	+$30
Option 09	✓	✓	✓	✓		UL 544 Component Recognized	NC
Option 10		✓	✓			25-Pin Remote Program Connector	+$55
Option 12		✓	✓			GM (P7) Phosphor with Internal Graticule	+$65
Option 13				✓		Reverse Video	+$85
Option 14				✓		20 MHz Video Amplifier	+$145
Option 15				✓		Variable Line Rates	+$280
Option 15					✓	Variable Line Rates + 20 MHz Video Amplifier	+$600
Option 16				✓		25-Pin Video Input	+$55
Option 20			✓ (6,31)* 1			AC Delete	−$20
Option 21		✓				Full Differential Inputs	+$60
Option 22		✓				Extended Gain Range	+$45
Option 23		✓ (28)* 1	✓ (6,28,31)* 1			Handle, Feet and Covers	+$120
Option 24		✓				Linearized Z-axis	+$75
Option 25		✓				TTL Blanking	+$75
Option 25			✓			TTL Blanking	+$50
Option 28	✓ (6)* 1	✓ (23)* 1	✓ (6,23,31)* 1			Covers Only	+$90
Option 29		✓				Metal Bezel	+$75
Option 31			✓			Delete all Rear BNC's, DC Power Connector and AC Power Supply and Switch	−$25
Option 76		✓	✓			GM (P7) Phosphor	+$65

* 1 *Not available with these options.*

Special pricing terms and conditions are available to qualified OEMs. Contact your local Tektronix representative for complete information.



NEW DX05

Video Monitor

TYPICAL APPLICATIONS

- **Closed-Circuit Television**
- **Display For CCD Video Camera (C1001)**
- **Display For Digital Camera System (DCS)**

BENEFITS

- **General Purpose Monitor**
- **Small Size**

FEATURES

- **NTSC Format**
- **Medium Resolution**
- **Low Cost**

The DX05 is a nine-inch diagonal, desktop, black and white display video monitor. It is suitable for general purpose video applications requiring the NTSC format.

The low cost of the DX05 makes it an easily affordable accessory. Its small size (8.3×9.5 in.) makes it especially suitable for applications with limited space.

The loop-through video connection means it can be used in series with other video devices such as the HC01/HC02 Video Copiers or the C1001 CCD Video Camera.

CHARACTERISTICS

CRT

CRT—9-inch diagonal, 90° deflection angle.
Resolution—≥600 lines.
Phosphor—P4.

ELECTRICAL

Input Switchable Impedance—10 kΩ/75 Ω.
Output Impedance—75 Ω.
Video Input (NTSC)—Composite 0.5 to 2.0 V p-p.
Sync Input—Negative.
Power Requirements—27 W typical. Input voltage selected by range switch: 100 to 120 V ac standard, 220 to 240 V ac, Option A1.
Line Frequency—50 to 60 Hz.

ENVIRONMENTAL

Operating Temperature Range—20 to 50 °C.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	240	9.5
Width	220	8.3
Depth	246	9.75
Weight ≈	**kg**	**lb**
Net	5.9	13.0

ORDERING INFORMATION

DX05 Video Monitor. **$290**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.

COMMUNICATIONS PRODUCTS

CONTENTS

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Communications Products are quality instruments designed to test, time, measure, and monitor a variety of data communications network, RF, and television signals.

Communications Network Analyzers

Tektronix Communications Network Analyzers division and LP-COM, a subsidiary of Tektronix, provide a full range of network communications testing solutions. The range of equipment includes: metallic cable testers, fiber cable testers, LAN media and protocol analyzers, and telecommunications test systems.

The network communications testing products are easy to use, portable, and rugged. The equipment is designed to help find and solve problems in the networks and reduce downtime.

Tektronix now has a versatile, modular test system that offers extensive test and analysis for Telecommunications and Datacommunications. The TC-2000 is a software-based product that can replace several expensive individual test products by a single compact package.

Television

The Television products division continues meeting customers' needs for high-performance test, measurement, monitoring and synchronizing equipment.

Tek's family of vectorscopes and waveform monitors offers more performance than ever before with the introduction of the 1708R Video Measurement Set. This multi-function, multi-input measurement package enables precise evaluation of studio and transmission system performance.

The VM700 Video Measurement Set now performs more than television transmission measurements for broadcasters. New added capabilities extend its use to testing and comparing equipment performance.

The generator product line has grown rapidly over the last year. Responding to new customer demands and technological developments, Tek introduces seven new generators: the TSG-170D Digital Composite NTSC Generator provides both digital and analog test signals and audio tone outputs; the TSG-422 Digital Component Generator provides all the test signals needed to operate, maintain and evaluate 4:2:2 digital equipment; the TPG-625 PAL Test Pattern Generator performs a comprehensive visual check of both the monochrome and color aspects of color monitor and television receiver performance; and the TSG-100 Test Signal Generator provides a low-cost NTSC test signal generator for maintenance and alignment of video equipment in most television environments. With the addition of the ECO-170A Synchronous Changeover Unit and the new high performance SPG-271 PAL Sync Generator, Tek now offers a PAL Master Sync System.

Designed for the developing world of high definition television, the 1730 HD High Definition Waveform Monitor provides the necessary bandwidth to test, evaluate and operate HDTV equipment.

Virtually every major television facility in the world uses Tektronix television products. This year, Tektronix won its second Emmy from the National Academy of Television Arts and Sciences for its technical contributions.

Spectrum Analyzers

The Frequency Domain Instruments (FDI) Division continues to provide communication solutions with microwave and VHF/UHF spectrum analyzers, software, and waveguide mixers and components. In addition, Tek offers new spectrum analyzers: the 3052 Digital Spectrum Analyzer and the 2630 Fourier Analyzer.

The new 3052's hundred-fold speed improvement over conventional FFT techniques solves difficult measurement and analysis problems in communications, radar ATE and monitoring, high throughput automated testing, and signal processing. The new 2630 provides complete spectrum, network, and waveform analysis from dc to 20 kHz.

MMIC applications are met with the TPAK and new TPAK Seies of MMIC Hermitic Packages. These offerings provide high performance in a low-cost, surface-mountable MMIC package.

NETWORK COMMUNICATIONS TESTING PRODUCTS

Fiber Cable, Metallic Cable, LAN, Telecommunications and Data Communications Testing Equipment.

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Data Communications Testing
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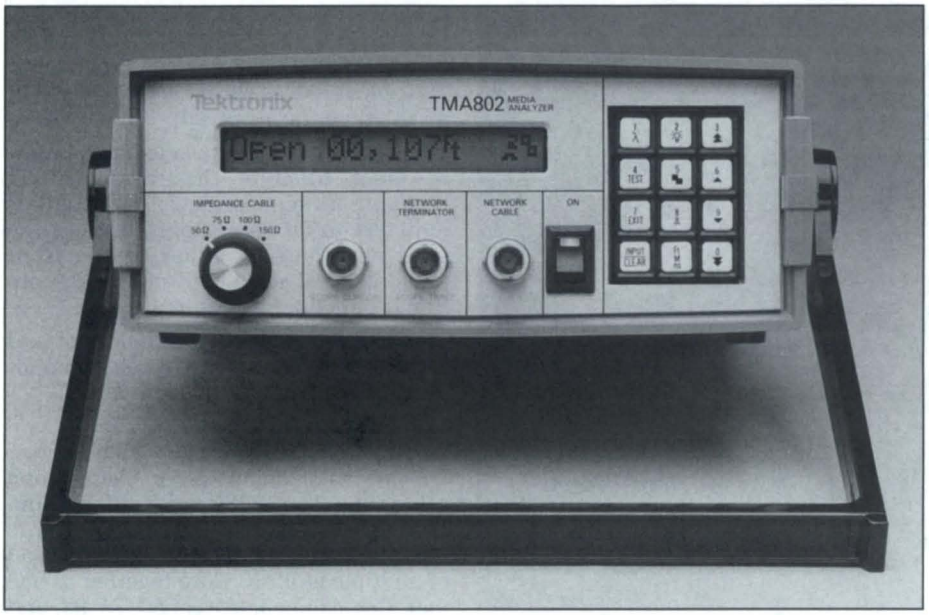
835 Protocol Analyzer 70
836 Protocol Analyzer 70
Telecommunications Testing
TC-2000 PCM/BERT Tester 72
TC-2000 Protocol Analyzer 72
TC-2000 TIMS Tester 72
TC-2000 Signaling Tester 72

If your testing needs include fiber cable, metallic cable, data communications or telecommunications, Tektronix offers a wide selection of networking communications test equipment to find and solve your problems.

Tektronix has the equipment to test the physical media of your communications network. The 1500B Series MTDRs can check your metallic cable for opens, shorts, crimps and other cable faults. The OF150 and OF235 OTDRs give you the ability to check fiber cables for breaks, splice loss, end-to-end loss, and to perform distance measurements. With the OF192 you can measure bandwidth of multimode fiber and make loss measurements.

For testing data integrity on the physical media, Tek offers the TC-2000, an integrated telecommunications test system for PCM/BERT testing, protocol testing, LAN protocol testing, TIMS testing and signal testing. Tek also offers the 830 Series Protocol Analyzers for field service data communications troubleshooting and the TMA802 for LAN media testing.

The following pages include descriptions and ordering information for Tektronix Network Communications Testing products that are ideal for installation and maintenance of cabling and communications systems. The products are easy to use, portable and reliable—tools to get the job done.



TMA802 Media Analyzer

TYPICAL APPLICATIONS

- **Coax or Twisted Pair LAN Network Testing**
- **Nonintrusive Monitoring of Network Traffic Load**
- **Ethernet, Cheapernet, Starlan, Broadband and Token Ring**
- **Use with 50 MHz Scope to View the Network**

BENEFITS

- **Applications for Multiple Networks**
- **Affordable**

FEATURES

- **Easy to use**
- **Quick and Accurate**
- **Reports Distance to Fault in feet or meters**
- **Measures Round Trip Propagation Delay in ns**
- **Portable (8 lbs), Battery-Powered**

LAN Testing with the TMA802 Media Analyzer

The TMA802 monitors the data traffic load and uses TDR techniques to check the physical condition of the cable. The TMA802 is designed to test LANs compatible with the IEEE 802 standards. (Optional interfaces support testing of LANs in use today.)

The TMA802 is a comprehensive LAN media analyzer with three modes of operation: Standalone, scope, and monitor mode.

Standalone Mode

Standalone mode provides a quick and easy means to pinpoint the location of any major fault that can disrupt the network. Simply set the proper impedance value, the velocity of propagation value, connect the cable to be tested, and press the Test button.

In Standalone mode the TMA802 reports the test results in plain English via its 16-character LCD. For example:

"OK to 500 M"
"OPEN 1640 ft"
"SHORT 615 ft"

Scope Mode

When a more detailed inspection of the network is needed, the TMA802 can be coupled with an oscilloscope. This combination provides an accurate and detailed view of the entire network, showing locations of transceivers, terminators, and faults.

The TMA802 is designed to work with the low-cost Tektronix 2225 or industry standard 2465 Oscilloscope. It will also operate with other oscilloscopes that have a minimum 50 MHz bandwidth. Physical adapters are available to mate the TMA802 into an-easy-to transport single system with 2200 or 2400 Series oscilloscopes.

Monitor Mode

The TMA802 provides a direct indication of network utilization independent of the protocol or vendor that is generating the traffic. Network traffic is monitored without disturbing the network (nonintrusive test) so it can be left on the network to monitor indefinitely. Network utilization is reported as a percentage of the network bandwidth being used:

- Over the last two seconds
- Over the last minute
- Since the instrument was last reset

CHARACTERISTICS

ELECTRICAL

Pulse Width—15, 150, 1100, 3700 ns.
Pulse Amplitude—−2 V.
Output Impedance—50, 75, 100, 150 Ω.
Accuracy—±4 ft to 1000 ft.

ENVIRONMENTAL

Temperature—Operating: −20 to +50°C. Nonoperating: −30 to +60°C.
Altitude—Operating: 15,000 ft. Nonoperating: 50,000 ft.
Humidity—90% noncondensing.
EMI—FCC Part 15, Subpart J, Class A, VDE 0871, Class B.

BATTERY

Can operate indefinitely from its charger.
Operating—3 hours.
Charging—5 hours to full charge.
Type—Sealed lead-acid, 2.6 amp/hr..

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	250	9.8
Height	90.0	3.5
Depth	403	15.8
Weight	**kg**	**lb**
Net	3.7	8.1

ORDERING INFORMATION

TMA802 Media Analyzer. **$2,495**
Includes: Four BNC terminators, 50 Ω (011-0141-00), 75 Ω (011-0142-00), 100 Ω (011-0143-00), 150 Ω (011-0144-00), 16 ft BNC-to-BNC 50 Ω cable (174-0533-00), U.S. Battery charger (119-2731-00), Operator's Manual (070-6273-00), carrying strap (346-0245-00). (Selection of one network kit (Option 01, 02, or 03) is included at no charge. Additional network kits may be ordered by part number for a charge.

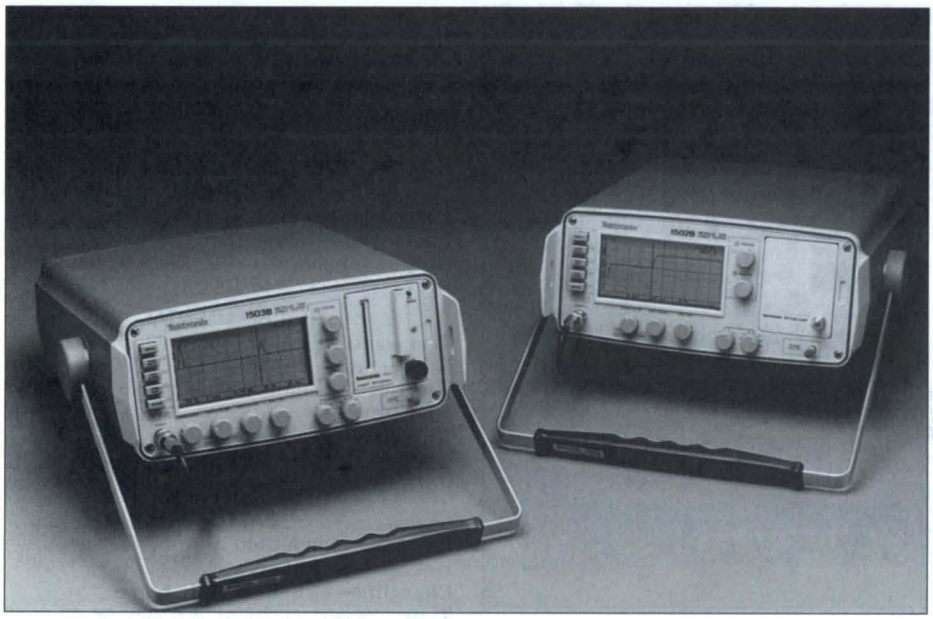
INTERNATIONAL BATTERY CHARGERS

Option 1C—Universal Euro 220 V, 50 Hz
Option 2C—UK 240 V, 50 Hz
Option 4C—Canada 115 V, 60 Hz

OPTIONAL ACCESSORIES

Scope Connector/Cable Kit—Opion 01 (016-0912-00). **$50**
Ethernet/Cheapernet Network Kit—Option 02 (016-0913-00). **$75**
Map Broadband Network Kit—Option 03 (016-0911-00). **$75**
Starlan Network Kit (TBA).
IBM Token Ring Network Kit*1
C7 Scope Camera—With flash. **$610**
2200 Series—Physical Adapter Kit. Order 014-0066-00. **$60**
2400 Series—Physical Adapter Kit. Order 014-0067-00. **$60**
Carrying Case—Order 016-0817-00. **$80**

*1 Contact your local sales representative.



1502B/1503B Metallic TDR Cable Testers

TYPICAL APPLICATIONS

- **Telephony**
- **Computer/LAN**
- **CATV**
- **Power Company Field Testing**
- **Communications Providers**
- **Cable Manufacturing Tests**
- **Third Party Maintenance**
- **Airline Maintenance/Testing**

FEATURES

- **Easy to Use**
- **Information Screens**
- **High Contrast LCD**
- **Portable**
- **Waveform Storage**
- **PC Controllable**
- **Optional Chart Recorder**
- **Optional Battery Pack**

Time Domain Reflectometry (TDR)

The portable, rugged 1502B and 1503B TDR Cable Testers are portable maintenance tools that are simple to operate and will test most dual conductor metallic cable under virtually any condition. The 1500B Series uses TDR to identify and locate cable faults. When the tester is connected to the line to be tested it sends out electrical pulses that are reflected back to the tester by impedance changes in the cable. The 1500B Series TDRs display impedance changes in the cable as a function of distance. Moving the cursor to the displayed fault produces an on-screen readout of distance to the fault.

Typical Cable Measurements

- Distance to faults
- Cable propagation velocity
- Loss and load mismatch
- Quantification of damage from opens, shorts, frays, crimps and water
- Faulty taps and unterminated lines in LAN and CATV environments
- Stripline and cable impedance
- Characterizing LAN installations

1502B High Resolution MTDR

The 1502B transmits 200 ps rise time step pulses down the cable under test. The reflected energy is displayed on the LCD and the type of fault can then be determined by the user. When testing 50 ohm cable with a velocity of propagation equal to 0.66, the 1502B Metallic TDR allows the determination of 0.5 ohm cable faults. Multiple faults as close together as 0.8 of an inch can be resolved.

The 1502B has a menu selectable ohms-at-cursor function that allows direct readout of impedances. The 1502B is matched to 50 ohm cables, but may be used on others by adjusting the front panel vertical scale control or using optional impedance adapters.

The 1502B has a range of 2000 feet and is the best MTDR for high resolution fault location on short lengths of cable.

1503B General Purpose MTDR

The 1503B MTDR provides high-energy, 1/2-sine shaped pulses for testing long cable runs. The 1503B has 2, 10, 100 and 1000 nanosecond pulse widths. Use of the 2 ns pulse width results in determination of multiple faults as close together as one foot. Cable impedances of 50, 75, 93, and 125 ohms are selectable at the front panel. The 1503B is input protected to 400 volts.

The 1503B has a range of 50,000 feet and is the best metallic TDR for general purpose applications.

1503B Option 06 for Ethernet Testing

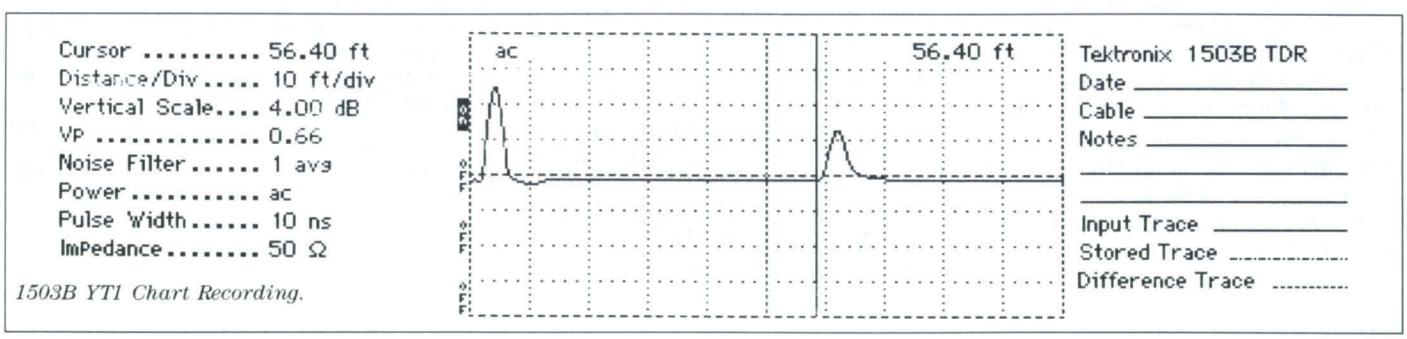
The 1503B with Option 06 allows TDR testing of an active Ethernet bus. Tests are provided for detecting transceivers that ignore the collision signal (babbling transceivers) and transceivers that ignore the carrier sense signal.

Menu Selections

The 1502B and 1503B offer a variety of parameters and information that can be accessed using menus. The main menu allows you to access: Help Screens; Velocity of Propagation Values; Impedances of Different Cables; Instrument/Front Panel Configurations; and Instrument Diagnostics.

YT1 Cart Recorder

For permanent records of cable tests, the Option 04 (YT1) chart recorder is available for both the 1502B and 1503B.



1503B YT1 Chart Recording.

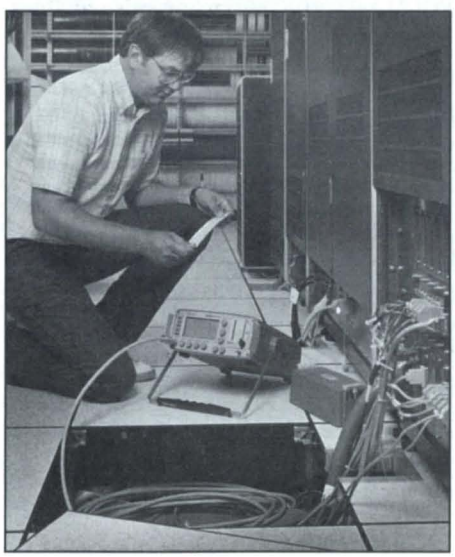
CHARACTERISTICS

1502B METALLIC TDR CABLE TESTER

Test Signal—Step rise ⎍.
Amplitude—300 mV nominal into 50 Ω load.
System Risetime—200 ps (1.15 in./2.92 cm).
Output Impedance—50 ohms ±1%.
Electrostatic Discharge Protection—1 kV/500 pF capacitor/1 k resistance.
DC Input Protection—±1 A.
Maximum Range—2,000 ft/625 meters.
Distance Readout Resolution—0.004 ft/0.001 m.
Noise Filtering—1 to 128 averages.
Vertical Scale—0.5 to 500 mρ/div.
Dist/Div—0.1 to 200 ft/div; 0.025 to 50 m/div.
Environmental—Meets capabilities of a Type III, Class 3, Style C instrument (except EMI where it meets FCC: Part 15,3,A, and VDE: 0871, Class B) as perscribed by MIL-T-28800D.

1503B METALLIC TDR CABLE TESTER

Test Signal—½ sine.
Amplitude—Terminated: −2.5 V. Unterminated: −5.0 V.
Pulsewidths—2, 10, 100, 1000 nsec.
Output Impedance—50, 75, 93, 125 Ω.
Input Protection—±400 V (dc + peak ac).
Maximum Range—50,000 ft/15,360 meters.
Distance Readout Resolution—0.04 ft/0.01 m.
Noise Filtering—1 to 128 averages.
Vertical Scale—0 to 63.75 dB Gain.
Dist/Div—1 to 5000 ft/div; 0.25 to 1000 m/div.
Environmental—Meets capabilities of a Type III, Class 3, Style C instrument (except EMI where it meets FCC: Part 15,3,A, and VDE: 0871, Class B) as prescribed by MIL-T-28800D.



COMMON CHARACTERISTICS

The following characteristics are common to both the 1502B and 1503B.

POWER REQUIREMENTS

AC Power—Line Voltage: 115 V ac (90 to 132 V ac) and 230 V ac (180 to 250 V ac). Line Frequency: 45 to 440 Hz.
DC Power—Battery Pack Operation (Option 03): At least 5 hours (15 to 25 °C charge and discharge temperature), no chart recordings. At least four hours, including 20 chart recordings.
Full Charge Time—20 hours maximum.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width (w/handle)	315	12.4
Width (w/o handle)	300	11.8
Height	127	5.0
Depth (handle extended)	475	18.7
Depth (handle not extended)	419	16.5
Weight ≈	**kg**	**lb**
Net (w/front cover and accessories)	8.2	21
Net (w/o front cover or accessories)	7.3	15
Domestic Shipping (complete) ≈	11.1	27
Export Shipping (complete) ≈	16.3	42

ORDERING INFORMATION

1502B Metallic TDR **$5,870**
Includes: AC power cord; 50 Ω BNC terminator (011-0123-00); Precision 50 Ω cable (012-0482-00); Female-to-female BNC connector (103-0028-00); Spare fuse; operator's manual (070-6266-00).

1503B Metallic TDR **$4,600**
Includes: AC power cord, 50 Ω BNC terminator (011-0123-00); Precision 50 Ω cable (012-0482-00); Spare fuse; 9 ft BNC-to-clip lead cable (012-0671-02); Operator's manual (070-6268-00).

OPTIONS

Option 03—Battery Pack **+$175**
Option 04—YT1 Chart Recorder **+$950**
Option 05—Metric Version **NC**
Option 06—Ethernet Testing (1503B only) **+$250**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz
Option A2—UK 240 V, 50 Hz
Option A3—Australian 240 V, 50 Hz
Option A4—North American 240 V, 60 Hz
Option A5—Switzerland 220 V, 50 Hz.

OPTIONAL ACCESSORIES (1502B/1503B)

Battery Pack—Order 016-0813-00.*1 **$300**
YT1 Chart Recorder— **$1,195**
Chart Paper—
(1 roll) Order 006-7647-00. **$4**
(25 rolls) Order 006-7677-00. **$140**
(100 rolls) Order 006-7681-00. **$520**
Terminator—75 Ω BNC.
Order 011-0102-00 **$19.25**

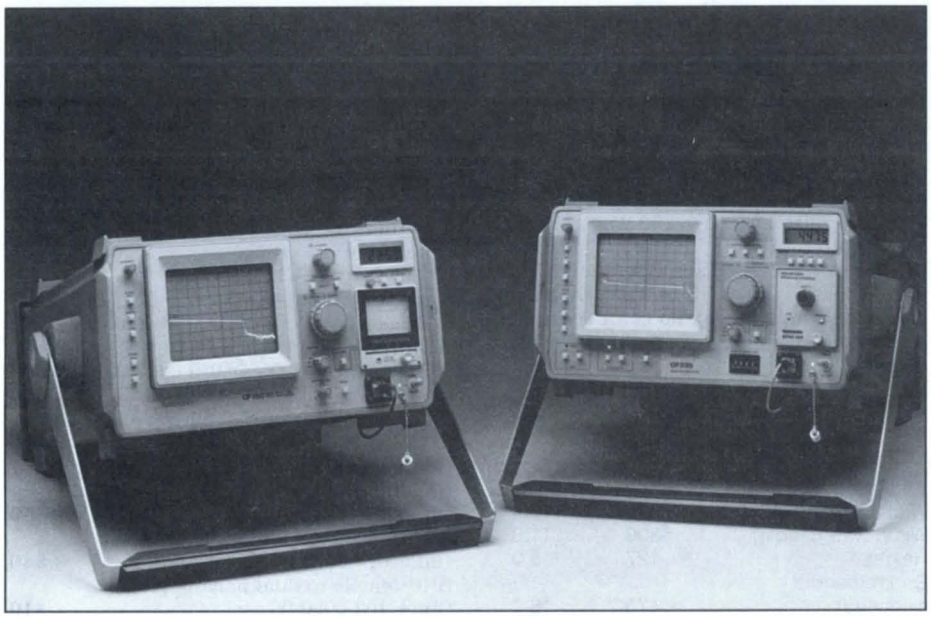
(1502B only)

Service Manual—Order 070-6267-00.
Contact your local sales representative.
Adapters—
(Direct Current) Order 015-0327-00. **$280**
(50/125 Ω)*1 Order 017-0090-00. **$210**
(50/75 Ω)*1 Order 017-0091-00. **$210**
(50/93 Ω)*1 Order 017-0092-00. **$210**
Connectors—
BNC female-to-BNC male.
Order 103-0045-00. **$8.50**
BNC female-to-clip leads.
Order 013-0076-00. **$40**
BNC female-to-dual banana plug.
Order 103-0090-00. **$10**
BNC female-to-F male.
Order 103-0158-00. **$5**
BNC male-to-N female.
Order 103-0058-00. **$9.25**
BNC male-to-UHF female.
Order 103-0032-00. **$6.50**
BNC male-to-dual binding post.
Order 103-0035-00. **$18.25**
(GR-to-BNC male)
Order 017-0064-00. **$100**
(GR-to-BNC female)
Order 017-0063-00. **$55**

(1503B only)

Service Manual—Order 070-6269-00. **$100**
Isolation Network—Order 013-0169-00. **$275**
Connectors—
BNC female-to-clip leads.
Order 013-0076-00. **$40**
BNC male-to-female.
Order 103-0058-00. **$9.25**
BNC female-to-dual banana plug.
Order 103-0090-00. **$10**
BNC male-to-dual binding post.
Order 103-0035-00. **$18.25**
BNC male-to-BNC male.
Order 103-0029-00. **$10**
BNC female-to-UHF male.
Order 103-0015-00. **$6**
BNC female-to-UHF female.
Order 103-0032-00. **$6.50**
BNC female-to-type F male.
Order 103-0158-00. **$5**

*1 *Should be purchased with the following connectors: BNC female-to-GR 017-0063-00; BNC male-to-GR 017-0064-00.*



OTDRs
Fiber Optic Cable Testers

TYPICAL APPLICATIONS

- **Fault Location**
- **Splice Loss Measurements**
- **End-to-End Loss Measurements**
- **Distance Measurements**

FEATURES

- **Easy to Use**
- **Rugged and Portable**
- **Quick, Accurate Measurements**
- **Reliable**
- **Meets Military Specifications**
- **LCD Readout**

Optical Time Domain Reflectometry
The Tektronix OF150 and OF235 OTDRs use optical time domain reflectometry principles. The OTDRs launch pulses of energy into the fiber under test and monitor the reflected energy, which is affected by fiber characteristics such as scattering, absorption, reflections and fiber defects. The reflected energy is displayed on a CRT as a function of distance, permitting fiber characteristics to be analyzed.

OF150 Multimode OTDR

TYPICAL APPLICATIONS

- **850 nm Wavelength Measurement**
- **LAN Testing**

FEATURES

- **29 dB Measurement Range**
- **8 M Loss Measurement Deadzone**
- **2 cm Data Point Spacing**

The OF150 OTDR will quickly and easily measure signal loss and breaks on multimode fiber. The OF150 has single-function manual dials that are fast to use and easy to control. The built-in CRT displays sharp, well defined traces and is uncluttered with distance and loss measurements, which are displayed on a large format LCD.

The OF150 OTDR lets you see the fiber in detail. The measurement range is 29 dB, and 2 cm data point spacing allows precise location of the fiber features. The small dead zone allows you to make loss measurements within 8 meters and locate faults within 3 meters of a mechanical interface.

The OF150 OTDR can be used in virtually any environment. It has no fan and can withstand 95% humidity. It is portable with a single handle for carrying ease and can operate from a 12 V DC vehicle system, an external battery pack or AC line voltage.

ORDERING INFORMATION

OF150 Fiber Optic Time Domain Reflectometer (specify connector).	**$13,500**
Option 01—XY1 Output Module.	**+ $300**
Option 04—Chart Recorder.	**+ $1,050**
Option 20—AT&T Biconic Connector.	**NC**
Option 22—FC Connector.	**NC**
Option 23—SMA Connector.	**NC**
Option 26—ST Connector.	**NC**
Option 27—Deutsch Connector.	**NC**

OF235
Singlemode Dual Wavelength OTDR

FEATURES

- **1300/1550 nm Wavelengths (Switchable)**
- **1 m Resolution**
- **0.01% Distance Measurement Accuracy**
- **GPIB**

The OF235 OTDR features switchable lasers for single mode fiber testing at the 1300/1550 nm wavelengths. With the OF235, quantitative and calibrated measurements can be made quickly, easily and reliably. Distance measurements can be made to within one meter resolution and 0.01% measurement accuracy. For splice loss measurements, the OF235's automatic mode allows for quick approximations and the Tek developed Slope-Fit Control facilitates fast and repeatable measurements.

OF235 Optional Waveform Storage and Analysis
The OF235 allows storage of 400 waveforms in the optional EFM101 memory module. In conjunction with the EFM101, an optional PC software package, the Fiber Optic Cable Manager (FOCMAN) allows data storage, waveform comparisons and analysis in a PC, and upload of waveforms back to the OF235. The FOCMAN software package also enables remote testing capabilities.

ORDERING INFORMATION

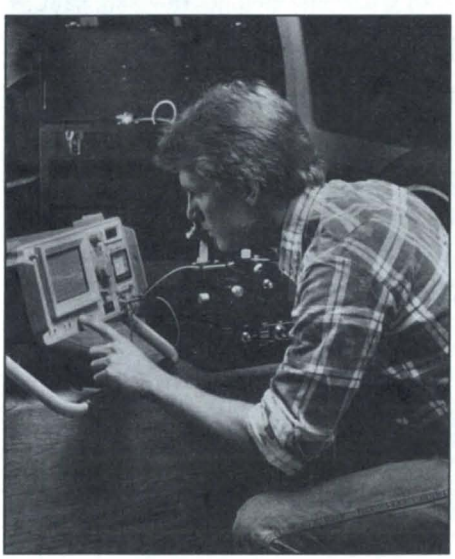
OF235 Fiber Optic Time Domain Reflectometer. (Diamond 3.5 connector) **$27,000**
Option 01—XY1 Output Module. **+$300**
Option 02—EFM101 Waveform Storage Module. **+$950**
Option 03—FOCMAN PC Software Package. **+$595**
Option 04—Chart Recorder. **+$1,050**
Option 07—Delete 1550 nm Laser. **–$8,000**
Option 08—Delete 1300 nm Laser. **–$3,000**
Option 12—17 m Short Pulse. **NC**
Option 20—AT&T Biconic Connector. **NC**
Option 22—FC Connector. **NC**
Option 23—NEC-D4 Connector. **NC**
Option 24—Diamond 2.5 Connector. **NC**
Option 25—Radial Connector. **NC**
Cable Assemblies—
(Diamond 3.5 to AT&T Biconic) Order 175-9708-00. **$600**
(Diamond to FC) Order 175-9707-00. **$560**
(Diamond to Diamond) Order 175-9695-00. **$600**

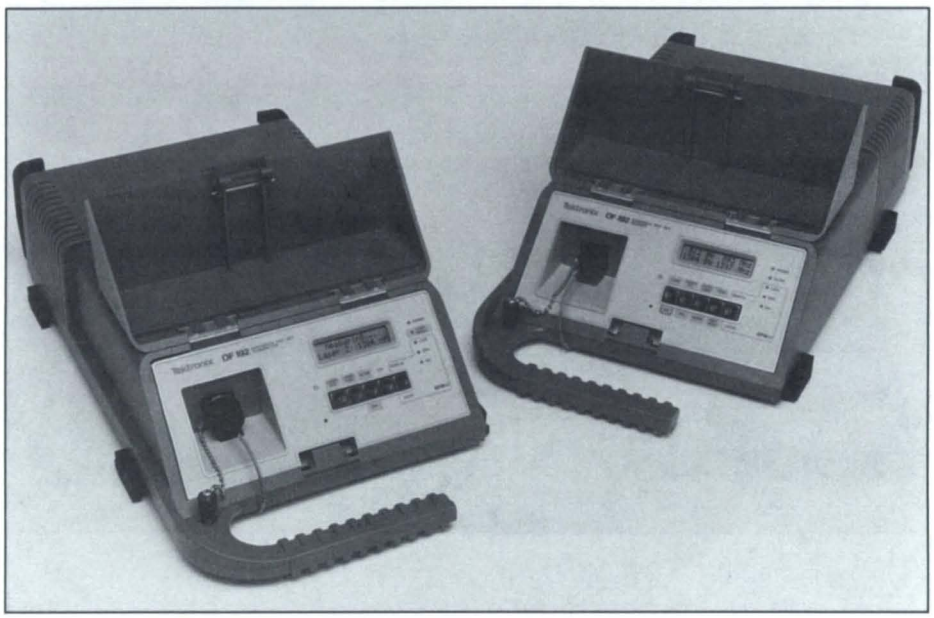
INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UL 240 V, 50 Hz.
Option A3—Australian 240 v, 60 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

OPTIONAL ACCESSORIES (OF150, OF235)

Chart Recorder—016-0506-07. **$1,200**
Chart Paper—
(one roll) 006-3618-00 **$12**
(25 rolls) 006-3618-01 **$245**
(100 rolls) 006-3618-02 **$1,000**
XY1—Output Module. **$350**
Receptacle Connector, Optical—
(Deutsch) Ten each. 013-0207-02. **$480**
Accessory Kit—Deutsch Tools and Plugs. 015-0474-00. **$900**
Sun Visor—016-0653-00. **$35**
C-5C—Camera. **$495**
C-7—Camera. **$610**
Cases—
(Transit) Order 016-0658-00. **$795**
(Soft) Order 016-0659-00. **$140**





OF192

Multimode Bandwidth Test Set

FEATURES

- **825/850/1300 nm Wavelengths**
- **40 dB Measurement Range**
- **1.45 GHz Frequency Range**
- **GPIB**

The OF192 is a portable, rugged two-unit test set that measures the bandwidth and loss of multimode optical fibers. Use the OF192 to test your fiber for upgrading to higher speeds. In the automatic mode, the OF192 tests fiber bandwidths of up to 1.450 GHz in a total measurement time of ten seconds. Bandwidth testing capability is extended in the OF192 with it's Gaussian curve-fitting mode. The OF192 is also capable of functioning as a Loss Test Set, making loss measurements to within +1.5 dB.

ORDERING INFORMATION

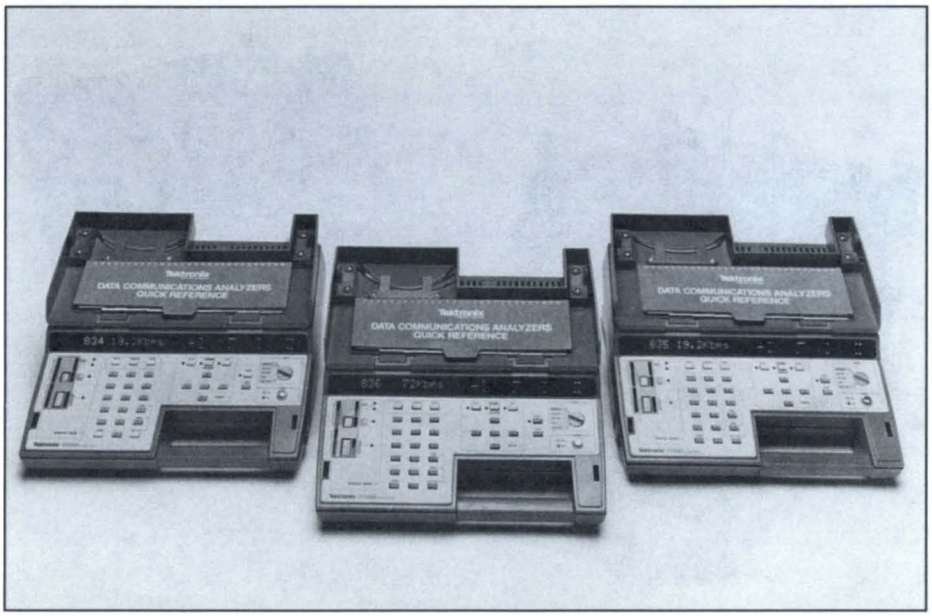
OF192 Fiber Optic Bandwidth Test set. **$32,000**
Includes: Two AC power cords (161-0118-00); Two calibration cables; AT&T connector (174-0043-00); Diamond 3.5 connector (174-0045-00); FC connector (174-0047-00); Operator Manual (062-8337-00).

OPTIONS

Option 05—850 nm Transmit Module. **+$3,000**
Option 06—825 nm Transmit Module. **+$3,000**
Option 07—1300 nm Transmit Module. **+$7,500**
Option 20—AT&T Biconic Connector. **NC**
Option 21—Diamond 3.5 Connector. **NC**
Option 22—FC Connector. **NC**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A4—Australian 240 V, 50 Hz.
Option A5—North American 240 V, 60 Hz.
Option A6—Switzerland 220 V, 50 Hz.



830 Series Programmable Communications Analyzers

TYPICAL APPLICATIONS

- **Simulation**
- **Monitoring**
- **BERT Testing**

BENEFITS

- **Wide Range of Applications**
- **Reliable**
- **Adaptable to Custom and Future Needs**
- **Lab or Field Use**
- **Three-year Warranty**

FEATURES

- **Easy to Operate**
- **Lightweight, Rugged and Portable**
- **25 Software Application Packs Serving a Full Range of Protocols**
- **Multiple Interfaces**
- **Fully Programmable**

Data Communications Testing

The 830 Series of Data Communications Protocol Analyzers are designed to help find and solve problems with communication protocols and interfaces. These advanced diagnostic tools plug into serial data communication cables and connectors. Once in place they can monitor data or actively simulate the behavior of one type of device to enable you to verify the performance of another device. The 830 Series lets you control parameters like baud rate, link protocol and transmission code so the analyzers can be made compatible wth practically any device or network you might want to test.

834/835/836 Protocol Analyzers

- Triggering capability
- 834/835 Test up to 19.2K baud
- Supports async, HDLC/X.25, SDLC/SNA, BISYNC and other protocols.

835/836 Protocol Analyzers

- Battery backed RAM
- Supports library and memory packs
- Extended capture buffer
- Upload/download capabilities
- 835 Upgradeable to 836

836 Protocol Analyzer

- Tests up to 72K full duplex all modes and 144K half duplex monitor mode
- Multiple triggers
- Data compression (HDLC)

Modes of Operation

Monitor

The 830 Series monitors and records activity occurring on the interface without interfering with data transmission. Triggering capability allows selective capture of data.

DCE Simulation

In this mode the 830 Series functions as DCE equipment for testing of DTE equipment. Messages can be sent and received for testing the DTE equipment. The sequence of events can be controlled by a user-developed program or from tests stored in the optional ROM packs.

DTE Simulation

Operation in this mode is similar to DCE simulation, except the test is initiated from the DTE (830 Series) to the DCE equipment.

BERT Mode

The 830 Series performs bit and block error rate testing using the 511-bit CCITT Standard pseudo-random pattern. Additional patterns and testing capabilities are available with 830R03 and 830R03B ROM packs.

Software Application Packs

Tektronix has developed a series of software applications ROM packs that both extend and automate the capabilities of the 830 Series. Software power allows the user to quickly adapt the 830 Series to the protocol or type of test needed, and with a minimum of steps, run extensive tests and find problems quickly and easily.

The 835 and 836 support use of the library and memory packs. These packs include combinations of software for a wide range of applications.

Programming for Solutions

The 830 Series in combination with ROM packs gives access to over 40 programming instructions. The instructions are easy to use and allow full programming flexibility to meet specific and unusual network testing needs. The testing needs may include network trouble shooting, preventative maintenance, engineering R&D and manufacturing quality assurance (QA).

Interface Adapters

The 830 Series is adaptable to many different interfaces. Tektronix supports the RS-232, current loop, RS-449, MIL-STD-188C, two-wire direct, V.35 and X.21 physical interfaces. Tektronix also offers a Tri-state break-out-box.

836TV Television Production Protocol Analyzer Package

The 836TV Analyzer package is designed for installing, testing and maintaining equipment using the EBU/SMPTE interface. The 836TV provides interactive simulation of the controllers and tributaries on the EBU/SMPTE bus. The 836TV package includes the: 836, 836L18 ROM pack, A6746 interface adapter and carrying case.

ORDERING INFORMATION

836 Programmable Data Communications Analyzer **$3,495**
835 Programmable Data Communications Analyzer **$2,750**
834 Programmable Data Communications Analyzer **$1,995**

INTERFACE OPTIONS

Option 02—Current Loop Interface. **+$400**
Option 03—RS-449 (RS-422/RS-423) Interface. **+$400**
Option 04—MIL-STD-188C Interface. **+$400**
Option 05—Two-Wire Direct Interface. **+$400**
Option 06—V.35 Interface. **+$400**
Option 09—X.21 Physical Interface. **+$400**

SPECIAL PACKAGES AND APPLICATIONS

835BS Bisynchronous/SDLC/SNA Package **$3,260**
Includes: 835; 830L02; Software; Case.
835SL Selection Package **$3,550**
Includes: 835; 830L03; Software; Case.
835PR PARS/IPARS Package **$2,980**
Includes: 835; 830R07; Case.
836DV Development Package **$4,205**
Includes: 836; 830M09; Software; Case
836CL Current Loop Package **$3,975**
Includes: 836; 02 Current Loop Interface; Case.

TV ANALYZERS

836TV Television Production Protocol Analyzer **$4,405**
Includes: 836; 836L18; A6746; case.
836L18 Television Production Library Pack **$430**
Includes: TV software (Ampex, Sony BVU-800/ BVH-2000, GVG 100/300, EBU/SMPTE).
A6746 EBU/SMPTE Bus Interface **$400**

ROM PACKS

830RDA—ROM Development Aid **$150**
830R01—Asynchronous ROM Pack **$150**
834R02A—Bisynchronous (EBCDIC) ROM Pack **$150**
830R02B—Bisynchronous ROM Pack **$250**
830R03—Link Test ROM Pack **$150**
830R03B—Link + Async ROM Pack **$250**
834R04—HDLC/X.25 ROM Pack **$150**
834R05—Extended Instruction ROM Pack **$70**
834R06—Bisynchronous (ASCII) ROM Pack **$150**
830R07—PARS/IPARS ROM Pack **$150**
830R10—SDLC/SNA (FID2) ROM Pack **$150**
830R10B—SNA (FID2) ROM Pack **$250**
834R11—Extended Monitor ROM Pack **$150**
830R13—SDLC/SNA (FID3) ROM Pack **$150**
830R31—Multipurpose ROM Pack **$250**

LIBRARY PACKS (835/836 only)

The library and memory packs may be specified to contain one software option for each 16K ROM bank.

Product	Memory	Banks	Price
830L01	32K	2	$120
830L02	64K	4	$170
830L03	128K	8	$200

830L30—IBM Solutions Library Pack **$550**

MEMORY PACKS (835/836 only)

Product	RAM	Banks	ROM	Banks	Price
830M07	48K	3			$325
830M08	48K	3	16K	1	$390
830M09	48K	3	64K	4	$500

SOFTWARE OPTIONS (Memory & Library Packs)

Option 01—830S01 Asynchronous. **+$65**
Option 02—830S02 Bisync (EBCDIC). **+$65**
Option 2B—830S2B Bisynchronous. **+$105**
Option 03—830S03 Link Test. **+$65**
Option 3B—830S3B Link and Async. **+$105**
Option 04—830S04 HDLC/X.25. **+$65**
Option 06—830S06 Bisync (ASCII). **+$65**
Option 10—830S10 SDLC/SNA (FID2). **+$65**
Option 0B—830S0B SNA(FID2). **+$105**
Option 11—830S11 Extended Monitor. **+$65**
Option 13—830S13 SDLC/SNA (FID3). **+$65**
Option 1A—830SDA ROM Development Aid. **+$65**
Option 2A—830SDA with Option 01. **+$65**
Option 31—830S31 Multipurpose. **+$105**

TV SOFTWARE OPTIONS

Option 19—Ampex VPR3/VPR6. **+$65**
Option 20—Sony BVU-800/BVU-2000. **+$65**
Option 21—GVG 100/300. **+$65**
Option 22—EBU/SMPTE (ESbus). **+$65**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz
Option A2—UK 240 V, 50 Hz
Option A3—Australian 240 V, 50 Hz
Option A4—North American 240 V, 60 Hz
Option A5—Switzerland 220 V, 50 Hz

OPTIONAL ACCESSORIES

Service Manual—Order 070-5600-00 **$100**
Carrying Case—Order 016-0672-00 **$85**
Large Carrying Case—Order 016-0812-00 **$110**
Ribbon "T" Cable—Order 175-7176-00. **$95**
RS-232 V.24 Tri-State Break-Out Box—Order A6743 **$265**
Interface Adaptors—
RS-449 Interface. Order A6741 **$400**
Two-Wire. Order A6742 **$400**
V.35. Order A6744 **$400**
Current Loop. Order 015-0361-00 **$480**
X.21. Physical Interface. Order A6747 **$400**

New accessories are continually being introduced. Please check with Sales Engineers at the local Sales Offices.

ADDITIONAL INFORMATION

830 Series Brochure—Request 22-W-5910
830 Series Selection Guide—Request 22-W-5901
Essentials of Data Communications—Request 062-8101-00
Getting Started with Your Data Communications Analyzers—Request 22-W-6243

A variety of training accessories are also available including workbooks, videotapes, etc.

TC2000

Telecommunications Test System

TYPICAL APPLICATIONS

- **Analog and Digital Networks**
- **Network Test System**

BENEFITS

- **Multiple Configurations**
- **Programmable**
- **Flexible**

FEATURES

- **20 MB Hard Disk**
- **640K RAM**
- **5¼'' 360K Floppy Disk Drive (3½'' 720Kb Option)**
- **Serial Port for Remote Control (RS-232C)**
- **Parallel Port for External Printer**
- **7 Inch High Resolution CRT**
- **RGB Interface for External Multisync Color Monitor**
- **MS-DOS Compatible**

The TC2000 is a software based, modular test system. The modular concept allows configurations with one or all of the following test functions:

- T1/PCM/BERT
- Protocol Analyzer
- LAN Protocol Analyzer
- Enhanced Macros
- TIMS
- Signaling
- Voice Band Spectrum Analyzer
- Remote Operation

T1/PCM/BERT

The TC2000 B1 is an extensive analyzer with simultaneous DS1 and DS0 analysis, dual T1 support, drop and insert for data or voice, DS1 statistics, full error/alarm analysis and emulation, framing modes (DID, D2, D3/4, ESF), complete dual line support, full remote, DS1 and DSO BERT framed or unframed.

TC 2000-C1 PCM/BERT CCITT (CEPT) Analyzer for 2048Kbps (32 channel) systems; provides dual line, drop and insert, frame capture, alarms and statistics.

Protocol Analyzer

TC2000 B2 Protocol Analyzer provides complete dual port/split screen monitoring at 72 kbps and emulating up to 64 kbs, full duplex, supports protocol SDLC, HDLC, SNA, X.25, DDCMP, LAP-D, decode and statistics capability, time stamping on character basis, 1 Mb capture buffer provides recording of line data, lead states, time stamps, four interface ports of any combination (RS-232C, RS-449, V.35, MIL 188, X.21).

LAN Protocol Analyzer

TC2000 B4 LAN Protocol Analyzer provides analysis for LAN systems operating at 10 Mbps (baseband). Supports Ethernet 1.0 and 2.0 and IEEE 802.3, decoding of TCP/IP, XNS and ISO, error reporting, plus extensive packet filtering.

Enhanced Macros

TC2060 12 and TC2060 13 are linked with other software packages. The enhanced macros work with DACS, PBX, analog or digital switches. Enhanced macros analyze data, store results within established data base, generate reports and graphs and can be used in a local or remote environment.

Transmission Impairment Measurement System

The TC2000 B3 is a wideband test set compliant with BELL PUB 41009 and IEEE 743, operating from 20 Hz to 110 KHz. TIMS measurement range includes voice band spectrum analyzer with a 70 dB dynamic range and provides auto test, data storage, and plotting.

The TC2000 C3 data line analyzer is compliant with CCITT ''O'' series recommendations.

Signaling Supervision/Addressing

TC2020 B5 signaling test set combines with the TC2000 B3 TIMS test set. The signal test set features battery and ground, SF, E and M Types I-V, loop start/ground start, and reverse battery. The test set also includes: send, receive, dial pulse, MF, DTMF, 32 digit receive display (stores 7 numbers, 32 digits each). All MF codes in both send and receive modes makes the test set useful for testing CAMA, TSPS and IDDD trunks.

Remote Communications

Both the TC2060 10 and TC2060 11 provide full remote RS-232 or DDD operation, attended or unattended. They also provide full transfer, perform auto test routines remotely (remote far-to-near and near-to-far opertion), and is TC and IBM PC controllable.

WARRANTY

One year warranty with annual extensions and software update service is available.

ORDERING INFORMATION

TC2000 B1—T1/PCM/BERT Analyzer.	**$12,500**
TC2000 B2—Protocol Analyzer.	**$12,500**
TC2000 B3—TIMS.	**$12,500**
TC2000 B4—LAN Protocol Analyzer.	**$14,500**
TC2020 B1—T1/PCM/BERT Subsystem.	**$8,500**
TC2020 B2—Protocol Subsystem.	**$8,500**
TC2020 B3—TIMS Subsystem.	**$8,500**
TC2020 B4—LAN Protocol Subsystem.	**$6,950**
TC2020 B5—Signaling Subsystem.	**$1,700**
TC2030 03—Internal 1200/2400 baud modem.	**$500**
TC2060 10—Remote Software (TC2000).	**$500**
TC2060 11—Remote Software (PC XT/AT).	**$750**
TC2060 12—Enhanced Macros (TC2000).	**$650**
TC2060 13—Enhanced Macros (PC XT/AT).	**$650**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North Anerican 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

TELEVISION PRODUCTS

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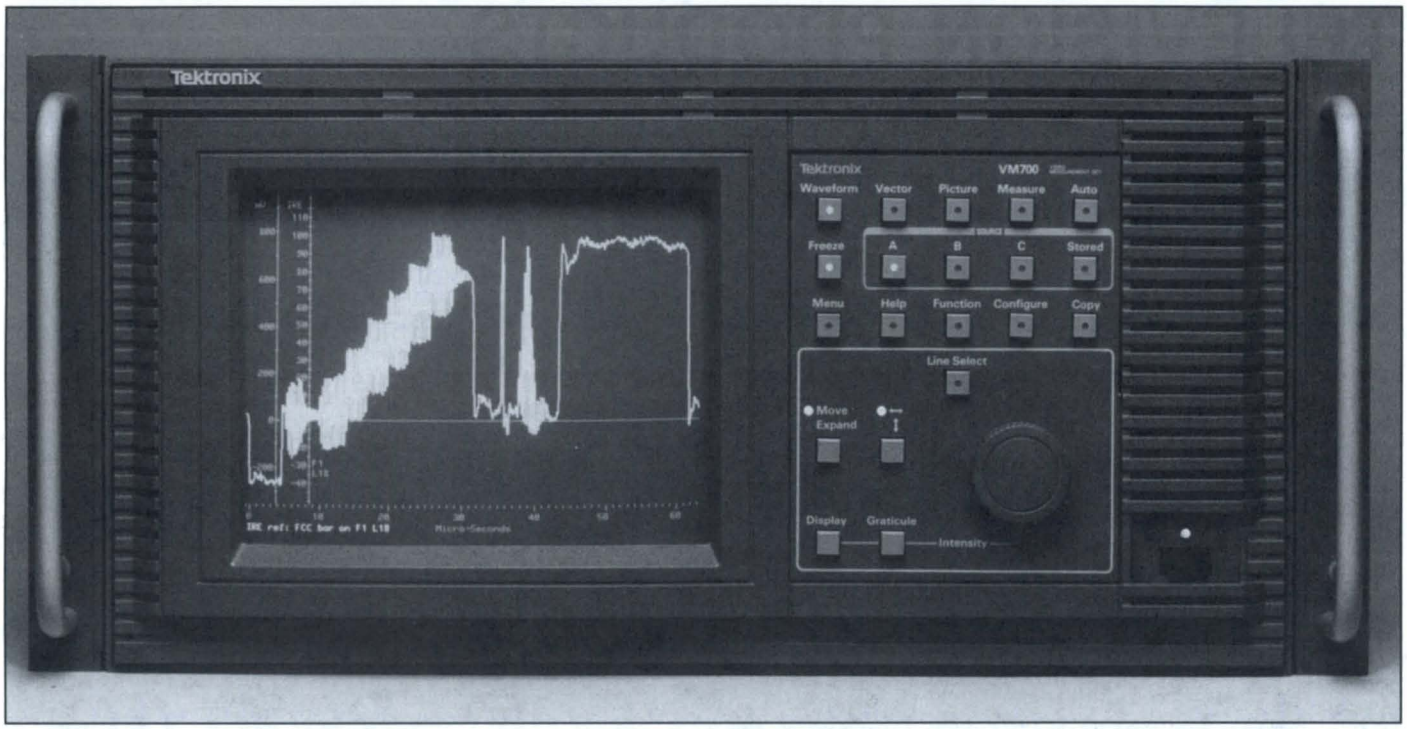


VM700 Video Measurement Set

VM700

Video Measurement Set

- **Automatic Monitoring**
- **User-Programmable Functions**
- **Digital Waveform Monitor/Vectorscope**
- **Hard Copy Capability**

The VM700 is a complete video monitoring and measuring instrument which can be used for automatic monitoring, as well as for manual measurements. The user can select a display of numeric values to confirm the quality of the signal path, or may select graphic displays for more detailed analysis.

Automatic Video Measurement Set

The VM700 makes most standard television measurements automatically, including those specified in RS-250B/EIA-250C, NTC-7, and RS-170A. These measurements can be compared with user-defined limits and an alarm message generated when these limits are violated.

New graphic displays are provided for measurements such as signal-to-noise ratio and group delay, enabling the user to better understand (and improve) the transmission path.

User-Programmable Functions

Any sequence of operations may be identified with a user-defined function. For example, the measurements to be made on a transmitter demodulator output could be identified with a function labeled DEMOD. A technician would simply select this function to make all measurements, including a print-out.

Digital Waveform Monitor/Vectorscope

For more detailed analysis of the waveform, the actual signal may be displayed and additional measurements made manually.

In waveform mode, cursors are available to aid in measuring time, frequency and amplitude. These cursors allow a very quick and precise location of the 10%, 50%, or 90% points on any transition.

The WAVEFORM DISPLAY can be expanded around any point both vertically and horizontally. Because the data is digitized, the display remains bright at all expansion factors. The axes automatically expand with the waveform, so all units are correct as displayed.

The VECTOR DISPLAY mode provides the normal vectorscope display. The vectors may be rotated or expanded, with the rotation angle and gain values displayed numerically on the screen.

Line Select can be used to quickly specify any line for display or automatic measurement.

Hard Copy

All information on the screen may be printed on printers supporting Epson® or Postscript® graphics via the standard RS-232C interface. Automatic measurement results can be printed on most ASCII printers using the same interface.

Picture Mode

The signal source can be quickly verified using the picture display, and any line may be selected on the picture for viewing in the waveform or vector displays.

CHARACTERISTICS

Measurement	Range	Accuracy	Test Signal
RS-170A Horizontal Blanking Interval Timing Measurements			
Color Burst Width	6-13 cycles	±1 cycle	Horizontal Blanking
Front Porch Duration	0.5-2 μs	±20 ns	Horizontal Blanking
Horizontal Blanking Width	6-30 μs	±50 ns	Horizontal Blanking
Horizontal Sync Rise Time and Fall Time	80-120 ns 120-300 ns 300 ns to 1.0 μs	−10 to +30 ns ±20 ns ±30 ns	Horizontal Blanking
Horizontal Sync Width	1-8 μs	±15 ns	Horizontal Blanking
SCH Phase	±90 deg	±5 deg	Horizontal Blanking
Sync to Setup	5-18 μs	±20 ns	Horizontal Blanking
Sync-to-Start-of Burst	4-8 μs	±140 ns (0.5 cycles) ±20 ns	Horizontal Blanking
RS-170A Vertical Blanking Interval Timing Measurements			
Equalizing Pulse Width	1-20 μs	±15 ns	Vertical Blanking
Serration Width	1-20 μs	±15 ns	Vertical Blanking
Vertical Blanking Width	19-29 lines	−0.1 to +0.2 lines	Vertical Blanking
FCC Horizontal Blanking Interval Timing Measurements			
Breezeway Width	0.2-3.5 μs	±25 ns	Horizontal Blanking
Color Burst Width	6-13 cycles	±0.1 cycle	Horizontal Blanking
Front Porch Duration	0.5-2 μs	±25 ns	Horizontal Blanking
Horizontal Blanking Width	6-30 μs	±25 ns	Horizontal Blanking
Horizontal Sync Rise Time and Fall Time	80-120 ns 120-300 ns 300 ns to 1.0μs	−10 to +30 ns ±20 ns ±30 ns	Horizontal Blanking
Horizontal Sync Width	1-8 μs	±25 ns	Horizontal Blanking
Sync to Setup	5-18 μs	±25 ns	Horizontal Blanking
Sync-to-End-of-Burst	6-15 μs	±20 ns	Horizontal Blanking
FCC Vertical Blanking Interval Timing Measurements			
Equalizing Pulse Width	25-200% of nominal horizontal sync pulse width	±0.5%	Vertical Blanking
Serration Width	1-20 μs	±25 ns	Vertical Blanking
Vertical Blanking Width	19-29 lines	−0.1 to +0.2 lines	Vertical Blanking
Amplitude and Phase Measurements			
Bar Top	0-90% of max carrier	±0.4%	FCC/NTC-7 Composite
Bar Amplitude	0-200 IRE	±0.5 IRE	FCC/NTC-7 Composite
Chrominance-Luminance Delay	±300 ns	±10 ns	FCC/NTC-7 Composite
Chrominance-Luminance Gain	0-160%	±1%	FCC/NTC-7 Composite
Differential Gain	0-100%	±0.3%	FCC/NTC-7 Composite
Differential Phase	0-360 deg	±0.3 deg	FCC/NTC-7 composite
Luminance Non-linear Distortion	0-50%	±0.5%	FCC/NTC-7 Composite
Relative Burst Gain	±100%	±0.3%	FCC/NTC-7 Composite
Relative Burst Phase	±180 deg	±0.3 deg	FCC/NTC-7 Composite
Burst Amplitude (% of Sync)	25-200% of sync	±1.3% of sync or ±0.5 IRE, whichever is greater	Horizontal Blanking
Burst Amplitude (% of Bar) (Bar not used)	10-80% of Bar (10-80 IRE)	±0.5% (±0.5 IRE)	Horizontal Blanking
Sync Amplitude (Bar not used)	20-80% of Bar (20-80 IRE)	±0.5% (±0.5 IRE)	Horizontal Blanking
Blanking Level	0-90% of max carrier	±0.5%	Horizontal Blanking
Sync Variation (Zero Carrier not used) (Zero Carrier & Bar not used)	0-50% of max carrier (0-50% of Bar) (0-50 IRE)	±0.5% (±0.5%) (±0.5 IRE)	Horizontal Blanking
Blanking Variation (Zero Carrier not used) (Zero Carrier & Bar not used)	0-50% of max carrier (0-50% of Bar) (0-50 IRE)	±0.5% (±0.5%) (±0.5 IRE)	Horizontal Blanking

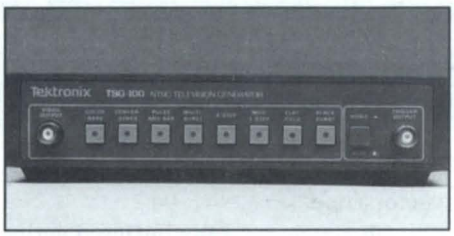
Measurement	Range	Accuracy	Test Signal
Frequency Response and Group Delay Measurements			
Multiburst Flag Amplitude (Zero Carrier not used) (Zero Carrier & Bar not used)	0-90% of max carrier (20-130% of Bar) (20-130 IRE)	±0.5% (±0.5%) (±0.5 IRE)	Multiburst/NTC-7 Combination
Multiburst Packet Amplitudes (6 results)	0-100% of Flag	±2%	Multiburst/NTC-7 Combination
Frequency Response and Group Delay Measurements (cont)			
Envelope (Group) Delay	±300 ns	±10 ns	SIN X/X
Amplitude Response vs Frequency	±50%	±2%	SIN X/X
Incidental Carrier Phase Modulation			
ICPM	0-30 deg	±1.0 deg	FCC/NTC-7 Composite
Color Bar Measurements			
Color Bar Amplitude Errors	±100% of nominal	±1% or ±1 IRE, whichever is greater	FCC/EIA/SMPTE Color Bars
Color Bar Phase Errors	±180 deg from nominal	±1 deg	FCC/EIA/SMPTE Color Bars
Color Bar Chrominance-Luminance Gain Ratio	0-200% of nominal	±2%	FCC/EIA/SMPTE Color Bars
Waveform Distortion Measurements			
Line Time Distortion	0-40% of Bar	±0.5%	FCC/NTC-7 Composite
Pulse-to-Bar Ratio	10-125%	±1%	FCC/NTC-7 Composite
Short-Time Waveform Distortion	0-25% SD	±1% SD	NTC-7 Composite
Chrominance Non-linear Gain Distortion	5-35 IRE (20 IRE chroma) 45-160 IRE (80 IRE chroma)	±0.5 IRE	NTC-7 Combination
Chrominance Non-linear Phase Distortion	0-360 deg	±0.5 deg	NTC-7 Combination
Chrominance to Luminance Intermodulation	±50 IRE	±0.5 IRE	NTC-7 Combination
2T K-Factor	0-10% Kf	±0.5% Kf	FCC/NTC-7 Composite
VIRS Measurements			
VIRS Setup (Reference Black) (Bar not used)	−20 to 130% of Bar (−20 to 130 IRE)	±0.5% (±0.5 IRE)	VIRS
VIRS Chrominance Reference Amplitude (Burst not used) (Burst & Bar not used)	0-200% of burst amplitude (0-80% of Bar) (0-80 IRE)	±1.0% (±0.1%) (±1.0 IRE)	VIRS
VIRS Chrominance Phase Relative to Burst	±180 deg	±1.0 deg	VIRS
VIRS Luminance Reference (Bar not used)	30-100% of Bar (30-100 IRE)	±1.0% (±1.0 IRE)	VIRS VIRS
Signal-To-Noise Ratio Measurements			
Unweighted SNR	26-60 dB 61-70 dB	±1.0 dB ±2.0 dB	Quiet Line
Luminance Weighted SNR	26-60 dB 61-70 dB	±1.0 dB ±2.0 dB	Quiet Line
Periodic SNR	26-60 dB 61-70 dB	±1.0 dB ±2.0 dB	Quiet Line
Out-Of-Service Measurements			
Long Time Distortion	0-20 IRE 20-100 IRE	±0.5 IRE ±1.0 IRE	Bounce
Field Time Distortion	0-40%	±0.5%	Field Square Wave

ORDERING INFORMATION

VM700 Video Measurement Set **$15,000**
(Option 01 is required)

OPTIONS

Option 01—NTSC Measurements **+$3,000**
Option C1—Cabinet Version **+$300**



TSG-100 Test Signal Generator.

NEW TSG-100

Test Signal Generator

- **Simple Yet Functional Test Signal Complement**
- **Eight-Bit Digital Generation**
- **Conforms to RS-170A Timing Specifications**
- **1 kHz Audio Tone**
- **H or V Rate Scope Trigger Signal**
- **DC Power Operation**
- **Compact and Lightweight**

The TSG-100 is a low cost NTSC Test Signal Generator ideally suited for the maintenance and alignment of video equipment in most television environments.

The eight-bit digital test signal generator ensures conformance to RS-170A timing specifications while providing good, long-term signal stability.

TSG-100 test signal includes:

- SMPTE color bars
- Convergence pattern
- Multiburst
- Pulse and bar with window and modulated pulse
- 5 step staircase
- Modulated 5 step
- White field
- Black burst

Front and rear panel test signal outputs provide convenient access to test signals for both rackmount and service bench applications.

A front panel scope trigger output is provided for service applications. Horizontal or vertical repetition rate is front panel selectable.

The TSG-100 includes a 1 kHz audio tone generator for continuity and level checks. Level of the tone is user adjustable over a 0 to +8 dBμ range. The level 0 dBμ is equivalent to 0 dBm in a 600 Ω environment. Output is on a rear panel XLR connector.

The TSG-100 is housed in a compact, rugged mechanical package and, with DC power operation, is suuitable for studio, mobile unit, and field portable applications.

ORDERING INFORMATION

TSG-100 NTSC Television Generator. **$1,250**

TSG-170D Digital Composite NTSC Generator.

NEW TSG-170D

Digital Composite NTSC Generator

- **Digital and NTSC Analog Test Signal Outputs**
- **Digital and Analog Audio Tone Outputs**
- **Simple, Effective Test Signal Complement**
- **Genlock with Output Timing Offset**
- **Twelve Character Identification**
- **Tape Leader Countdown**

The TSG-170D is a digital composite NTSC generator suitable for both the operation and maintenance of NTSC composite digital television equipment. The TSG-170D provides test signals and audio tone in both digital and analog form plus an analog black burst for equipment synchronization.

The TSG-170D uses 10-bit digital test signal generation conforming to the Proposed American National Standard for digital encoding of composite video video signals (System M/NTSC). The test signal digital output is a 10-bit parallel interface clocked at 4 Fsc.

The digital test signal data is converted to analog with a precision digital to analog converter. This ensures signal accuracy and long-term stability.

ORDERING INFORMATION

TSG-170D Digital Composite NTSC Generator. **$5,600**

NEW TSG-422

Component Generator

- **Conforms to CCIR Recommendation 601, SMPTE RP 125, and EBU Tech. 3246-E**
- **4:2:2 Format**
- **Ten-Bit Signal Generator**
- **Digital Test Signal Outputs**
- **Separate Y, B-Y, R-Y Clock Outputs**
- **525/60 and 625/50 Operation**
- **NTSC or PAL BLack Burst Outputs**
- **Genlock to 525/60 or 625/50**

The TSG-422 is a CCIR 601, 4:2:2 format Digital Test Signal Generator. The TSG-422 provides all the test signals needed to operate, maintain and evaluate 4:2:2 digital equipment. analog black burst outputs are provided for equipment synchronization.

The TSG-422 signal generation is 10-bit in all channels and is clocked at 13.5 MHz for the luminance channel and 6.75 MHz for the color difference channels. Color difference samples are co-sited with the odd numbered luminance samples.

The TSG-422 signal complement contains general purpose signals plus those tailored specifically to the 4:2:2 environment.

ORDERING INFORMATION

TSG-422 Digital Component Generator. **$5,500**

SPG-271 PAL Sync Generator

NEW SPG-271

PAL Sync Generator

- **Conforms to EBU Statement D23 and D25**
- **Precise 12-Bit Digitally Generated Color Bars and Black Burst**
- **SCH Phase Accuracy Guaranteed by Use of a Single DAC**
- **High Stability Internal Reference for Master Sync System Applications**
- **Reliable Slave Operation Provided by Digital Genlock**
- **Separate Genlock and Sync Timing Controls with Presets**
- **Character Identification, Audio Tone Option**

The SPG-271 uses digital signal generation and a precision 12-bit to ensure accuracy and long term stability. Digital generation of the composite PAL signal, without analog modulators, allows use of a single DAC which inherently match chrominance and luminance timing. This ensures accurate SCH phasing.

The SPG-271 sync generator's stable subcarrier standard and unique digital genlock make it ideal for either master generator or slave operation. All outputs are correctly SCH phased, even if the SPG-271 is locked to an improperly SCH phased reference input. The digital genlock calculates sync timing and subcarrier phase to correctly identify color framing of the reference signal. The SPG-271 automatically senses composite video reference input and, in the absence of a reference input signal, automatically switches to its own internal reference. With its constant temperature oven, this high stability crystal oscillator ensures long term frequency stability.

ORDERING INFORMATION

SPG-271 PAL Sync Generator **$3,000**

OPTION

Option 01—Adds 12-character ID, Audio Tone, Tape Leader Countdown. **+$635**

DP-100

Digital Video Probe

- **Convenient Analog Display of Digital Television Signals**
- **Fully Buffered ECL/TTL Probe**
- **Up to 100 MS/s Data Rates**
- **Precision 10-Bit DAC**
- **Switchable Reconstruction Filter**
- **Adjustable Clock Phasing**
- **Adjustable Sync Timing**

The DP-100 Digital Video Probe is a simple, yet versatile, tool for evaluating digital television equipment. You can tap into a data bus, convert the signal to analog, and display it on any scope or waveform monitor, picture monitor or vectorscope.

The DP-100 uses a fully buffered active logic probe to minimize loading of the circuit under test. This probe transfers data to the DP-100's DAC. A separate clock probe locks the DP-100 to your system clock.

The DP-100 incorporates a 10-bit, 100 MS/s precision DAC for compatibility with a wide range of television equipment.

The DP-100 inserts a blanking reference level on the video output, making it compatible with clamping circuits in conventional picture monitors and waveform monitors. The DP-100 also provides a sync pulse output to drive these monitors.

You can preset sync timing, or use the front-panel sync timing controls for continuous cross-pulse displays.

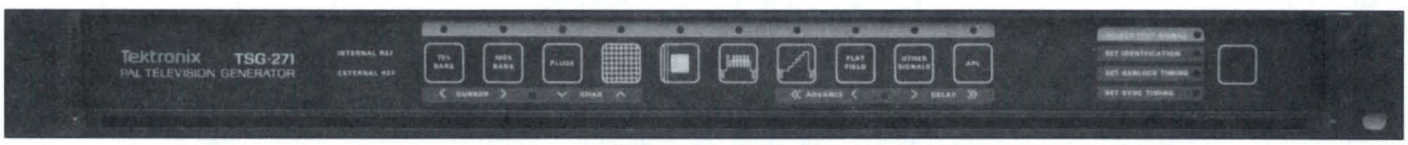
ORDERING INFORMATION

DP-100 Digital Video Probe **$2,965**

Includes: P6460 data probe; P6454 clock probe; instruction manual 061-3452-00.

OPTION

Option 01—Deletes the P6460 Data and P6454 Clock probes **−$965**



TSG-271 PAL Television Generator

TSG-271

PAL Television Generator

- **Precise 12-bit Digitally Derived Test Signals**
- **SCH Phase Accuracy, Guaranteed by Use of a Single DAC**
- **Conforms to EBU Statements D23 and D25**
- **Stable Internal Reference, Ideal for Master Sync Operation**
- **Reliable Slave Operation Through Use of Digital Genlock**
- **Separate Front-Panel Genlock and Sync Timing Controls**

Until now, your choices in PAL test signal generators were limited. Now, with Tek's TSG-271 PAL Television Generator, you can choose performance unmatched for the price. The TSG-271 features a unique digital architecture and innovative technology.

The TSG-271 uses digital signal generation and a precision 12-bit DAC to insure test signal accuracy and long term stability. Digital generation of the composite PAL signal, without analog modulators, allows use of a single DAC to inherently match chrominance and luminance timing. This insures accurate SCH phasing.

The TSG-271 sync generator's stable color standard and unique digital genlock make it ideal for either master generator or slave operation. All outputs are correctly SCH phased, even if the TSG-271 is locked to an improperly SCH phased reference input. The digital genlock calculates sync timing and subcarrier phase to properly identify color framing of the reference signal. The TSG-271 automatically senses composite video reference input and, in the absence of a reference input signal, automatically switches to its own internal reference. With its constant temperature oven, this high stability crystal oscillator insures long term frequency stability.

ORDERING INFORMATION

TSG-271 PAL Television Generator **$4,950**

OPTION

Option 01—Adds character ID, Audio Tone, and Tape Leader Countdown **+$635**

SPG-170A NTSC Sync Generator.

SPG-170A NTSC Sync Generator

- **Digitally Generated RS-170A Black Burst**
- **Digital Genlock**
- **High-Stability Subcarrier**
- **Flexible Pulse Outputs**
- **Pulse Timing Independent of Black**
- **Remote Control Timing Presets**
- **Remote Control ID Presets**
- **SMPTE Bars, ID, and Audio Tone (Option 01)**

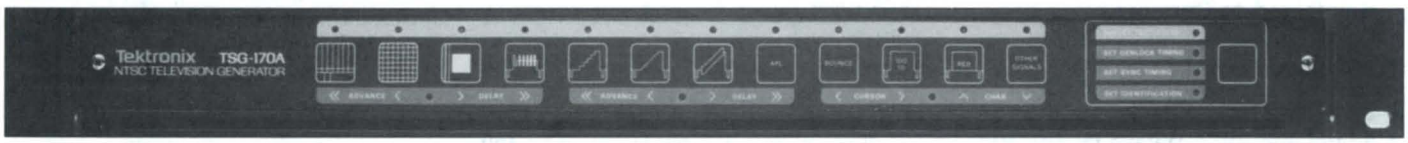
The SPG-170A sync generator offers all the features expected in a sync generator, plus the advantages of digital accuracy and system flexibility. Ideal for either master or slave generator operation, the SPG-170A features stable RS-170A performance and a rugged 1¾-inch package. The SPG-170A Option 01 provides even more versatility by adding SMPTE bars with programmable identification and audio tone.

ORDERING INFORMATION

SPG-170A NTSC Sync Generator **$3,300**

OPTION

Option 01—SMPTE Bars with ID and Audio Tone Output **+ $1,000**



TSG-170A NTSC Television Generator.

TSG-170A

NTSC Television Generator

- **Simple, Effective Test Signal Complement**
- **RS-170A Sync Pulse Generator With Digital Genlock**
- **Separate Timing Controls for Sync and Test Signals**
- **Separate SMPTE Bars Output With Programmable ID (Option 01)**
- **Audio Tone Output (Option 01)**
- **Tape Leader Countdown**

The Tektronix TSG-170A NTSC Television Generator offers you the test signals you need plus the advantages of master and genlock sync capability. It provides true 10-bit digital signal accuracy with a full complement of test signals and a stable RS-170A sync generator.

The rugged, compact TSG-170A is designed to support both operational and maintenance requirements. The TSG-170A Option 01 provides even more versatility by adding a separate SMPTE bar generator, programmable identification, and audio tone output.

Features

- SMPTE Bars
- Convergence
- Pulse and Bar with Window
- Multiburst
- 5-Step Luminance Staircase
- Luminance Ramp
- Modulated Ramp
- Selectable 10% or 90% APL
- Bounce
- 10 and 100 IRE Flat Fields
- Red Field
- Multibars
- NTC7 Composite
- System Test Matrix
- Monitor Set-Up Matrix
- 5-MHz Line Sweep
- Multipulse
- DAC Calibration Signals

ORDERING INFORMATION

TSG-170A NTSC Television Generator **$4,995**

OPTION

Option 01—Adds separate SMPTE Bars output with 12 Character ID, Audio Tone Output and Tape Leader Countdown. **+ $1,000**

ECO-170A Synchronous Changeover.

ECO-170A

Synchronous Changeover

- **Automatic Sync Changeover**
- **Clean Electronic Switching**
- **Unique Fault-Detection System**
- **8 Channels**
- **Manual Override**
- **Remote Control With Fault Indicators**
- **NTSC/PAL Systems Compatibility**

The ECO-170A Synchronous Changeover provides transparent, automatic selection of sync sources. Front-panel controls allow simple access to changeover functions. A two-level front-panel lockout protects these controls in critical master sync systems.

ORDERING INFORMATION

ECO-170A Synchronous Changeover **$2,000**

See TSG-300 Component Television Generator on page 82.

1410R Option 04 Test Signal Generator.

1410R/1411R/1412R

NTSC, PAL, and PAL-M Generators

- **Five Test Signal Generators and One Switcher**
- **Conforms to EIA Standard RS-170A (1410R)**
- **700 mV White Level on Field 1, Line 7 (1411R)**
- **Sync to Subcarrier Phasing Maintained or Corrected**
- **Color Frame Reference Output**
- **Genlock to Composite Video**
- **Lock to External References**
- **Adjustable Blanking Widths**
- **Adjustable Sync Delays (H and V)**
- **Parallel Test Signal Outputs**

Three different models are available. The 1410R is for NTSC applications, the 1411R for PAL, and the 1412R for PAL-M applications.

ORDERING INFORMATION

1410R NTSC PACKAGES
STANDARD CONFIGURATIONS

	Option 03	Option 04
TSG2 Convergence	x	
TSG3 Linearity	x	x
TSG5 Pulse and Bar		x
TSG6 Multiburst		x
TSG7 Color Bars	x	x
TSP1 Switcher		x

1410R NTSC Mainframe and SPG2A **$4,200**

OPTIONS

Option 03*1—NTSC Package Installed and Tested Together. **+$3,460**

Option 04*1—NTSC Package Installed and Tested Together. **+$8,280**

*1 *Cannot be combined with any other option.*

1411R PAL PACKAGES
STANDARD CONFIGURATIONS

	Option 03	Option 04
TSG11 Color Bars	x	x
TSG12 Convergence	x	
TSG13 Linearity	x	x
TSG15 Pulse and Bars		x
TSG16 Multiburst		x
TSP11 Switcher		x

1411R PAL Mainframe and SPG12 **$4,200**

OPTIONS

Option 03*1—PAL Package Installed and Tested Together. **+$3,000**

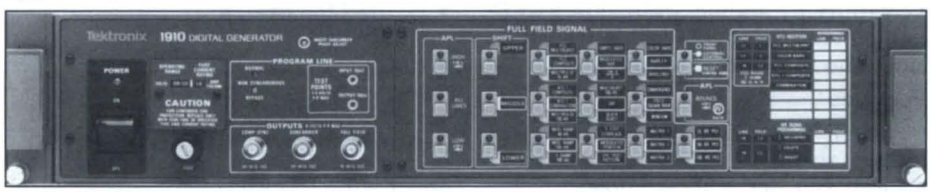
Option 04*1—PAL Package Installed and Tested Together. **+$7,500**

*1 *Cannot be combined with any other option.*

PAL-M PACKAGES

1412R PAL-M Mainframe and SPG22, TSG21 **$7,415**

Option 05—Adds TSG23/TSG25/TSG26/TSP21 Installed. **+$8,795**



1910 NTSC Digital Generator/Inserter.

1910 Digital Generator

- **Four External VITS Inputs for Insertion of Teletext, Closed Captioning, Source ID, etc.**
- **Nonvolatile Memory to Maintain Selected VITS and Full Field Signal Configuration After Power Interruption**
- **Signal Stored in Replaceable EPROM so Your 1910 Won't Become Obsolete**
- **The Accuracy and Stability of an All-Digital 10-Bit Sync and Signal Generator (RS-170A)**
- **User-Friendly RS-232C Control Port for Added Versatility**
- **New Signals (Eye Test Pattern, Special Multipulse, Color Multipulse), New Functions (VITS Sequence, Field Sequence and More)**

The 1910 Digital Generator is a state-of-the-art test signal generator designed for performance testing of NTSC video systems and equipment. The 1910 is especially suited where high accuracy and stability are required. It is also a VITS inserter (internal and external) with a full complement of signals that allow testing in studio, transmitter, production, or research environments. Four external VITS inputs permit insertion of signals such as teletext, closed captioning, source ID, and other similar sources. These four inputs may be converted to four pulse outputs for use in a production environment.

External interfacing of the 1910 is controlled by an internal microprocessor and its nonvolatile memory. Test signals are stored as 10-bit digital words and converted to analog form by a 10-bit precision DAC (with deglitching to reduce differential gain and differential phase) to ensure signal accuracy as well as long term stability and repeatability.

Since all signals are stored in replaceable EPROMs, changing needs and industry standards will not cause obsolescence.

Control and versatility of the 1910 are greatly enhanced by the use of its RS-232 control port. Most functions of the 1910 can be controlled, reconfigured and saved, including VITS and full field signal selection, matrix signal creation, sequences, and other features.

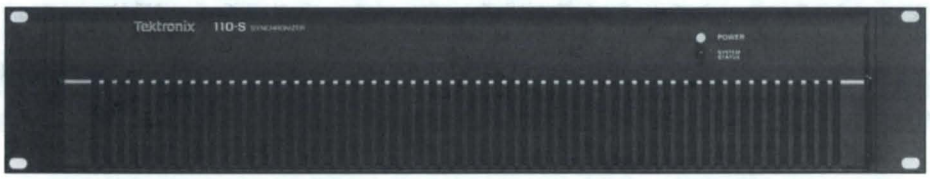
ORDERING INFORMATION

1910 Digital Generator **$9,990**

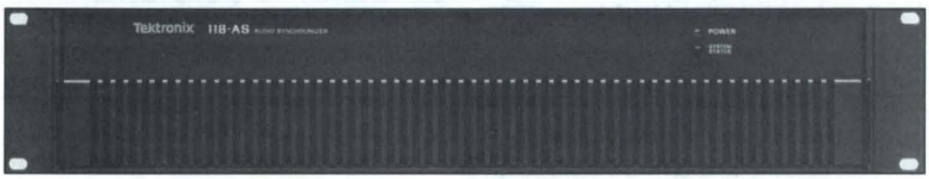
OPTION

Option 03—CBC Test Signals. **NC**

For complete Television product information, request the the Television Products Catalog.



110-S Video Synchronizer.



118-AS Audio Synchronizer

110-S Video Synchronizer/TBC

- **True 10-Bit Accuracy and Resolution**
- **Tracks Signals into the Noise**
- **Optional Four-Field Memory for the Highest Picture Quality**
- **Adaptive Decoding—Minimizes Picture Shifts While Preserving Horizontal and Vertical Detail, Provides Exceptionally High-Quality Picture Freeze**
- **Adaptive Clamping—Minimizes Streaking on Noisy Signals**
- **Digitally Precise RS-170A Sync and Burst Insertion**
- **Passes the Vertical Interval**
- **Processing Amplifier**
- **Precalibrated Boards in Modular Design**
- **Heterodyne Color Processing**
- **Auto VTR Signal Recognition**
- **Infinite Window Correction Range**

The 110-S is a high-quality, 10-bit, 4X fsc video synchronizer. The 10 bit architecture, adaptive decoding, and adaptive clamping combine to provide a synchronizer that performs well on noisy signals, minimizes horizontal picture shifts, and is virtually transparent to the processed signal.

10-Bit Precision

A Tektronix-designed 10-bit digitizer and a sampling rate of four times the subcarrier frequency result in negligible quantizing errors, low differential gain and phase, and a flat frequency response. Compared to 8-bit synchronizers, the 110-S has four times the accuracy and resolution. The resulting transparency to the video signal allows cascading of 110-S synchronizers in the signal path with minimum signal degradation.

Tracking Into Noise

When noise from a fading ENG microwave feed or static interference degrades the S/N ratio, the 110-S will continue to track the signal. If the original sync and burst are clean, they may be passed with the original signal. Noisy sync and burst are replaced with precise, digitally generated RS-170A sync and burst. The 110-S can be configured to track into the noise, freeze field, or go to black upon loss of the incoming signal. As noise increases, an adaptive clamp slows down to prevent horizontal streaking while still responding quickly to hot switches.

The 110-S TBC option adds time-base correction for heterodyne color VTRs to the 110-S Synchronizer.

ORDERING INFORMATION

110-S Video Synchronizer	**$4,975**
OPTIONS	
Option 10—Four-Field Memory Adaptive Decoder.	**+ $1,500**
Option 20—Adds time-base correction for heterodyne color VTRs	**+ $2,000**
110-RC Remote Control Unit	**50**

118-AS Audio Synchronizer

- **Automatic or Manual Control of Audio to Video Timing**
- **Simple One-Wire Interface to 110-S Video Synchronizer**
- **Expandable to Three Channels for Stereo and Auxiliary Channel**
- **Compensates for up to Ten Fields of Video Delay**
- **93.75-kHz Sampling Provides Accurate Stereo Phasing and Flat Frequency Response**
- **18-Bit Floating-Point Code for Wide Dynamic Range**
- **Built-In Diagnostics and Easy Module Access for Service**

The Tektronix 118-AS Audio Synchronizer provides automatic and/or manual control of audio delay to maintain proper audio to video timing. With 18-bit floating point code and 93.75 kHz sampling, the Tektronix 118-AS brings to audio synchronization the same high standards established for video synchronization by the Tektronix 110-S.

The 118-AS Audio Synchronizer automatically tracks the 110-S Video Synchronizer using a simple one-wire digital interface. The 118-F02 video interface board allows the 118-AS to automatically track the delay of other video equipment. Additional fixed audio delay may be added manually to compensate for audio to video timing errors present on an incoming signal.

The standard 118-AS is a single-channel audio synchronizer, which may be expanded to two or three channels for stereo or second-language applications.

ORDERING INFORMATION

118-AS Single-Channel Audio Synchronizer with 118-F02 Video Interface	**$5,50**
118-F01 Audio Channel Kit (adds one channel)	**$1,000**
118-F02 Video Interface Kit	**$1,400**
118-RC Remote Control Unit	**$850**

TSG-300 Component Television Generator.

TSG-300

Component Television Generator

- **Multiple Formats and Standards: Y,B-Y, R-Y (Y,P_b,P_r; SMPTE/EBU); GBR; Betacam®; MII; 525/60 and 625/50**
- **10-Bit Digital Signal Generation**
- **New Test Signals for Component Video: Bowtie; Coring; Valid Ramp; Shallow Ramp**
- **User Configurable Controls**
- **Digital Genlock**

From news gathering to post-production, component television is providing new levels of image quality and operational flexibility. While component television solves many problems inherent in composite NTSC and PAL, it brings with it a new set of concerns. The TSG-300 Component Television Generator provides innovative solutions to the measurement problems encountered in component television systems.

ORDERING INFORMATION

TSG-300 Component Television Generator **$6,500**

WFM-300 Component Television Waveform Monitor with Vector Display.

WFM-300

Component Television Waveform Monitor

- **Lightning Display**
- **Parade and Waveform Overlay Display**
- **Vector Display**
- **Bowtie Timing Display**
- **Color-Gamut Limit Indication**
- **Linearity Measurements**
- **Y,P_b,P_r; Y,B-Y,R-Y; G,B,R; Y,Q,I Input Options**
- **Electronic Graticule**
- **625/50 and 525/60 Selectable**
- **GBR Picture Monitor Output**

The versatile WFM-300 Component Television Waveform Monitor provides a comprehensive set of signal monitoring capabilities designed specifically for the component television environment. New component-based television equipment produces signals quite different from the composite television signals, and the WFM-300 provides new monitoring capabilities to meet this challenge. An innovative new Lightning display provides amplitude and timing information for all three channels simultaneously, allowing the operator to set up equipment accurately and efficiently. The traditional parade display of three signals provides side-by-side comparison of all signals. In addition, any combination of the three signals can be overlaid for accurate comparisons. Both horizontal and vertical magnification can be applied for detailed inspection of the signal being observed.

A vector display of the color difference signals provides the traditional color-bar vector display. The Bow-tie timing test signal from the TSG-300 component television test signal generator allows precise timing of three-wire component television systems. This signal utilizes a channel 1 minus channel 2 and 3 mode to provide a side-by-side differential comparison (1-2, 1-3) of all three channels.

The WFM-300 has full-frame line select, with alphanumeric readout. Any one or two lines of the entire frame can be selected and displayed, or the same line(s) in both fields can be viewed at one time. An intensified zone in the two-field sweep indicates the location of the line selection. In addition, any successive 15 lines can be overlaid.

The input signal can be color difference or GBR, with optional accommodation for several color difference formats. All of these signal types are converted to GBR for a dedicated picture monitor output. The valid GBR gamut limit is monitored to make sure the operator is warned if a combination of signals is not valid. The WFM-300 can be configured for either 525/60 and 625/50 signal standards.

ORDERING INFORMATION

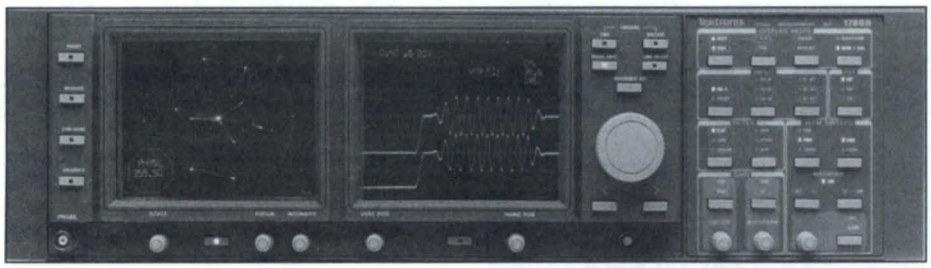
These instruments are configured for rack-mounting and are shipped without cases or covers. Order appropriate optional accessories on next page to configure for rack, bench, or portable use. The WFM-300 is a UL recognized component and meets the requirements for listing when used in the appropriate enclosure.

WFM-300 Component Television Waveform Monitor (525/60 operation) **$3,900**

OPTIONS

Option 01—For 625/50 operation. **NC**
Option 10—For Betacam transcoder. **NC**
Option 12—For YQI transcoder. **NC**
Option 14—for MII transcoder. **NC**

For complete Television products information, request the Television Products Catalog.



1780R

NEW 1780R Series
Video Measurement Set

FEATURES

- **Precision Waveform and Vector Measurements**
- **Graphic SCH Presentation, with Calibration**
- **Component or Composite Waveform Evaluation**
- **Electronic Time and Voltage Cursors**
- **Precision Diff Phase/Diff Gain Measurements with Noisy Signals**
- **Full Function RS232/RS422 Remote Control**
- **User Defined Semi-Automatic Setups**
- **Digital Control of all Functions**
- **Full Bandwidth Analog Video Processing**
- **Touch Screen User Interface**
- **Four Video Input Channels Plus Probe**
- **Front Panel Video/TTL Probe Input**
- **Stereo Audio Phase and Amplitude Display**

The 1780R Series Video Measurement Set offers features for precise evaluation of studio and transmission of performance. This multi-function instrument is a wide bandwidth, multi-input, and waveform/vector/SCH measurement package.

The advantages of separate waveform and vector instruments are provided in a single package. In addition, specific measurements take advantage of shared waveform monitor and vectorscope internal processing. Separate, optimized waveform and vector display CRTs allow simultaneous monitoring of several video parameters. Routine and specialized video evaluation is easily and quickly performed in this full function measurement instrument.

The 1780R Series provides a full menu of traditional waveform/vector/SCH monitor capabilities. Levels of performance previously unavailable, even in separate instruments, are characteristic of the 1780R Series.

A precision phase control allows differential display resolution to within 0.05 degree, with an absolute accuracy of 0.1 around the full 360 degree vector range. The Tektronix dual envelope differential phase measurement technique is enhanced with a digital recursive vertical filter to permit accurate readings in the presence of noise.

The digital recursive vertical filter is also used in the display of dual envelope differential gain.

The polar SCH display provides a graphic indication of phase of the burst subcarrier relative to the leading edge of horizontal sync.

Operator/instrument interface has been given a great deal of attention in the 1780R Series. Ease of operation and unusual flexibility are designed into the instrument. Many functions of the 1780R Series are accessed by the touch screens.

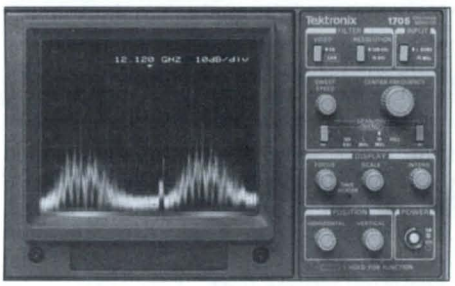
User and programmable semiautomatic setups, along with on-screen voltage/timing cursors and electronic graticules contribute to a new level of operational simplicity.

The 1780R Series are digitally controlled instruments. All front panel controls, including knobs, touch screen operations, and push-buttons, may be recalled remotely via an RS-232/RS-422 serial communications port.

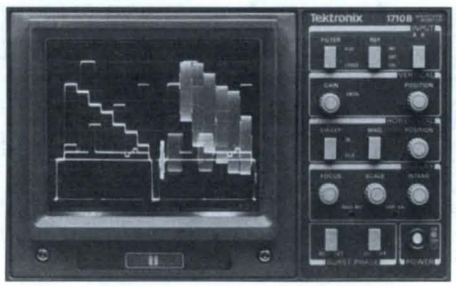
ORDERING INFORMATION

1780R Video Measurement Set.
525 line/60 field, NTSC. **$9,500**
INTERNATIONAL POWER PLUG OPTIONS
Option A1—Universal Euro 220 V, 50 Hz
Option A2—UK 240 V, 50 Hz
1781R Video Measurement Set. **$9,500**
INTERNATIONAL POWER PLUG OPTIONS
Option A1—Universal Euro 220 V, 50 Hz
Option A2—UK 240 V, 50 Hz
Option A3—Australian 240 V, 50 Hz

Portability kit provides feet, tilt stand, carrying handle, and (not shown) front and rear covers.



1705 Spectrum Monitor



1710B Waveform Monitor—Dual Filter Display

1705 Spectrum Monitor

- **Designed for Satellite News Gathering**
- **Easy, Reliable Operation**
- **Cost Effective**
- **On-Screen Ku or C-Band Frequency Readout**
- **On-Screen Setup Menu**
- **Selectable 2dB or 10 dB/Division Sensitivity**
- **L-band and 70 MHz IF Inputs**
- **Resolution Switchable to 10 or 300 kHz**
- **Span Range and Video Filter Selection**
- **Center Frequency Control**
- **Bright Clear Display**
- **DC Operation Available**

The Tektronix 1705 Spectrum Monitor is a special purpose radio frequency monitor designed for rapid response television satellite news gathering applications. Using the 1705, an operator can identify the spectral pattern of a particular satellite and transponder to determine which video, audio, and SCPC carriers are present. It assists in the accurate adjustment of azimuth, elevation and polarization of the downlink/uplink antenna. It also provides a display of satellite and locally generated signals.

Dual Band Operation

The 1705 features front panel selectable inputs for L-band (900-1450 MHz) monitoring of television downlink signals from a low noise block converter (LNB) located at receive antenna, and 70 MHz band (45-100 MHz) monitoring of the television uplink exciter or other IF signals. Input frequency is displayed on-screen in both L-band and 70 MHz modes, and the L-band readout may be reconfigured to display a satellite frequency in the range of 0.9-20.0 GHz. A dc output is provided to power the low noise block converter.

1710B Series Waveform Monitors

- **Cost Effective**
- **Easy Operation**
- **Burst Phase Indicator**
- **Dual-Filter Display**
- **Half-Rack Width**
- **Bright CRT Display**
- **Internal Graticule**
- **Light Weight**
- **Low Power Consumption**
- **Portable DC Power and Battery Available**
- **Available in NTSC and PAL Standards**

The 1710B Series waveform monitors provide all of the commonly used display modes. In addition, the 1710B Series adds relative burst phase indication and dual-filter display. All this capability in a cost-effective package for the user who wants high quality at a low price. These monitors are mechanically compatible and retrofit into an existing system that uses half-rack width, 5¼-inch waveform monitors.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	133	5.25
Width	214	8.42
Depth	429	16.88
Weight ≈	**kg**	**lb**
Net	3.6	8.0

ORDERING INFORMATION

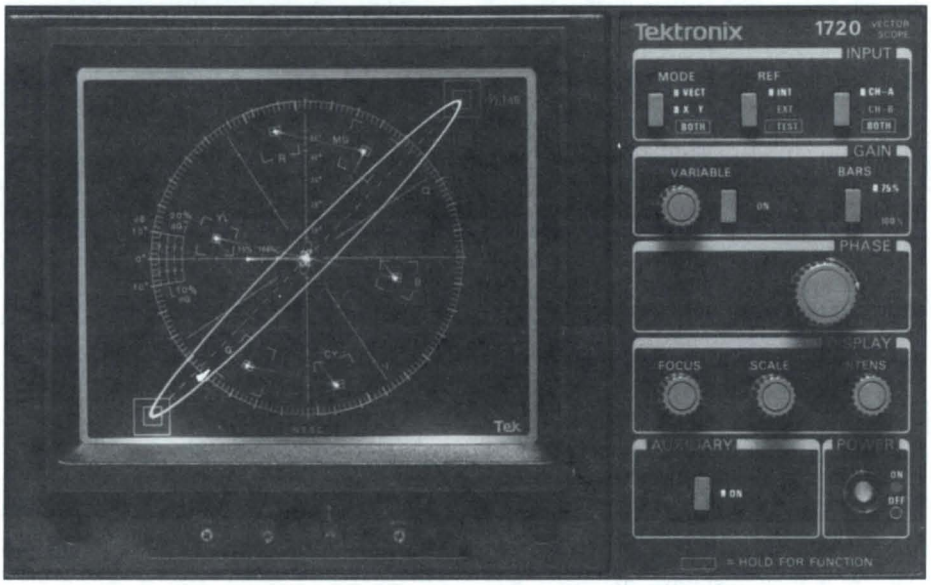
These instruments are configured for rack mounting and are shipped without cases or covers. Order appropriate optional accessories to configure for rack, bench or portable use.

1705 Spectrum Monitor	**$3,850**
1700F10 DC Power Converter Kit	**$200**
1700F02 Portable Cabinet and BP1 Battery Pack	**$85**
1710B Waveform Monitor (NTSC System Applications)	**$1,745**
1711B Waveform Monitor (PAL System Applications)	**$1,745**

OPTIONAL ACCESSORIES

Cabinets—	
(Plain) Order 1700F00	**$60**
(Portable) Order 1700F02	**$85**
Side-By-Side Rack Mount—For mounting two half-rack instruments in a standard 19-inch rack. Order 1700F05	**$195**
Blank Panel Adapter—For the side-by-side rack mount. Order 1700F06	**$60**
Viewing Hood—For high ambient light environments. Order 016-0475-00	**$20**
Cameras—	
(Regular) C-5C Option 02.	**$465**
(Automatic) C-7 Option 03.	**$580**
Battery Pack—Requires 1700F02 case, 1700F10 dc operation kit, and battery charger. Order BP1	**$600**
DC Operation Kit—12 V dc. Order 1700F10	**$200**

For complete Television products information, request the Television Products Catalog.



1720 Vectorscope—Vector and Stereo Audio Dual Display Mode.

1720/1730

- **Performance and Economy**
- **Complete Line Select**
- **Simultaneous Chan A/B Display**
- **Dual-Filter Display**
- **One-Button Front-Panel Recall**
- **Differential Phase and Gain Measurement**
- **Stereo Audio Phase Measurement**
- **RGB/YRGB Display Capability**
- **Vector Center-Dot Clamping**
- **Parallax-Free Internal Graticules**
- **Portable DC Power and Battery Available**
- **Remote Control Capability**
- **Available in NTSC, PAL, Dual PAL/ NTSC, and PAL-M Standards**

The 1730 Series Waveform Monitors and 1720 Series Vectorscopes provide a new dimension in television signal monitoring for both NTSC and PAL applications. These versatile instruments are lightweight, half-rack width, and have bright CRTs for comprehensive video signal monitoring. Both instruments exceed normal monitoring capabilities.

Their unique features make them even more powerful when operated in tandem. Each monitor has its own advanced feature set and the proven 1700 Series family performance to provide more monitor for the money. These monitors do the job faster, better, and easier at a low price.

Complete Line Select

The 1730 Series Waveform Monitor has full-frame line select, with alphanumeric readout, that can be tracked by the 1720 Series Vectorscope when in Auxiliary mode. Any one or two lines of the entire frame can be selected and displayed, or the same line(s) in both fields can be viewed at one time. An intensified zone in the two-field sweep and on the picture monitor output signal indicates the location of the line selection. In addition, any successive 15 lines can be overlaid for camera and VTR adjustments.

Simultaneous Channel A and B Display

These instruments have state-of-the-art microprocessor front-panel control. They are operator-friendly and provide features in half-rack waveform monitors or vectorscopes. Both the 1730 Series Waveform Monitor and the 1720 Series Vectorscope have dual-channel display capability, allowing both input channels to be displayed on the CRT simultaneously.

Dual-Filter Display

The 1730 (NTSC) and the 1731 (PAL) Waveform Monitors include dual filter display, which provides low-pass and flat information in the same display. The 2-Field and 2-Line Display Modes have the Low-Pass Filter applied to the left half of the trace. In the 1-Line Mode, the two signals are overlaid. These filter modes can also be used independently. Both versions of the 1730 Series have chroma filters centered around the subcarrier frequency.

One-Button Front-Panel Recall

Once the front panel has been set up in a frequently used mode, the configuration can be stored for later one-button recall. In addition, when the 1720 is used in tandem with the 1730, it will respond to this Store/Recall operation. Up to four operator-selected front-panel configurations can be stored from the front panel. Four other front-panel configurations are factory-programmed settings and are accessible from the Remote Control interface.

Differential Phase and Gain Measurements

The 1720 Series Vectorscope graticule has scales for measuring Differential Phase and Gain. The Differential Phase scale has markings at 2° intervals. The Differential Gain scale has markings at 5% intervals. For even greater precision, the 1720 and 1730 Series can be coupled for using the field or line sweep on the 1730 Series Waveform Monitor. The Waveform Chroma filter can be used for differential gain measurements.

Stereo Audio Phase Measurements

Balanced inputs for the X-Y mode are available on the 1720 Series Vectorscope through a separate input connector. This mode is particularly useful for evaluation of stereo audio using a special X-Y graticule scale for both amplitude and phase measurements. X-Y measurements can be displayed individually or in combination with a vector display. This input can also be used for other applications where X-Y monitoring is useful.

RGB-YRGB

The Waveform Monitor can display RGB or YRGB staircase. The RGB/YRGB staircase input is through a rear-panel connector.

Vector Center-Dot Clamping

These vectorscopes employ center-dot clamping in Vector mode for easy detection of residual subcarrier on the signal. In addition, with no signal present, the center dot automatically dims, prolonging the CRT life.

Parallax-Free Internal Graticules

Both instruments utilize post-accelerated, mesh-type CRTs equipped with internal graticules to provide parallax-free displays. Variable, evenly illuminated scales, along with molded bezels, make waveform photography simple.

Portable DC Power

In addition to being ideal for camera control units and video tape recorders, these instruments can be equipped with cabinet and field upgrades allowing them to operate from a 12 V dc source for portable operation. They can be used with the Tektronix BP1 or other 12 V supply. Coupling this dc operation with their light weight (about 9 pounds, including cabinet), low power consumption, and compact size makes these instruments well suited for use on a portable production cart.

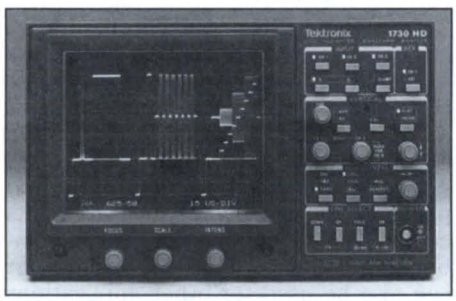
Remote Control

Internal front-panel presets, RGB/YRGB enable, along with front-panel recall/setup can be accessed through the Waveform Monitor Remote connector.

Available in NTSC, PAL, and PAL-M

Both the 1730 Series and the 1720 Series are available in either NTSC or PAL versions. The 1721 Vectorscope and the 1731 Waveform Monitor are the PAL versions.

The 1735 Waveform Monitor provides PAL/NTSC Dual Standard Monitoring. PAL-M instruments are available as a modified product.



NEW 1730 HD

High Definition Waveform Monitor.

FEATURES

- **HDTV Sweep Speeds**
- **Full 30 MHz Bandwidth**
- **Six Video Input Channels**
- **Parade and Overlay Displays**
- **Half Rack Width**
- **Complete Line Select**
- **10 ns/Division Sync Timing**
- **Accepts Tri-level Sync**
- **On Screen Readouts**

The Tektronix 1730 HD is multistandard, wide bandwidth, television waveform monitor developed in support of new generation *High Definition* television production and transmission systems. The familiar 1730 series operating system has been expanded to allow full High Definition waveform monitoring capabilities in camera, telecine, video tape and video transmission facilities.

Selectable Operating Formats

In addition to supporting the 1125 line/60 field High Definition production format, the 1730 HD also provides monitoring capabilities in 525 line/60 field and 625 line/50 field transmission standards. Sweeps are digitally derived and other High Definition line, field, and synchronizing formats may be ordered factory installed. The 1730 HD accepts tri-level or traditional bi-level synchronizing signals.

Multiple, Wideband Inputs

Six wide bandwidth input channels are provided for monitoring composite or component signals. New, SMD (Surface Mount Device) input amplifiers provide flat frequency response and excellent return loss characteristics through 30 MHz, permitting faithful display of High Definition video signals.

Input signal processing provides a choice of DC Restoration or an unclamped display. One signal may be displayed in a dual filter mode, with one line or field low pass filtered, and one unfiltered. Up to six inputs may be selected for simultaneous display, in specific combinations of side by side and overlay modes. When two or three different input signals are displayed, the second and third may be offset from the first to allow accurate comparison.

Accurate Timing Measurements

To facilitate timing measurements in the critical, High Definition environment, up to three signals may be presented side by side or overlaid. Calibrated timing is facilitated by a selectable horizontal magnifier. A direct 10 ns/division sweep permits measurements to 2 ns per minor graticule division for use with tri-level sync.

Full Line Select

Full frame line select, with on-screen readout of line number, is provided in each television line/field standard. The line to be displayed may be selected at the front panel and a predefined line may be easily recalled. The selected line is intensified in the field rate display and on the picture monitor output. A 14 line mode is also provided. A companion 1720 Series Vector Monitor may be connected to display a line selected (or full field) vector presentation in composite (NTSC or PAL) applications.

ORDERING INFORMATION

When ordering, please use the nomenclature given here. The standard instrument is configured for rack mounting and is shipped without a case, handle or cover. If your application is for bench or portable use, please order the appropriate enclosure from the optional accessories list.

The television operation standard, including line and field rate and sync type, must be specified at time of custom order quotation request. Contact your Tektronix sales office.

Please order appropriate optional accessories to configure for rack, bench, or portable use. The 1720, 1721, 1730, 1731, 1735 and 1730 HD are UL-recognized components and meet the requirements for listing when used in the appropriate enclosure.

1720 Vectorscope (NTSC System Applications) **$2,250**

1721 Vectorscope (PAL System Applications) **$2,250**

1730 Waveform Monitor (NTSC System Applications) **$2,250**

1730 HD High Definition Waveform Monitor. **$5,900**

1731 Waveform Monitor (PAL System Applications) **$2,250**

1735 Waveform Monitor (PAL/NTSC Dual Standard Applications) **$2,450**

PAL-M instruments are available as a modified product.

Portable DC Powered Applications 17XX (from above) plus 1700F10 DC Power Converter Kit, 1700F02 Portable Cabinet and BP1 Battery Pack. Battery charger not included.

OPTIONAL ACCESSORIES

Cabinets—
(Plain) Order 1700F00 **$60**
(Portable) Order 1700F02 **$85**

Side-By-Side Rack Mount—For mounting two half-rack instruments in a standard 19-inch rack. Order 1700F05 **$195**

Blank Panel Adapter—For the side-by-side rack mount. Order 1700F06 **$60**

Viewing Hood—For high ambient light environments. Order 016-0475-00 **$20**

Cameras—
(Regular) C-5C Option 02. **$465**
(Automatic) C-7 Option 03. **$580**

Battery Pack—Requires 1700F02 case, 1700F10 dc operation kit and battery charger. Order BP1 **$600**

DC Operation Kit—12 V dc. Order 1700F10 **$200**

For complete Television products information, request the Television Products Catalog.

1740 Waveform/Vector Monitors with optional carrying case and battery pack.

1740 Series Waveform/Vector Monitors

- **Two Instruments in One**
- **Optional DC Power Capability**
- **Bright CRT Display**
- **R-Y (V Axis) Mode**
- **VITS Monitoring**
- **RGB/YRGB Display Capability**
- **Remote Control Capability**
- **Available in NTSC, PAL, and PAL-M**

The 1740 Series provides all the basic waveform monitoring and vectorscope functions in a single, compact package. In addition, the 1740 Series adds dc power operation (optionally), single-line vertical interval display which is internally preset, an R-Y sweep mode for differential phase measurements, and remote control of waveform/vector mode and most of the front-panel sweep and vertical-amplifier response functions.

The 1740-Series monitors are half-rack width. They are intended for use where space, power consumption and/or portability are prime considerations and where simultaneous waveform and vector displays are not required.

Typical applications include video signal monitoring in VTR bridges, camera control units, production switcher consoles, and in field production units.

ORDERING INFORMATION

These instruments are configured for rack-mounting and are shipped without case or handle. Order appropriate options or optional accessories to configure for bench or portable use.

1740 Waveform/Vector Monitor (NTSC Applications) **$3,970**

1741 Waveform/Vector Monitor (PAL Applications) **$3,970**

1742 Waveform/Vector Monitor (PAL-M Applications) **$4,370**

OPTIONS

Option 05—Internal Waveform graticule, External Vector graticule. Standard with 1742. **+$60**

Option 07—Adds dc power operation capability, must be installed during manufacture. **+$200**

For portable operation—Order Option 07, BP1 Battery Pack and 1700F02 cabinet.

OPTIONAL ACCESSORIES

Battery Pack—Requires 1700F02 case to mount the BP1 to the 1740 or 1741. Order BP1. **$600**

Cabinet—Pained, no handle or feet. Order 1700F00. **$60**

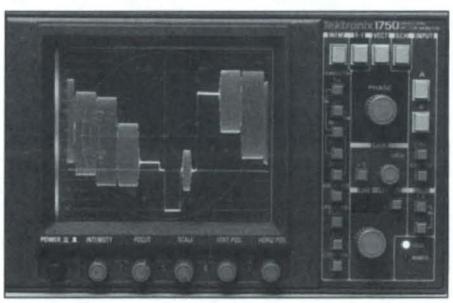
Cabinet—Pained, with handle and feet. Order 1700F02. **$85**

Side-By-Side Rack Mount—For mounting two half-rack instruments in a standard 19-inch rack. Order 1700F05. **$195**

Blank Panel—For one half of the side-by-side rack mount. Order 1700F06. **$60**

Viewing Hood—For high ambient light environments. Order 016-0475-00 **$20**

Camera—
C-5C Option 02. **$465**
Standard C-4. **$410**



1750 Waveform/Vector Monitor—Dual Filter/ Simultaneous Display.

1750 Series Waveform/Vector Monitors

- **SCH Phase Monitoring and Measurement**
- **R-Y (V Axis) Mode**
- **RGB/YRGB Mode**
- **Remote Control Capability**

The 1750 Series offers comprehensive monitoring and measurement of television signals, including SCH phase and color framing, in one compact unit. While similar in appearance to other 1700 Series instruments, the 1750 has enhanced performance in each of its operating modes.

The unique SCH phase display presents horizontal sync timing relative to reference subcarrier (burst) for verification of signal format and color framing. This mode enables easy analysis and monitoring of these important characteristics of the television signal; a task which previously required complex techniques, highly skilled operators, and/or additional instrumentation. The 1750's SCH phase and color frame displays are derived from the standard composite signals. No extra pulses or added signal details are required.

The 1750's SCH capability makes it particularly valuable in production and editing environments where maintenance of SCH phase and color frame are critical considerations. Applications include VTR bridges, camera control units, switcher consoles, master control, mobile and field production units, and maintenance operations supporting any of these areas.

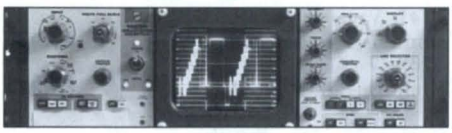
The 1750's half-rack package allows easy installation in environments where space and power requirements are important considerations. The 1750 is mechanically compatible with other 1700 Series Tektronix instruments.

ORDERING INFORMATION

These instruments are configured for rack-mounting and are shipped without cases or covers. Order appropriate optional accessories above to configure for rack, bench or portable use.

1750 Waveform/Vector Monitor (NTSC Applications) **$5,900**

1751 Waveform/Vector Monitor (PAL Applications) **$5,900**



1485R Option 01 PAL/NTSC Dual Standard Waveform Monitor (Rackmount).

1480 Series Waveform Monitors

- **Bright CRT Especially Suitable for Vertical Interval Testing**
- **Advanced Measurement Modes**
- **Amplitude Measurement Accuracy Approaching 0.2%**
- **Digital Selection of Line and Field**
- **Probe Input Option**
- **15-Line Display for VTR Applications**

Full feature capability for demanding video measurements in a range of applications

The 1480 Series was designed to meet the monitoring needs of CCU, VTR, control room, transmission facilities, transmitter and special systems with optimum accuracy, precision and performance. It features a variety of advanced measurement modes, amplitude measurement accuracy approaching 0.2%, and an exceptionally bright CRT that's especially suitable for vertical interval testing... bright enough for one vertical interval test signal selected out of four fields to be seen with ease even in a well lit area.

Digital selection of line and field assures positive identification of displayed information.

In addition to a 0.2% amplitude standard, the 1480 Series provides superior resolving power through calibrated five-times expansion of the vertical display, plus offset comparison and fine CRT spot size for making highly accurate amplitude measurements.

A unique overlay mode makes it possible to superimpose portions of waveform displays for exact, side-by-side comparison of levels.

A noise measurement kit is available for factory or field installation in rack mounting instruments only.

Among many additional features are a probe input option, AFC sweep synchronization, selectable filters, and 15-line display for VTR applications.

The 1480 Series is available in NTSC, PAL, PAL-M and NTSC/PAL Dual Standard versions.

Side by side (1480C) or rackmounting (1480R) configurations are available.

PHYSICAL CHARACTERISTICS

	1480C		1480R	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	216	8.5	482	19.0
Height	210	8.3	133	5.3
Depth	430	16.9	457	18.0
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	9.8	21.5	11.2	24.6
Shipping	24.1	53.1	24.1	53.1

ORDERING INFORMATION

1480C NTSC Waveform Monitor	**$6,300**
1480R NTSC Waveform Monitor	**$6,300**
1481C PAL Waveform Monitor*1	**$6,300**
1481R PAL Waveform Monitor*1	**$6,300**
1482R PAL-M Waveform Monitor	**$6,790**
1485C PAL/NTSC Dual Standard Waveform Monitor*1	**$6,500**
1485R PAL/NTSC Dual Standard Waveform Monitor*1	**$6,500**

OPTIONS

Option 01—1 MΩ, 20 pF Probe Input (not available with Option 06, probe not included). Suggested Probe: P6108A 10X, 2 m Probe; or 3 m Opt.03	**+$300**
Option 06—(1480R only) 124 Ω WECO Style Inputs.	**+$2,075**
Option 07—Slow Sweep*2 (Option 07 performance included with Option 06. Do not order with Option 06).	**+$510**
Option 08—(1481C, 1481R, 1485C and 1485R only) SECAM Field Identification.	**+$315**
1480F30 Noise Measurement Kit 1480R, 1481R, 1482R, 1485R only.	**$600**

*1 *1481C/R, 1485C/R meets European Broadcast Union Tech. 3221-E, Guiding Principles for design of Television Waveform Monitors.*

*2 *Option 07 satisfies EBA Tech 3321-E § 3.2.2.*

NEW TPG-625

Television Pattern Generator

- **PAL Television Receiver Test Pattern**
- **Color Monitor and Receiver Testing**
- **Programmable Character Identification**
- **Ten Bit Digital Generation**
- **Digital Genlock**
- **Black Burst Outputs**

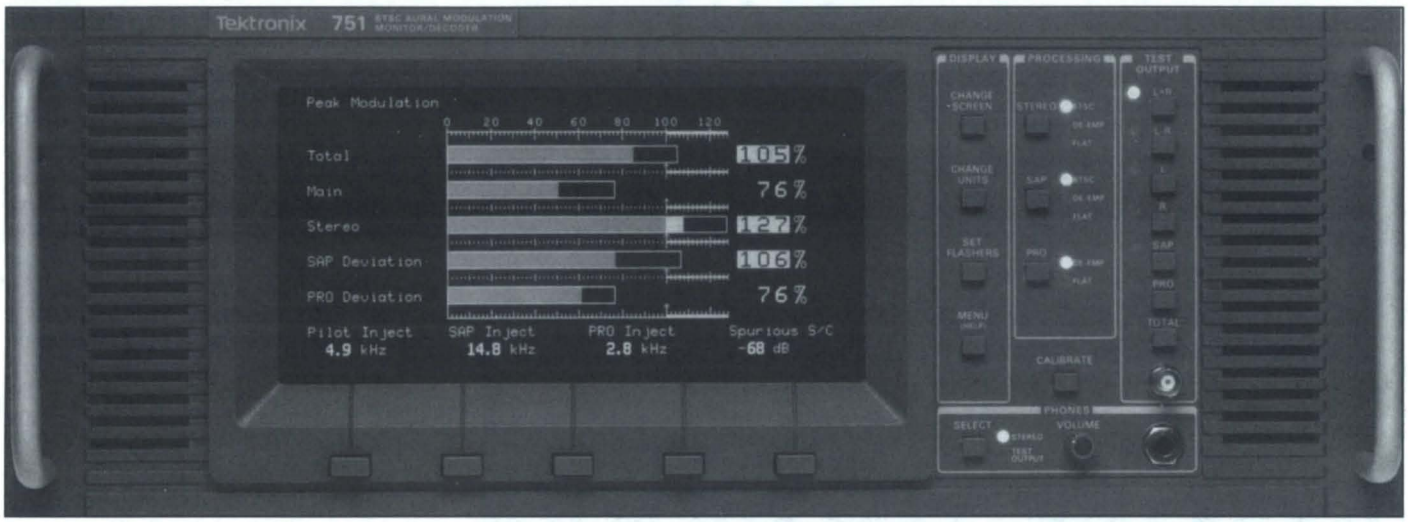
The TPG-625 is a test pattern generator for the PAL color television system. The TPG-625 pattern contains the elements needed to perform a comprehensive visual check of both the monochrome and color aspects of color monitor and television receiver performance. In addition, the TPG-625 provides text insertion in two areas of the pattern for source identification. This facility is useful for broadcast and cable system transmission during non-program hours.

The TPG-625 uses 10 bit 4 F sc digital signal generation. All elements of the pattern are stored in memory. This architecture, coupled with a precision 12 bit D to A converter, provides a high degree of accuracy with superior long term stability.

ORDERING INFORMATION

TPG-625 Pattern Generator	**$7,500**

For complete Television products information, request the Television Products Catalog.



751 BTSC Aural Modulation Monitor/Decoder.

751

BTSC Aural Modulation Monitor/Decoder

- **Precision Modulation Monitor for Entire BTSC Sound Channel**
- **Simultaneously Displays All Components Necessary to Assure Modulation Remains Within Legal Limits**
- **Bars Feature Peak Indicators With Timed Peak Hold and Easily Set Peak Limits**
- **Digital Readout Accompanies Each Bar for Accurate Setups**
- **Alternate Display of Processed Audio Levels for Left, Right, Sum, Difference, SAP and PRO**
- **Electroluminescent Bar Graph Display With Precisely Controlled Dynamics**
- **Internal Auto-Calibrator Assures Accurate Modulation Measurements**

The 751 BTSC Aural Modulation Monitor/Decoder provides accurate modulation monitoring and measurement of the BTSC encoded TV sound channel.

The 751 comes ready to monitor the entire BTSC sound channel, including SAP and PRO. Should the needs of your station change, a simple key sequence on the front panel can add or delete SAP or PRO from the display.

Two sets of parameters, peak modulation and processed audio, can be alternately displayed by a simple front panel selection.

Bar graph and digital readout units of measure can be changed from % of maximum to kHz deviation or dB with the simple push of a button.

Also displayed are injection levels for SAP, PRO, and Stereo Pilot, as well as the level of Spurious Stereo Subcarrier.

Instantaneous peak values as well as "held" peak values are displayed as calibrated bars. Each bar is accompanied by a digital readout that corresponds to the "held" peak value. The bar and readout both indicate when an easily set peak limit has been exceeded.

Processing is front-panel selected from Expand, De-emphasis, and Flat. A monitor output is provided on both the front and rear panels for external measurements of the Left and Right stereo channels, SUM, DIFF, SAP, and PRO. A switchable headphone output is also located on the front panel.

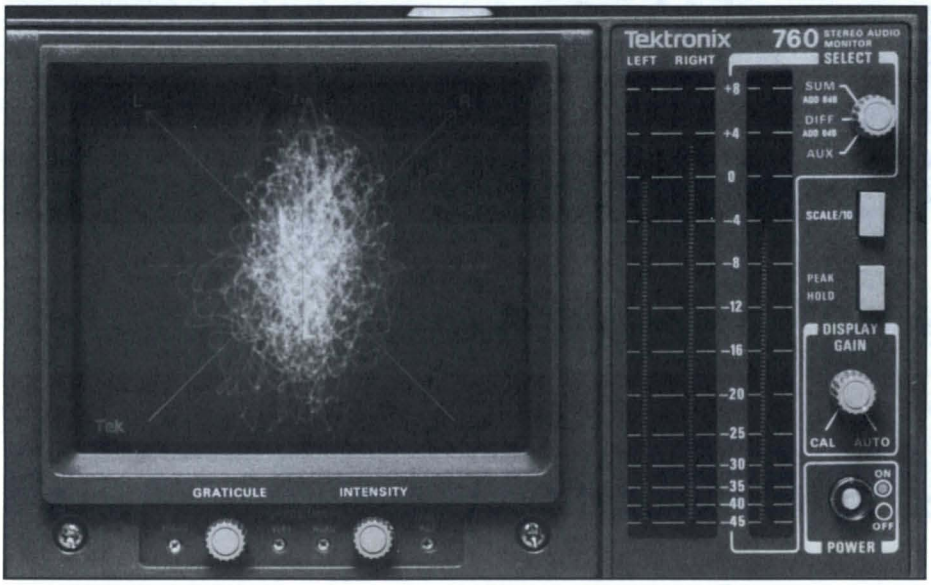
Precisely decoded Left and Right stereo channels, SAP, and PRO 600 Ω balanced-line outputs are provided on the rear panel through XLR connectors.

Remote alarm contact closures for No Pilot, Pilot/Sync Unlock and (stereo) Phase/Inverted are provided on the rear panel through a 9-pin D sub-miniature connector. Alarm conditions are also indicated on the display. H sync for measuring Pilot Phase Lock is obtained via the rear panel Composite Video loop-through connector.

The 751 is a 178 mm (7 inch) high, full-rack-width instrument that weighs approximately 13.5 kg (30 lb).

ORDERING INFORMATION

751 BTSC Aural Modulation Monitor/Decoder **$12,000**



760 Stereo Audio Monitor.

760 Stereo Audio Monitor

- **Graphic CRT Display of Stereo Audio Signal**
- **AGC for Continuously Viewable Pattern**
- **Bar Graph for Quick Setups and Accurate Peak Indication**
- **Third Bar Indicates Monaural Levels When Set to SUM**
- **Suitable for Phase and Amplitude Measurements**

With Tektronix' 760 Stereo Audio Monitor, the audio engineer can analyze a pattern display of the stereo audio signal. This display, along with a high-resolution bar graph, provides accurate monitoring and measurement capabilities. Used in both operation and setup, the instrument provides immediate feedback of the audio signal for creative or technical correction. With the appropriate test signals, the unit can also be used for accurate phase and amplitude measurements. On the CRT and adjacent bar graph, you can observe amplitude information, stereo separation, and phase correlation between the Left and Right channels. Also of great importance, you can see monaural amplitudes resulting from the stereo channels.

Your choice of automatic or manual gain control provides flexible control of the pattern size. With no input signal, the display will dim to prolong CRT life.

Two calibrated bars are dedicated to the Left and Right channels. The input to a third bar is selectable from Sum, Difference (both internally derived), and an Auxiliary input on the rear panel. These bars give the operator accurate level indicators featuring a three-second "peak hold" that makes level monitoring easier than ever.

The 760 is ideally suited for use in editing suites, master control, transmission, and any other locations where monitoring the stereo audio signal is a must.

ORDERING INFORMATION

These instruments are configured for rack-mounting and are shipped without cases or covers. Order appropriate optional accessories to configure for rack, bench or portable use. The 760 is a UL recognized component and meets the requirements for listing when used in the appropriate enclosure.

760 Stereo Audio Monitor **$1,990**

Portable Dc Powered Applications

760 Stereo Audio Monitor plus 1700F10 Dc Power Converter, 1700F02 Portable Cabinet, and BP1 Battery Pack.

AVC-20 Audio Vector Converter.

AVC-20 Audio Vector Converter

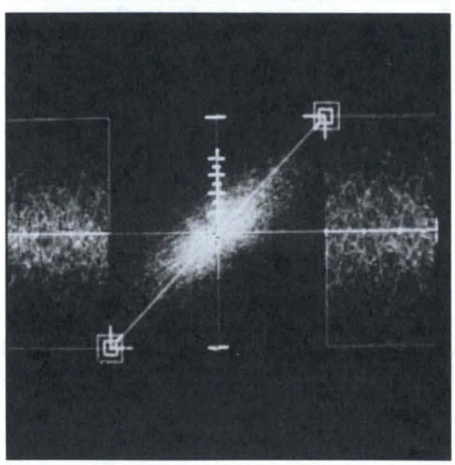
- **For Any NTSC Vectorscope**
- **Balanced Line Level Inputs**
- **Time Code or Third Channel Input**
  - **Field Locked for Time Code Phase**
- **User-Selectable Display Formats**
  - **Lissajous Pattern with Calibrated Amplitude**
  - **Lissajou Pattern and Sweep Displays of Both Channels**
- **Time Versus Amplitude Sweep Display**
  - **Selectable Between All Three Inputs**
  - **Left Plus Right Sweep**
- **Low Power Consumption**
- **Cost Effective**
- **No Front-Panel Space Required**
- **Simple Remote Control**

The AVC-20 provides stereo audio monitoring capability when installed with an NTSC vectorscope. Complete audio monitoring can be added to VTR bridges, master control consoles, and other locations requiring stereo audio monitoring without modifying the vectorscope and without using front-panel space. Stereo phase, individual signal amplitudes, and audio distortions can be observed by simply using the B input to an existing vectorscope. A third audio input channel and a field-locked sweep are available for monitoring time code or a second-language program.

The Tektronix AVC-20 is easy to operate, install, and afford. It's an excellent choice for stereo television facilities.

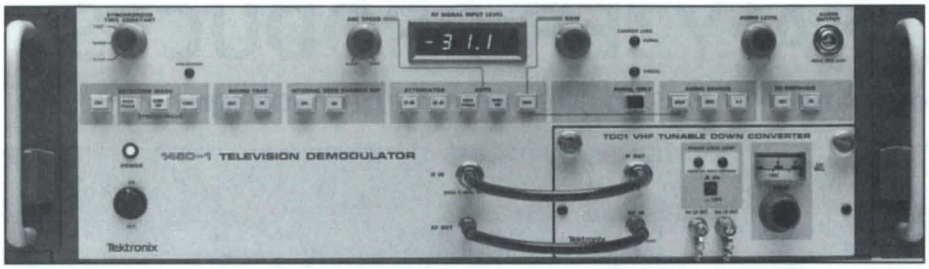
ORDERING INFORMATION

AVC-20 Audio Vector Converter **$495**



Live audio, left and right channels, time versus amplitude sweep display, and Lissajous pattern (center) with correct stereo phase.

For complete Television products information, request the Television Products Catalog.



The 1450-1 is compatible with System M Television Transmission, the 1450-2 is compatible with System B/G, and the 1450-3 is compatible with System I.

1450-1/1450-2/ 1450-3

Television Demodulators

- **Measurement-Quality Performance for Negligible Distortion**
- **Synchronous Detection Eliminates Quadrature Distortion**
- **Envelope Detection for Accurately Determined Differential Phase**
- **Surface Acoustic Wave Filter Provides Precise Nyquist Slope; Excellent Long and Short-Term Stability**
- **Digital Readout of Input Power Level for Easy, Accurate Field Strength Readings**
- **Constant-Bandpass Characteristics Over Wide Dynamic Range**
- **Any Single VHF or UHF Channel Operation**
- **UHF and VHF Tunable Down Converters**

The 1450-1 (System M), 1450-2 (System B/G) and 1450-3 (System I) demodulator mainframes are combined with a Tektronix Television Down Converter (TDC) to provide an accurate link between your transmitter's RF signals and video baseband measuring equipment.

ORDERING INFORMATION

SYSTEM M

1450-1 Television Demodulator (Order one Vision IF option) **$14,900**

OPTIONS

Option 01—37 MHz Vision IF. **NC**
Option 02—38.9 MHz Vision IF. **NC**
Option 03—45.75 MHz Vision IF. **NC**

For demodulation of RF signals, one of the following three down converters must be plugged into the 1450-1 mainframe. Order one Vision IF option and either Option 11 or Option 14.

TDC Fixed Channel Down Converter. Stipulate channel number when ordering. **$4,100**
TDC-1 Tunable Down Converter VHF Band. **$7,660**
TDC-2 Tunable Down Converter UHF Band. **$7,660**
Option 01—37 MHz Vision IF. **NC**
Option 02—38.9 MHz Vision IF. **NC**
Option 03—45.75 MHz Vision IF. **NC**
Option 11—System M Countries.* **NC**
Option 14—Japan and Okinawa. **NC**

FIELD UPGRADE KIT

For upgrading 1450-1 (S/N BO19999 and below) to provide a wide band audio output suitable for use with BTSC System multichannel sound in the U.S. and with stereo sound in Japan.
1450F20—Field Upgrade Kit **$2,150**

* *Except Japan and Okinawa.*

1430 Random Noise Measuring Set

1430 Random Noise Measuring Set

- **Conforms to CCIR Recommendation 568**
- **In-Service Testing**
- **Out-of-Service Testing**
- **Program Material Protected by Fail-Safe Provisions**
- **525/60 or 625/50 Standards**

ORDERING INFORMATION

1430 Random Noise Measuring Set (525/60). **$4,115**
Option 01—Random Noise Measuring Set (625/50). **+$85**

ORDERING INFORMATION

SYSTEM B/G

1450-2 Television Demodulator (Order both Option 02 and Option 09) **$13,145**

OPTIONS

Option 02—38.9 MHz Vision IF. **NC**
Option 09—+90ns/170 ns Group Delay. **NC**

For demodulation of RF signals, one of the following three down converters must be plugged into the 1450-2 mainframe. Order both Option 02 and Option 12.

TDC Fixed Channel Down Converter. Stipulate channel number when ordering. **$4,100**
TDC-1 Tunable Down Converter VHF Band. **$7,660**
TDC-2 Tunable Down Converter UHF Band. **$7,660**
Option 02—38.9 MHz Vision IF. **NC**
Option 12—System B/G/I countries. **NC**

ORDERING INFORMATION

SYSTEM I

1450-3 Television Demodulator (Order Option 02) **$13,145**

OPTION

Option 02—38.9 MHz Vision IF. **NC**

For demodulation of RF signals, one of the following three down converters must be plugged into the 1450-3 mainframe. Order both Option 02 and Option 12.

TDC Fixed Channel Down Converter. Stipulate channel number when ordering. **$4,100**
TDC-1 Tunable Down Converter VHF Band. **$7,600**
TDC-2 Tunable Down Converter UHF Band. **$7,600**
Option 02—38.9 MHz Vision IF. **NC**
Option 12—System B/G/I Countries. **NC**

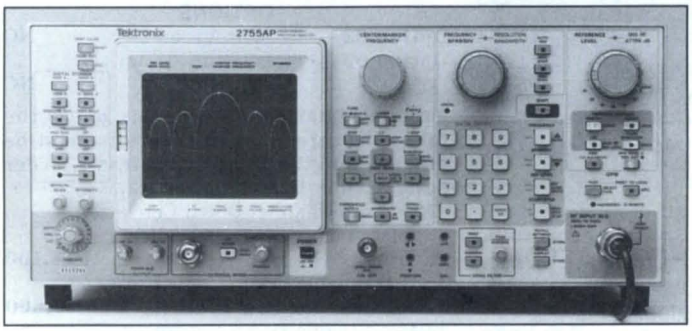
ORDERING INFORMATION

SYSTEMS D AND K

1450 Series Television Demodulators and Down Converters with modifications. Contact Tektronix for quote.

SPECTRUM ANALYZER PRODUCTS

Spectrum Analyzers And PC Based Measurement Packages



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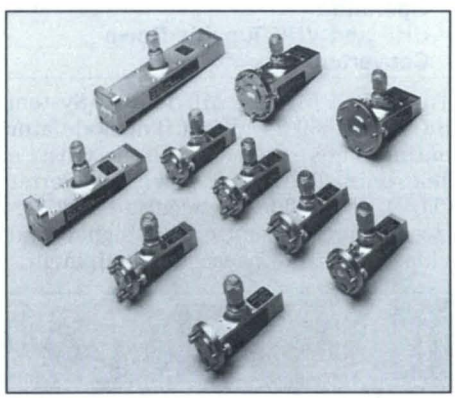


WM490 Series Waveguide Mixers

SPECTRUM ANALYZER PRODUCT SELECTION GUIDE

DIGITAL SPECTRUM ANALYZERS

Model	Frequency Range	Displayed Bins	Signal Resolution	Reference Level Range	Sensitivity	A/D Converter	Amplitude Accuracy	Center Freq & Marker Accuracy	Interface	Page
3052	Center Frequency Range DC to 10 MHz. Frequency Spans: 1 kHz to 2 MHz (Real Time); 5 to 10 MHz (Batch). 1024 pt complex conversion every 200 μs (max).	800 (1024 Real and 1024 Imaginary are calculated)	≤3 bin widths (also holds for one signal at reference level and the other at ≤70 dBc)	+33 to −140 dB	−150 dBm/Hz (7 nV√Hz at 100 kHz) 1/f noise corner at 20 kHz	25.6 MS/s 10 bits	±0.2 dB at 12.5 kHz ±0.5 dB at all frequencies, with error correction	≤1×10⁻⁹ per day and ≤1×10⁻⁷ per year of value displayed	RS232 standard GPIB optional	94
2630	Frequency: 5 Hz to 10 kHz (RealTime); 20 kHz (Batch).	25 to 1600	0.006 to 800 Hz (selectable)	Selectable	55 mV to 10 V full scale	51.2 kHz 12 bits	±0.2 dB	0.01%	RS232	96

MICROWAVE SPECTRUM ANALYZERS

Model	Counter	Frequency Range: Coaxial Input	Frequency Range: w/Exter. Mixers	Frequency Accuracy	Ref Accuracy	Resolution Bandwidth	Average Noise Level (Min RBW)	Amplitude Meas. Range	GPIB	Config.	Page
2756P	Y	10 kHz to 21 GHz	325 GHz	Freq X Ref Accuracy +0.2 X (Span/div or Resolution Bandwidth) +(2N+25) Hz	10^{-9}/day 10^{-7}/year	10 Hz min to 3 GHz max	−131 dBm	+30 dBm to −131 dBm	Yes	Lab	106
494AP	Y								Yes	Portable	116
NEW 2755AP	Y				5×10^{-7}/year 10^{-6} @ 25°C within 30 minutes	100 Hz min to 3 MHz max	−120 dBm	+30 dBm to −120 dBm	Yes	Lab	108
NEW 492BP	Y								Yes	Portable	118
2754	N	50 kHz to 21 GHz	N/A		10^{-5}	1 kHz min to 1 MHz max	−110 dBm	+30 dBm to −110 dBm	Plot	Lab	110
2754P	N								Yes		110

VHF/UHF SPECTRUM ANALYZERS

2753P	Y	100 Hz to 1800 MHz	Freq X Ref Accuracy +0.2 X (Span/div or Resolution Bandwidth) +15 Hz	10^{-9} /day 10^{-7} /year	10 Hz min to 3 MHz max	−131 dBm	+30 dBm to −131 dBm	Yes	Lab	112
495	Y			10^{-9} /day 10^{-7} /year				Plot	Portable	120
495P	Y							Yes		120
2710	*1	10 kHz to 1800 MHz	Freq X Ref Accuracy ±5 kHz without counter; ±10 Hz with counter	3×10^{-6}/year typical	3 kHz min to 5 MHz max	−117 dBm −129 with preamp	+20 dBm to −129 dBm	*2	Portable	122
Opt 01			Freq X Ref Accuracy ±700 Hz without counter; ±10 Hz with counter	2×10^{-6}/year typical	300 Hz min to 5 MHz max	−127 dBm −139 with preamp	+20 dBm to −139 dBm			122

*1 *With Option 02.* *2 *Centronics plot option.*

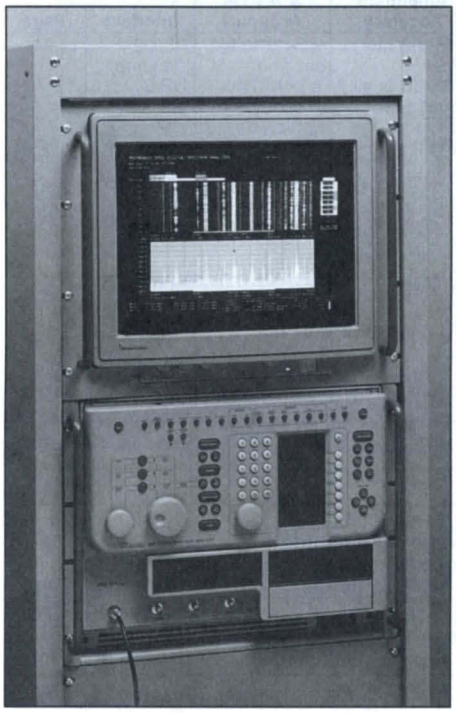
LOW FREQUENCY ANALYZER

7L5 with L3	N	20 Hz to 5 MHz	Freq X Ref Accuracy ±5 Hz	2×10^{-6}	10 Hz min 30 kHz max	−135 dBm (−148 dBV)	+21 dBm −135 dBm	No	7K Series Plug-in	124

SPECTRUM ANALYZER SOFTWARE

Software Package	Function	Language	Host	Instrument	Page
GRASP Applications Software: S26RF00	High level menu operated: • Measurements • Waveform Operations • Filter Tests • Utilities • Signal Searches	IBM Advanced Basica 2.1 or higher Tek 4041 Basic HP Basic 3.0	IBM Compatibles, Tek 4041, HP 200 Series	All 275xP and 49xP	126
EMI Prequalification Software: S26EM00	FCC/VDE Conducted or Radiated Mil-Std 461B/462 Conducted and Radiated	IBM Compiled Basic 2.0	IBM Compatibles	Depends on test being run	126
Remote Site Monitoring: S26RM00 Host/Operators S26RM01 Remote Site	Monitor/Control/Acquire waveforms from multiple remote spectrum analyzers via modems/GPIB interfaces	IBM Basica 2.1 or higher	IBM Compatibles	All 275xP and 49xP	127

FASTEST REAL TIME BANDWIDTH—2 MHz



NEW 3052
Digital Spectrum Analyzer

TYPICAL APPLICATIONS

- **Communications**
- **Signal Analysis**
- **Radar Signal Processing**
- **Telephony**

BENEFITS

- **Wide Real Time Bandwidth Captures Elusive Spectral Transients**
- **Digital Interface Transfers Data Quickly (Option 10)**
- **System Flexibility Through Use of Industry Standards**

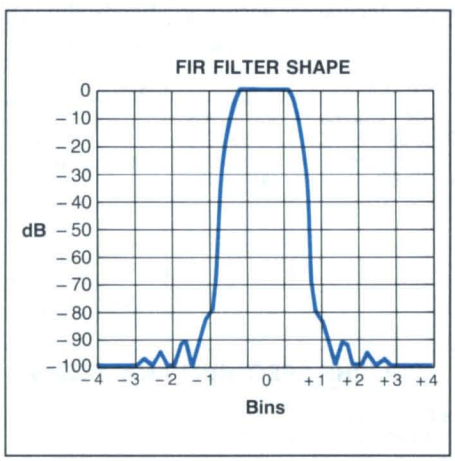
FEATURES

- **Real Time Output in Spans to 2 MHz**
- **Bank of 1024 Complex Bandpass Filters Outputs Spectral Frames at Real Time Rates: Every 200 μs in 2 MHz Span**
- **800 Frequency Bins Displayed in All Spans. Resolves Signals Three Bins Apart. 1.25 Hz Minimum Marker Resolution**
- **Spans From 1 KHz to 10 MHz, with Center Frequency Tunable Across the DC to 10 MHz Range**
- **Trigger and Capture 500 Sequential Spectrums at Real Time Rates and Scroll the Captured Block**

The 3052 Digital Spectrum Analyzer introduces nearly a hundred-fold speed improvement. It performs real time spectrum analysis at much wider frequency spans, which opens the way to solve difficult measurement and analysis problems. At 2 MHz, its widest real time span, the 3052 updates its spectral output every 200 μs.

Spectral frames are the output of a digitally implemented bank of 1024 parallel bandpass filters. The output of each filter consists of both real and imaginary data components.

Filter Bank. The shape of each filter is the key to several of the 3052's performance characteristics: frequency flatness, amplitude accuracy, spectral resolution, dynamic range, sensitivity, and the suitability of its digital output (Option 10) for post processing.



The center frequency of the filter bank is tunable, enabling any frequency within the 10 MHz range of the instrument to be viewed at narrow spans.

Display. The 3052 display is a high resolution, 16 inch, color monitor that displays 800 frequency bins*1. The displays include power vs frequency, phase vs frequency, spectrogram and waterfall. One display can occupy the full screen, or two can be presented on a split screen. At wider spans, the spectral frame rate of the filter bank exceeds the update rate of the display. To display as much of the filter bank's spectral output as possible at wide spans, the data is automatically formatted by use of one of the following signal processing selections: Average, Peak, Min/Max and R^{th}, where R is the output number of frames from the filter bank for each one displayed. For more general signal processing, R can be manually set to values in the range 1 to 1024 for signal averaging, and 1 to 65535 under the other three signal processing selections.

Front Panel. Knobs provide quick operation of basic spectrum analyzer controls. In addition, a liquid crystal display presents menus of more extensive functions, and prompts the entry of parameters. The front panel is also detachable for flexibility in positioning and handling.

Block Capture Mode. A block of 500 sequential spectral frames is transferred to memory. The block is then transferred to the monitor for display in the spectragram mode.

With this mode, a user can trigger on a spectral event, capture 500 sequential frames, then scroll back and examine the captured block frame by frame.

System Architecture and Software. The system architecture is based upon the VMEbus. Cards comprising the main part of the instrument are "pipelined" to a stage that links with the standard VMEbus. The instrument software operates under the SYSTEM V/68*2 version of UNIX*3. Instrument controls and functions are implemented in C language and card-modular firmware. Programmers have access to selected UNIX and C libraries for the development of application programs via an RS232 port.

Real Time Interface (Option 10). This optional interface provides access to real-time spectral data output: 32-bit spectral data is divided into two parts, available at two separate RS422 connectors. Data format selections are: 1) Real and Imaginary, 2) Power (dB) and Phase, 3) Voltage Magnitude and Phase; and 4) Power (linear) and Phase.

Option 10 also provides a Spectral Event Detect output. Two spectral limit masks can be set up: a maximum and a minimum. When the spectral output is outside one of these limits, a TTL low accompanies the data to identify the spectral frame and bin.

Analog outputs to drive an oscillographic recorder, an x-y monitor or an oscilloscope are provided as part of the Option 10.

*1 *A bin is a hardware storage location for the complex data output of each filter in the bank. Each spectral frame is comprised of the parallel outputs from the 1024 bins. The central 800 bins are displayed, and cover the selected span of the 3052. Each bin is considered to have a width of 1/800th of the displayed span. (All 1024 bins are accessable with Option 10.)*

*2 *SYSTEM V/68 is a trademark of Motorola.*

*3 *UNIX is a trademark of AT&T.*

CHARACTERISTICS

FREQUENCY RELATED

Range—DC to 10 MHz.
Span—1 kHz to 10 MHz in a 1,2,5 sequence.
Resolution Passband (FIR Filter 0.05 dB Bandwidth)—Span+800.
Shape Factor (Ratio of FIR Filter 3 dB to 60 dB Bandwidths)—<1.7.
Center Frequency Setability—Tuning increments are finer than one bin width in spans below 10 MHz. In 10 MHz span, the center frequency is fixed at 5 MHz (see table below).
Displayed Bins—800 for all spans.

Display Update Rate[*2]—Amplitude/Frequency plot: ≤50 ms, typical. Spectragram plot: 16 ms/row, typical.

MODES

Display Format—Average, Min/Max, Peak, R^{th}, Block Capture.
Vertical Display—1 dB/div, 2 dB/div, 5 dB/div, 10 dB/div, Linear; 1–15 dB/div (keyboard definable).
Display Range—10 divisions.

INPUT TRIGGERING AND ACQUISITION START/STOP

Sources—Internal, External, Line, Free Run.

Span-Related Characteristics

Span	Processing Mode	Resolution Passband	Spectral Frame Output Interval	Sensitivity, at 100 kHz	
				dBm	dBv
10 MHz	Batch	12.5 KHz	200 μs	−107	−120
5 MHz	Batch	6.25 KHz	200 μs	−110	−123
2 MHz	Real Time	2.50 KHz	200 μs	−114	−127
1 MHz	Real Time	1.25 KHz	400 μs	−117	−130
500 KHz	Real Time	625 Hz	800 μs	−120	−133
200 KHz	Real Time	250 Hz	2 ms	−124	−137
100 KHz	Real Time	125 Hz	4 ms	−127	−140
50 KHz	Real Time	62.5 Hz	8 ms	−130	−143
20 KHz	Real Time	25.0 Hz	20 ms	−134	−147
10 KHz	Real Time	12.5 Hz	40 ms	−137	−150
5 KHz	Real Time	6.25 Hz	80 ms	−140	−153
2 KHz	Real Time	2.50 Hz	200 ms	−144	−157
1 KHz	Real Time	1.25 Hz	400 ms	−147	−160

Bin Width—Span+800 (see table).
Center Frequency and Marker Accuracy—$\leq 1\times10^{-9}$ per day and $\leq 1\times10^{-7}$ per year of value displayed.
Frequency Resolution With FIR Filter—≤3 bin widths (also holds for one signal at Reference Level and the other at ≤70 dBc).

AMPLITUDE RELATED[*1]

Reference Level Range—+33 to −140 dBm.
Accuracy—±0.2 at 12.5 kHz; ±0.5 dB at all frequencies, with error correction.
Flatness Across Span—±0.85 dB normalized to 12.5 kHz; ±0.33 dB, with error correction.
Marker Resolution—0.03 dB.
Display Dynamic Range—110 dB.
Sensitivity—−150 dBm/Hz ($7nv\sqrt{Hz}$) at 100 kHz. 1/f noise corner at 20 kHz. (See table above).
Aliased Products—≥80 dBc.
A/D Converter—25.6 mega-samples/per second, 10 bits.
Maximum Input Range—+33 to −57 dBm. Note: Signals above the Maximum Input Level are clipped by the A/D Converter.
Harmonic Distortion (with signal 6 dB below maximum input)—DC to 1 MHz: 65 dBc; 1 MHz to 10 MHz: 58 dBc.
IM Distortion (2nd and 3rd order, with two signals 6 dB below maximum input—
DC to 1 MHz: 65 dBc;
1 MHz to 10 MHz: 60 dBc.
Residual Responses—≥80 dB below maximum input.
Zero Frequency Spur—DC coupled: 10 dB below Max Input.
AC coupled: 40 dB below Max Input.

Continuous Modes—One spectral frame output from the filter bank. Automatic rearm after hold-off of 12 times the frame update interval.
Single Frame Mode—One spectral frame output from the filter bank. Manual rearm from front panel.
Start—Indefinite number of frames output from the filter bank.
Positioning—Trigger sample can be positioned in the time domain data window for first spectral frame.
Acquisition Start/Stop Mode—External control line turns on/off spectral output from the filter bank via trigger connector. START begins acquisition data for first frame. Final frame is the one completed prior to receipt of STOP.

CLOCK

Internal Reference—Frequency: 10 MHz; Frequency Drift: 1 part/billion/day, 100 parts/billion/year.
External Reference—1 MHz, ±200 Hz; 5 MHz, ±1 kHz; 10 MHz, ±2 kHz.
Loop Bandwidth—1 kHz.

DISPLAY MONITOR

Pixel Resolution—1024 by 768.
Refresh Rate—60 Hz non-interlaced.
Displayable Colors—256 concurrent.
Size—16 inch.

INPUT/OUTPUT

Analog/Digital Converter Auxiliary I/O—12 bit digital signal input, bypassing the analog front end.
Digital Down Converter Output/Filter Bank Input—16-bit heterodyned and filtered time domain signal data output. 16-bit direct input to filter bank.
Real Time Output—Option 10.
RS232 Port—2 ports, one DTE and one DCE.

SIGNAL INPUT

Coupling—(AC and DC) AC: −3 dB at 10 Hz.
Impedance—50 Ω, 1 MΩ.
Maximum Rated Input—50-Ohm: 5 Vrms (+27 dBm) 1 Megohm: 500 V dc, 17 Vrms ac (+25 dBv).

POWER REQUIREMENTS[*1]

Line Frequency—47–63 Hz.
Line Voltage—90–132 V AC, 180–264 V AC.
Input Power—800 Watts (typical).

ENVIRONMENTAL[*1]

Altitude—Operating: 10,000 ft. Nonoperating: 15,000 ft.
Temperature—Operating: 5–40 °C. Nonoperating: −20 to +60 °C.
Relative Humidity—Noncondensing: 5 to 95% over a temperature range of 10 to 30 °C.
Shock—Operating: 10 G (except disks: 5 G). Nonoperating: 10 G.
Vibration—Operating and nonoperating: 2 G (except disks).
EMI—Complies with FCC 20780, Part 15, Sub Part J, Class A.

Physical Characteristics

Dimensions	mm	in.
Width	483	19.00
Height	756	29-75
Depth	629	24.75
Weight	**kg**	**lb**
Net	463	210

ORDERING INFORMATION

3052 Digital Spectrum Analyzer **$75,000**
Includes: Operators manual; maintenance manual; and operators guide.

OPTIONS

Option 01—GPIB (IEEE-488.2) Interface. Functions as a "listener/talker." **+$1,995**
Includes: VME board and driver software.
Option 10—Real-Time Interface **+$9,500**
Includes: Two RS422 compatible digital data outputs; Spectral Event Detect output; and analog outputs for Tek 608 monitor, oscilloscope and oscillographic recorder.
Option 11—Compatibility with Tektronix 4696 Color Ink-Jet Printer. **+$1,495**
Includes: parallel printer port, cable and driver software.

INTERNATIONAL POWER PLUG OPTIONS

A1—Universal Euro 220 V/16 A, 50 Hz.
A2—UK 240 V/13 A, 50 Hz.
A3—Australian 240 V/10 A, 50 Hz.

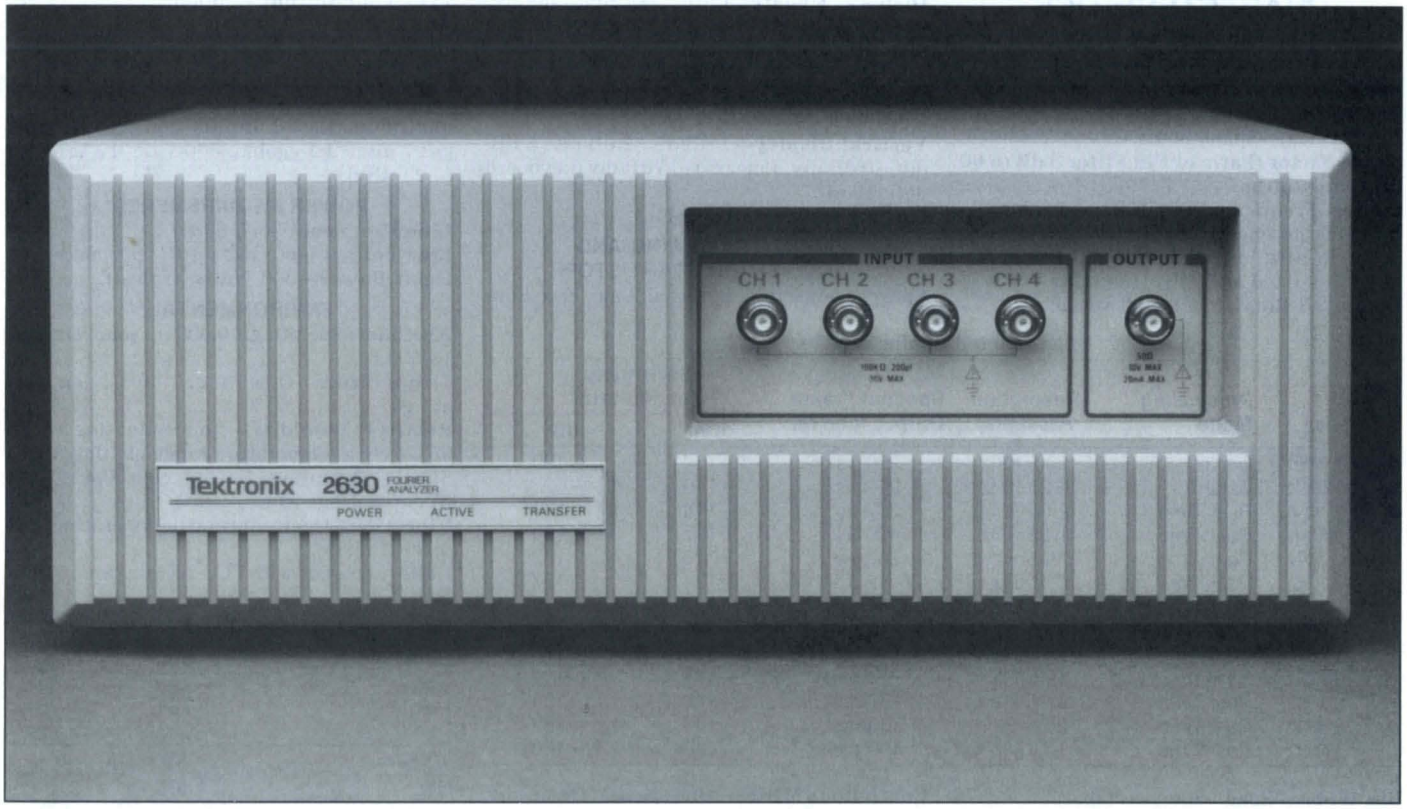
OPTIONAL ACCESSORIES

P6134—10X, 10 MΩ passive probe. **$170**
Rack—Order 437-0398-00. **$1,500**

WARRANTY

On-site 90 days part and labor.

[*1] *The specifications in this section are preliminary and subject to change.*
[*2] *No markers, single waveform.*



NEW 2630 Fourier Analyzer: complete spectrum, network, and waveform analysis from dc to 20 kHz.

NEW 2630 Fourier Analyzer

TYPICAL APPLICATIONS

- Structural Analysis
- Control Systems
- Machine Vibration
- Audio and Acoustic Tests
- General Purpose Signal and System Analysis

BENEFITS

- Spectrum Analysis, Network Analysis, and Waveform Recording for Complete Signal and System Analysis
- Easy-To-Learn User Interface Requires Minimum Operator Training
- Completely Programmable for Fast, Accurate, and Repeatable Production Testing

FEATURES

- 2 or 4 Channels
- DC to 20 kHz Frequency Range
- 10 kHz Realtime Bandwidth
- 75 dB Dynamic Range
- Full Alias Protection
- Works With Any IBM PC™ or Compatible
- Zoom Capability (Options 2H & 3H)
- Programmable Source (Option 4H)
- Extensive Programming Library for Developing Custom Measurements and Displays (Option 2S)

The 2630 Fourier Analyzer represents a new generation signal analyzer that links the power of high-performance dedicated signal acquisition and analysis with the value of PC mass storage and graphics. The result is a high-quality, cost-effective measurement solution for electrical, mechanical, and electromechanical applications in the DC to 20 kHz frequency range.

Measurement Power When You Need It—Where You Need It

When you run the 2630's "IP" application program, the PC and its peripherals become the display, mass storage, keyboard, and hardcopy devices of a highly integrated signal analysis system. Measurement setups are entered quickly and easily from the PC using an instrument style user interface provided by the IP program. The PC's monitor also displays the 2630's measurements results—but that's where the 2630's dependance on the PC stops. All of the data acquisition, data management, signal processing and other computationally intensive operations are reserved for the 2630's high-performance measurement and analysis hardware.

Connected to the PEP 301 System Controller, the 2630 forms a powerful signal analysis workstation.

And the 2630 is well equipped to handle the toughest measurement problems. A full 12-bit A/D in each input channel (up to 4) provides accurate waveform recording and a full 75 dB dynamic range free of spurs and distortion products. Simultaneous sampling on all channels provides accurate gain and phase data within ±0.2 dB and ±2 degrees. When the measurement situation requires that large amounts of data be recorded for

for later analysis, the 2630's optional parallel interface allows A/D data to be stored directly to the PC's hard disk. The data can then be played back into the 2630 at any time and analyzed using the 2630's wide variety of analysis functions.

For accurate frequency domain measurements, built-in analog and digital antialias filters automatically track all of the 2630's bandwidth settings from 5 Hz to 20 kHz. A selection of frame sizes from 64 to 4096 samples allow you to choose the best trade-off between acquisition time and frequency resolution for your particular application. When high frequency resolution around a specific signal is needed, the optional "zoom" feature is the solution. It allows you to focus up to 1600 spectral lines within a span as small as 10 Hz about the frequency of interest. The result is detailed analysis with a resolution of up to 0.00625 Hz!

But measurement performance also means signal processing speed and the 2630 is at the top of its class. It performs a 1024 point FFT in 28 milliseconds. Even more important, the 2630 supports that level of performance right through to the averaging process to provide a 10 kHz realtime bandwidth. That's the kind of performance typically reserved for analyzers costing two to three times more.

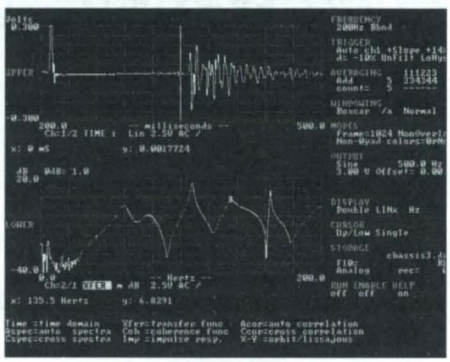
Complete Time and Frequency Domain Analysis

All of the key analysis functions are built into the 2630, and are easily selectable from the on-screen display. A few menu-driven keystrokes is all it takes to apply any of the 2630's powerful built-in features. Standard analysis functions include: transfer function (frequency response), auto and cross spectra, coherence, impulse response, as well as auto and cross correlation measurements. No programming is needed.

Time-domain data can also be analyzed with the Tektronix 2630 Fourier Analyzer. Up to four graphs on the screen allows signals in all four channels to be monitored simultaneously. Triggering is easy too. Selectable threshold, slope, and hysteresis allow signals acquisitions to be triggered on a variety of waveform conditions. Triggering can also be used to capture exactly the portion of the signal desired.

Many complimentary features such as versatile display scaling, engineering units, data cursors and data labeling allow you to extract and retain important information about your data. Data and instrument setup storage to the PC's hard or floppy disks is also easy and convenient. When data is stored, complete setup information, including all display parameters, is also saved with the data. This means when you recall the data it will be displayed just as it was when you stored it. To document your efforts, complete screen dumps with data and setup information can be sent to a plotter or dot-matrix printer.

For stimulus/response testing, the 2630 provides an optional built-in source with arbitrary function generation and playback capability. You can either choose one of the many standard stimulus signals or create the special signal you may need by either programming it directly or simply regenerating previously acquired data.



Any standard EGA™ compatible display will allow multiple waveforms to be viewed simultaneously. Here the stimulus and response waveforms (top) are displayed with the computed frequency response (bottom).

Additional Tools and Applications

While the extensive set of standard features listed above will meet most measurement and analysis requirements, more power can be added. The 2630 can be individualized to specific applications with the optional TurboPac Application Library software. This programming library allows you to obtain full control of the 2630, acquire data, and develop custom operator interfaces using Borland's efficient TurboPascal™ programming language. In addition to basic commands, TurboPac includes example application programs which can serve as building blocks for developing your own custom programs. The example programs include:

- Third octave analysis
- Spectral mapping
- System identification (curve fitting)
- Swept sine transfer function analysis
- Waveform math functions

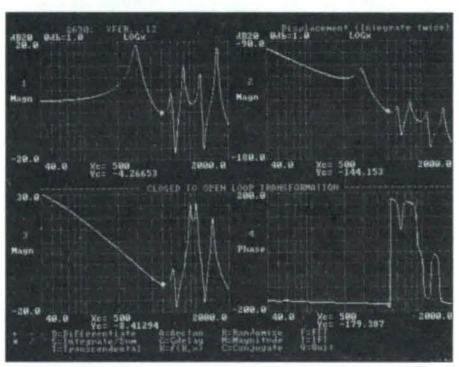
The waveform math example application is an extremely advanced program and will generally provide a complete solution to most waveform calculation needs. This program can be used with any data file that is in the 2630's Instrument Program format, and provides the same easy operation as the 2630's operator interface, including interactive displays and graphic output of results. Math functions include: define and modify waveforms; add, subtract, and multiply waveforms; add a constant or multiply by a constand; raise to a power; sine or cosine (real or complex); log and exp (real or complex); complex conjugation; integrate and differentiate; direct and inverse Fourier transforms; arctangent with phase unwrapping; magnitude of complex data; closed-loop to open-loop transforms; phase randomization; and group delay. The math program can be invoked easily from the instrument program by using the F10 key, allowing math to access any data available in the 2630. There is even an option for sending modified waveforms to the 2630's optional arbitrary signal generator.

Open System Advantages

The 2630 uses a standard PC for general tasks such as display and mass storage. All that's needed is an IBM PC™, XT, AT, PS/2, or compatible with a serial port, one floppy drive, at least 512K RAM, and an Enhance Graphics Adapter (EGA)™ display.

The 2630 connects directly to the PC's serial port; no special interface is needed. The Instrument Program software supplied with the 2630 provides all the operating software and equips the 2630 with all the standard analysis features. No additional software is necessary.

By integrating the PC into the 2630 design, the 2630 provides an extremely flexible and cost effective measurement solution. The high quality display, keyboard and mass storage units are all components of your measurement system that can be economically upgraded as PC component technologies advance in capability and value. You can also take advantage of low-cost networking to other PCs and mainframes.



Using the example Math program provided with the optional TurboPac Application Library, waveforms can be manipulated quickly and easily. Here the upper-left acceleration trace is integrated twice to provide a displacement vs frequency trace (upper right). The lower traces represent the open-loop frequency response of a control system calculated from a closed-loop measurement.

The availability and value of complementary software to support your design, analysis, test and documentation needs further contributes to the value of your 2630 system. Borland's TurboPascal is an excellent example. When teamed with the TurboPac programming library, this consumer-priced package provides a powerful environment for the rapid development of custom analysis routines and measurement automation programs.

Another benefit of the 2630 design is that the acquisition and analysis capabilities are not limited by the performance of the PC. All of the acquisition and analysis is done in the 2630 itself, passing only interum and final results to the PC. As a result, you can access the full power of the 2630 with any properaly configured PC.

However, when using complementary software packages such as TurboPac or other application software, consider Tek's PEP 301 instrument controller.

The PEP Series provides the full power of the Intel 80386 running at 16 MHz to quickly handle even the most intensive analysis problems.

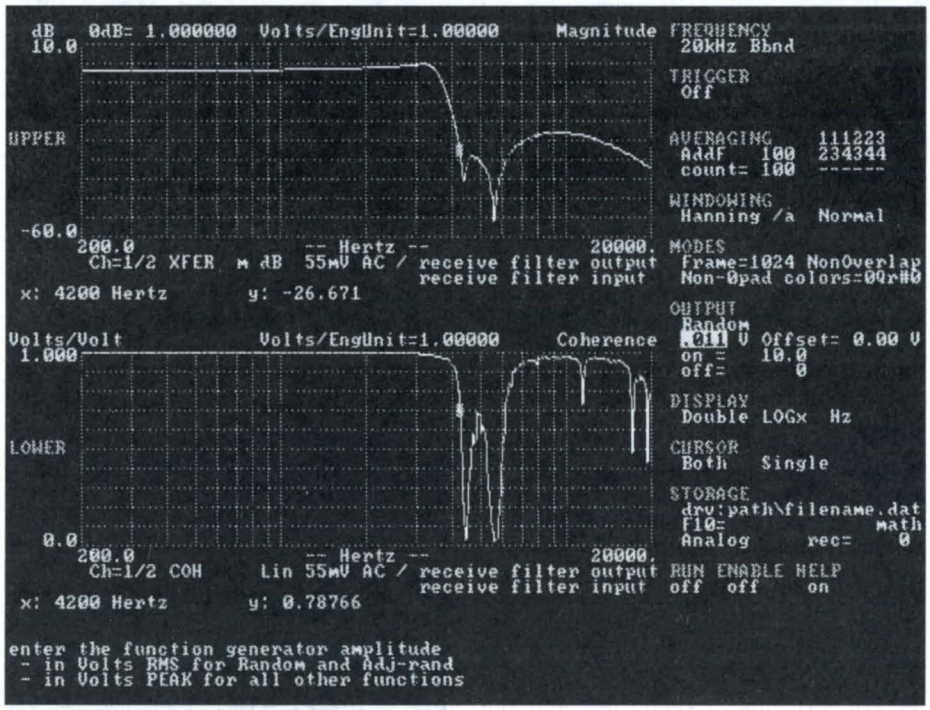
For portability, laptop computers are the way to go. The 2630 together with a laptop computer adds up to a complete system weighing less than 35 pounds. This lets your complete analysis system be carried to the field with shoulder bag convenience.

Of course, no job is complete without documentation. That's why the 2630 provides complete screen dump capabilities. All screen graphics and text, including setup information, can be copied to a dot-matrix printer or digital plotter like the Tektronix HC100 Color Plotter.

A Friendly Control Panel with Built-in Help.

The 2630 is so easy to learn that inexperienced operators will be using it in a matter of minutes. They only need to know one command, "IP". When IP is typed, the 2630's Instrument Program puts a dual-grid display on the screen (see illustration above). The 2630's entire setup and processing status is shown on the screen along with current plots. A simple single-level menu lets the operator change anything—from acquisition parameters to processing selections—by just typing the first letter of the highlighted menu item.

The built-in Help function is smart enough to supply exactly the information needed, when it's needed. It's context sensitive. There's always a Help message at the bottom of the screen to describe the current selection when you want it.



To show how easy the 2630 is to operate, a free demonstration disk is available for exploring the entire Instrument Program. A few minutes with this disk will demonstrate the 2630's capabilities and operation, without ever looking at a manual. Copies are available by calling the nearest Tektronix sales office.

CHARACTERISTICS

INPUT SUBSYSTEM

Channels—Two (four optional).
Sample Rate—51.2 kHz per channel, with simultaneous sampling on each channel.
Bandwidth—DC to 20 kHz, with 12 range selections from 5 Hz to 20 kHz in a 1,2,5 sequence.
Input Type—Differential with low side returned to chassis through 10 ohms.
Input Impedance—100 kΩ, 200 pf.
Common Mode Rejection—60 dB at 1 kHz.
Maximum Input Voltage—30 Volts continuous.
Coupling—DC or AC coupling, individually selectable or programmable for each channel.
Sensitivity—16 ranges in 3 dB steps from 55 mV to 10 V full scale, individually selectable or programmable for each channel.
Dynamic Range—>75 dB (two tone test).
Channel Matching—Gain matched within 0.2 dB, phase matched within 2 degrees.
Crosstalk—>90 dB isolation between channels.
Frequency Accuracy—Better than 0.01%.
Zoom (optional)—to 0.006 Hz resolution for any center frequency between DC and 20 kHz. Center frequency resolution is better than 1 Hz.
Antialiasing Filters—Analog elliptic filter with 20 kHz cutoff followed by TMS320-based digital filters. Provides 400 alias-free lines from a 1024-point FFT. Overall ripple $< \pm 0.2$ dB.
Autocalibration—Done by internally zeroing the input to measure amplifier DC offset and by internal connection to the optional output channel for gain calibration.
Triggering—Internal: Pre or post delay, selectable threshold, slope, and hysteresis. Trigger source may be any channel, filtered or unfiltered. External: TTL input.

CONTROL PROCESSOR

Central Processing Unit—National 32016 with NS32202 Interrupt Control Unit, NS32081 Floating Point Coprocessor, and four Direct Memory Access channels.
Memory—1 Mbyte RAM, 8 Kbyte PROM. (PROM contains diagnostics and code to download (the RAM over the serial interface.)
Serial Interface-Primary (to Personal Computer): supports RS-232, 422, 423 at rates from 1.2 to 115 Kbaud. Auxiliary: supports RS-232, 422, 423 at 1.2 to 38.4 Kbaud.
Parallel Interface (optional)—16-bit parallel, with sustained transfers to disk at 100 Kbytes/sec (nominal). Speed determined by PC disk. Includes a 4096-word input FIFO and a 4096-word output FIFO.

ARRAY PROCESSOR

Central Processing Unit—Texas Instruments TMS32010.
Memory—4K×16 control store (static RAM) and 8K×16 data store (static RAM) with address sequencer.
Interface—Direct Memory Access to system bus, processor interrupts.

Functions—FFT, windowing, and auto-spectrum.
Fast Fourier Transform (FFT)—Block floating point with 80 dB dynamic range. Power-of-two frame sizes between 64 and 4096 points. Choice of 12 different windows. A 1024-point real transform with windowing takes 28 mS.
Real-Time Rate—10 kHz real-time bandwidth for single-channel measurements, including an FFT with full floating-point autospectral averaging.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	381	15
Height	147	5.8
Depth	394	15.5
Weight ≈	**kg**	**lb**
Net	7.7	17

POWER REQUIREMENTS
Line Voltage—115 or 230 V. ±10%.
Power Comsumption—>120 W.

ENVIRONMENTAL
Operating Temperature—0 to 50° C.
Electromagnetic Interference—Conforms to VDE 0871 Class B.
Shock and Vibration—Conforms to MIL-T-28800C Type 3 Class 5 Style E.

CONNECTORS AND INDICATORS
Front Panel—One output BNC connector with output channel option, up to four input BNC connectors, three LED indicators (Power, Active, Transfer).
Rear Panel—Two female 9-pin D-type connectors (serial ports),f two male 9-pin D-type connectors (external sampling, external trigger), reset switch, power switch, fuse, ISO power cable connector.

OUTPUT SUBSYSTEM OPTION
Channels—One analog output channel.
Output Functions—User-defined functions of preprogrammed sine, square, sawtooth, triangle, impulse, random, translated random, and burst psuedo random functions.
Output D/A—16-bit digital-to-analog converter with 14-bit linearity and 75 dB dynamic range.
Smoothing Filters—Analog smoothing filters with same characteristics as input subsystem antialiasing filters. Includes sin (×) /× correction.
Drive—20 mA drive capability, unconditionally stable.
Level—10 V full scale with 12-bit MDAC for level attenuation.
Output Impedance—50 ohms.
Protection—To 20 Volts continuous. Relay shorts the output under power fail conditions to protect external equipment.

MINIMUM SYSTEM REQUIREMENTS
The 2630 Fourier Analyzer operatoes with an IBM PC, XT, AT, PS/2 (or compatible) having the following minimum requirements:

- DOS 3.0 or higher
- 512 Kbytes of Ram
- One serial port
- Flexible diskette drive
- Intel 8087, 80287, or 80387 coprocessor
- Enhanced Graphics Adapter (EGA)
- Monochrome or color EGA monitor

ORDERING INFORMATION

When ordering the 2630 fourier Analyzer, please use the exact nomemclature given here:
2630—Fourier Analyzer with two input channels **$9,950**
Includes: Instrument Program Software and 90 days of upgrades; 2630 Users Guide (070-6910-00); System Simulator Box (020-1651-00);1 Power Cord (please specify); Serial Interface cable (please specify)

OPTIONS
Option 1B—Serial Cable for IBM PC or XT (25-pin, D-type, 020-1648-00).*1
Option 2B—Serial Cable for IBM AT or PS/2 (9-pin, D-type, 020-1649-00).*1
Option 1C—Soft Carrying Case 020-1646-00. **+$125**
Option 2C—Transit Case 020-1647-00. **+$475**
Option 1H—Two additional input channels 020-1639-00. **+$3,000**
Option 2H—Two-channel zoom 020-1640-00. **+$1,000**
Option 3H—Four-channel zoom (four-channel systems only) 020-1641-00. **+$2,000**
Option 4H—One output channel 020-1642-00. **+$2,000**
Option 5H—Parallel Interface (for high-speed disk acquisition, requires Option 25). 020-1643-00. **+$3,000**
Option 25—PEP 301 System Controller. **+$7,995**

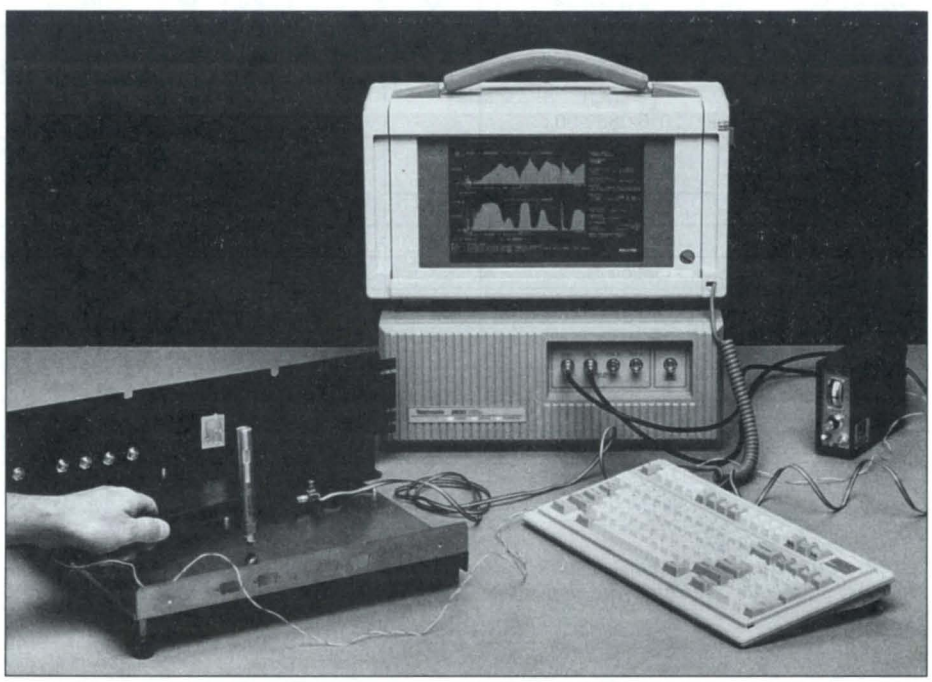
SOFTWARE OPTIONS
Option 2S—TurboPac, Application Library 020-1644-00 (includes one year update service) and TurboPac Reference Guide 070-6911-00. **+$1,100**
Option 2R—TurboPac Run-Time License for addisional 2630s 020-1652-00. **+$250**
Option 3S—PC-Matlab (includes Control Systems Toolkit.) 020-1645-00. **+$1,100**

INTERNATIONAL POWER PLUG OPTIONS
Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

WARRANTY-PLUS SERVICE PLANS
1M—Plus 1 year of hardware warranty **+$900**
1U—Plus 1 year of update service for Instrument Program Software **+$250**
2U—Plus 1 year of update service for TurboPac Application Library Software **+$250**

*1 *Contact your local sales representative.*

IBM, PC, AT, and PS/2 are trademarks of International Business Machines Corporation.
Turbo Pascal is a registered trademark of Borland International, Inc.
MATRIX is a trademark of Integrated System.



Lightweight and rugged, the 2630 can be used with a portable PC to make an easily transportable system.

OPTIONS AND ANCILLARIES FOR 275X AND 49X PRODUCTS

	Instrument/ Option	2756P	494AP	2755AP	492BP	2754	2754P	2753P	495	495P	Page
Preselector		S	S	S	S	S	S				101
Precision Reference		S	S					S	S	S	101
75Ω*1	Option 07*2	X	X	X	X	X	X	X	X	X	101
WG Mixers	Option 21	X	X	X	X						101
WG Mixers	Option 22	X	X	X	X						101
GRASP+	Option 23	X	X	X	X		X	X		X	101
Compaq PC+	Option 24	X	X	X	X		X	X		X	101
Compaq PC+	Option 25	X	X	X	X		X	X		X	101
Compaq PC+	Option 26	X	X	X	X		X	X		X	101
Compaq PC+	Option 28	X	X	X	X		X	X		X	101
Printer	Option 29	X	X	X	X		X	X		X	101
Plotter	HC100	X	X	X	X	X	X	X	X	X	101
Rackmount	Option 30	X		X		X	X	X			101
Rackmount	Option 31	X		X				X			101
Rack Adaptor	016-0844-01		X		X				X	X	101
PEP 301	Option 32	X	X	X	X		X	X		X	101
PEP 301+GRASP	Option 33	X	X	X	X		X	X		X	101
PEP 301+EMI SW	Option 34	X	X	X	X		X	X		X	101
Silver Battery	Option 39	X	X	X	X			X	X	X	101
Digital Radio	Option 41	X	X	X	X						101
Wide IF Out	Option 42	X	X	X	X			X	X	X	101
MATE/CIIL	Option 45	X	X	X	X			X		X	101
Instrument Cart	K217	X		X		X	X	X			101
Instrument Cart	K212		X		X				X	X	101
Tracking Generator	TR503	X	X	X	X	X	X	X	X	X	101
TV Sideband Adapter	1405	X	X	X	X	X	X	X	X	X	101
Transit Case (2750 Series)	016-0962-00	X		X		X	X	X			101
Hard Shipping Case (490 Series)	016-0658-00		X		X				X	X	101
Soft Carrying Case	016-0659-00		X		X				X	X	101
International Power Cords	A1, A2, A3, A4, A5	X	X	X	X	X	X	X	X	X	101
Scope Cameras	C-4 or C-5C	X	X	X	X	X	X	X	X	X	101
Service Manuals	Option B1	X	X	X	X	X	X	X	X	X	101
Complete Manuals Set	Option B2	X	X	X	X	X	X	X	X	X	101
490 Series Operator Training Videotape	*3		X		X				X	X	101
Warranty-Plus	Option M1	X	X	X	X	X	X	X	X	X	564
Warranty-Plus	Option M2	X	X	X	X	X	X	X	X	X	564
Warranty-Plus	Option M3	X	X	X	X	X	X	X	X	X	564

S = Standard
X = Available

*1 *No external mixer.*
*2 *Option 07 cannot be combined with Options 21 and 22.*
*3 *Various formats available. See page 101 for part numbers.*

OPTIONS AND ANCILLARIES' DESCRIPTIONS FOR 275X AND 49X PRODUCTS

OPTION DESCRIPTION

Option 07—75 Ω dBmV input and calibration in addition to normal 50 Ω dBm input and calibration. **+$750**
Includes: 42-in. BNC to BNC connector 75 Ω coax cable (012-0074-00) and BNC male to female adapter connector (013-0126-00). (Not combinable with Options 21, 22. No external mixer capability).

Option 21—High Performance 18- to 40-GHz Waveguide Mixer Set includes two mixers A and K (18 to 26.5 GHz, and 26.5 GHz to 40 GHz). **+$2,650**
Includes: Diplexer assembly (015-0385-00).

Option 22—High Performance 18- to 60-GHz Waveguide Mixer Set includes three mixers A, K, and U (18 to 26.5 GHz, 26.5 to 40 GHz, 40 to 60 GHz). **+$4,460**
Includes: Diplexer assembly (015-0385-00).

Option 23—GRASP and GPIB Interface. **+$1,750**
Includes: GRASP software, National's PC2A (GPIB) card for PC, and GPIB cable.

Option 24—Compaq Portable II, Model 2. **+$4,800**
Includes: GRASP, PC2A, GPIB cable, Compaq Portable II (Model 2), 80286 processor, 256K byte RAM, 2 each 360K-byte floppy drives, built-in monitor, and serial/parallel interface.

Option 25—Compaq Deskpro, Model 2. **+$4,900**
Includes: GRASP, PC2A, GPIB cable, Compaq Deskpro (Model 2), 8086 processor, 256K byte RAM, 2 each 360K-byte floppy drives, enhanced color display, and serial/parallel interface.

Option 26—Compaq Deskpro 286, Model 1. **+$6,400**
Includes: GRASP, PC2A, GPIB cable, Compaq Deskpro 286 (Model 1), 80286 processor, 256K byte RAM, 1.2M-byte/360K-byte floppy drives, enhanced color display, and serial/parallel interface.

Option 28—Compaq Deskpro 286, Model 20. **+$8,400**
Includes: GRASP, PC2A, GPIB cable, Compaq Deskpro 286 (Model 20), 80286 processor, 640K byte RAM, 20M-byte hard drive, 1.2M-byte/360K-byte floppy drives, enhanced color display, and serial/parallel interface.

Option 29—Epson printer. **+$550**
Includes: Epson FX-86E printer and parallel interface cable.

Option 30—Rackmount 19-in. rack width. **+$250**
Includes: Rack slides.

Option 31—Rackmount 19-in. rack width with rear panel input/output capability (no front panel inputs). **+$450**
Includes: Rack slides.

Option 32—Tek PEP 301 systems controller, extra floppy drive. (see page 129) **+$8,120**

Option 33—Tek PEP 301 systems controller, extra floppy, GRASP software. (see page 129) **+$8,995**

Option 34—Tek PEP 301 systems controller, extra floppy drive, EMI software. (see page 129) **+$9,595**

Option 39—Non-Lithium (Silver) batteries for battery-powered memory. **+$50**

Option 41—Digital Microwave Radio Enhancement. **+$450**
Includes: Wider bandwidth preselector for better signal symmetry in digital radio bands; Narrow video filter (approximate 1/3000th resolution bandwidth); Improved frequency span/div accuracy at 5-MHz/div span.

Option 42—Replaces MARKER/VIDEO input port on the rear panel with a 110 MHz IF output port which provides a signal with a 3 dB bandwidth ≥4.5 MHz and makes the analyzer suitable for broadband, swept-receiver measurements. **+$1,500**

Option 45—CIIL language for P-versions only (except 2754P). **+$4,975**

Option B1—Service Manuals Vol. 1, Vol. 2. **+$250**

Option B2—Operators Manual, Programmers Manual (P-instruments only) and Service Manuals (Vol. 1 & 2 where applicable). **+$300**

INTERNATIONAL POWER PLUG OPTIONS

A1—Universal Euro 220 V/6A, 50 Hz.
A2—UK 240 V/5A, 50 Hz.
A3—Australian 240 V/6A, 50 Hz.
A4—North American 240 V/12A, 60 Hz.
A5—Switzerland 220 V/6A, 50 Hz.

VIDEOTAPE/LITERATURE

490 Series—Operator training videotape program for 490 series portable spectrum analyzers with counter and synthesized markers.
Order 068-0283-00 ¾-inch U-MATIC **$60**
Order 068-0283-01 Beta **$60**
Order 068-0283-02 Beta II **$60**
Order 068-0283-03 Beta III **$60**
Order 068-0283-04 VHS **$60**
Order 068-0283-06 PAL **$60**
Order 068-0283-07 SECAM **$60**

Numerous data sheets, application notes, and magazine article reprints on spectrum analyzers and their measurements are available. Contact your Tektronix Sales Office or representative.

STANDARD ACCESSORIES

(May vary slightly from instrument to instrument).

50 Ω Coax Cable—BNC to BNC Conn, 18 in. Order 012-0076-00. **$18.25**

Adapter Connector—BNC Male-to-F Female.*[1] Order 013-0126-00. **$19**

75 Ω Coax Cable—BNC-to-BNC Conn, 42 in.*[1] Order 012-0074-00. **$19.75**

Programmer's Manual—(P-instruments only).*[3]

Operator's Manual—*[3]

N Male to BNC Female Adapter—Order 103-0045-00. **$8.50**

2 Fast-Blo*[2] —4A Fuses Order 159-0017-00. **$.30**

Power Cord*[2] —Order 161-0104-00. **$6.75**

CRT Light Filter—Amber Order 378-0115-01. **$3.30**

CRT Light Filter—Gray Order 378-0115-02. **$6**

CRT Mesh Filter—Order 378-0227-01. **$85**

*[1] *Standard for Option 07 only.*
*[2] *For Options A1, A2, A3, A4, and A5, the fuses and power cord are replaced with appropriate fuses and power cord.*
*[3] *Contact your local sales representative.*

OPTIONAL ACCESSORIES/ANCILLARIES

Service Kit—Order 006-3286-01. **$810**
CRT Visor—Order 016-0653-00. **$35**
DC Blocking Capacitor—Type N conn. Order 015-0509-00. **$310**
DC Blocking Capacitor—Type BNC conn. Order 015-0221-00. **$115**
Power Splitter—50/75 Ω Order 067-1232-00. **$250**
Cable—GPIB Order 012-0991-00. **$160**
External Waveguide Mixers—
WM490K, 18 to 26.5 GHz **$1,310**
WM490A, 26.5 to 40 GHz **$1,310**
WM490Q, 33 to 50 GHz **$1,520**
WM490U, 40 to 60 GHz **$1,805**
WM490V, 50 to 75 GHz **$2,045**
WM490E, 60 to 90 GHz **$2,225**
WM490W, 75 to 110 GHz **$2,280**
WM490F, 90 to 140 GHz **$2,445**
WM490D, 110 to 170 GHz **$3,410**
WM490G, 140 to 220 GHz **$3,490**
(119-1728-00) Tapered Transition (used with WM490G), 220 to 325 GHz **$1,495**
Diplexer Assembly—Required for use with 2750/490 Series Spectrum Analyzers and WM490 Series Waveguide Mixers. Order 015-0385-00. **$235**
Diplexer Assembly Cable—Required for use with Diplexer Assembly. Order 012-0649-00. **$33**
Microwave Comb Generator—TM500/TM 5000 Series compatible. Order 067-0885-00. **$1,815**
Hard Case—Transit for the 490 Series. Order 016-0658-00 **$795**
Hard Case—Transit for the 2750 Series. Order 016-0962-00 **$450**
Soft Case—For the 490 Series. Order 016-0659-00 **$140**
TR503 Tracking Generator—100 kHz to 1800 MHz **$7,080**
TEK HC-100—Color Plotter **$825**

PROBES

A variety of probes are available in varying frequency and impedance ranges that can be used with 2750/490 Series spectrum analyzers.
FET Probe P6201—DC to 900 MHz. **$1,280**
FET Probe P6202A—DC to 500 MHz. **$735**
Conventional Probe P6056—DC to 3.5 GHz, 6 ft. **$200**
Conventional Probe P6057—DC to 1.4 GHz, 6 ft. **$195**
Current Probe P6022—DC to 150 MHz. **$495**

CAMERAS

A camera can greatly enhance the versatility of a spectrum analyzer. Many different units are available. However, the most popular units for the 2750/490 Series spectrum analyzers are:
C-4 Low-Cost Camera—Option 02: 2750/490 Series. **$410**
C-5C Camera—Option 01: 2750/490 Series. **$465**

CARTS

K212—Portable Instrument Cart (490 Series). **$350**
K217—Laboratory Instrument Cart (2750 Series). **$510**

DESCRIPTION OF MARKER FUNCTIONS AND SIGNAL PROCESSING FOR 275X AND 49X PRODUCTS

Menu-Selected, Intelligent Markers and Signal Processing

New dynamic markers automatically update frequency and amplitude data with every sweep. When used in conjunction with the 2750/490's powerful signal processing intelligence, you can use PULSE mode to mark the peak of a main lobe and peaks of side lobes at the push of a button. CW mode locates signals exhibiting CW characteristics and ignores all other signals. SPUR mode marks signals that meet user-definable or automatic threshold criteria. Threshold criteria are available for all signal processing modes.

The 2750/490 products also offer hands-off convenience for measuring the bandwidths of filters, amplifiers and other networks. Simply enter the desired bandwidth point, select BANDWIDTH mode, and markers automatically update to display the new value.

To assist the new, nontechnical or infrequent operator in using this sophisticated spectrum analyzer with a minimum of training and supervision, the 490 Series analyzers include a HELP mode. Contained in ROM, it offers descriptions of controls and functions in plain English.

Nonvolatile memory lets you store up to nine front-panel settings and nine waveforms, simplifying setup and making field operation easier. A permanent record of CRT displays can be obtained at the push of a button, without a controller, using the direct plot capability.

Fully Automated Spectrum Analysis

The P-versions are the GPIB-programmable versions. Programming increases speed and ensures measurement repeatability. Under program control, change front-panel settings, read data from the CRT display, and send waveforms from internal digital source memory to other GPIB devices. Tek's *Standard Codes and Formats* keep commands clear, consistent and universally understood.

You can increase programming flexibility and power with the P-versions' MATE/CIIL language extension (Option 45). It provides direct memory access for high speed data transmission, a requirement for MATE/CIIL compliance.

Tektronix Automated Spectrum Analyzer Packages

Convenient to order, these packages are configured around DOS based PC's and Tek's laboratory quality programmable spectrum analyzers. Coupling the PC to the analyzer via the IEEE-488 bus enables the user to take advantage of the PC's capability, as well as the power and versatility of Tek's spectrum analyzers. A highly versatile General RF Applications Software Package (GRASP) offers many different applications and utility routines which are selected through easy, menu-driven operation.

There are many other time-saving and accuracy-enhancing capabilities too numerous to discuss here. See the summary of signal processing and marker functions (opposite page) for a more complete idea of the measurement benefits. Talk to your Tektronix Spectrum Analyzer Sales Engineer for complete details.

Macro-Programming

Macro-Programming lets you download programs into NV RAM. This capability lets you execute your frequently-used measurement routines without the need of a dedicated controller.

The macroinstruction (macro) commands are divided into the seven categories of math, register, branching and looping, print, data, and general commands. The branching and looping commands are available only within macros; they cannot be used outside of macros.

Macros are prepared using a language such as BASIC and a controller (PC with GPIB interface, etc.). Once the macro is stored in the spectrum analyzer memory, it can be run at any time without the further use of a controller. Any stored macros will be lost if the battery power to the memory is interrupted (as when the battery is removed for long-term storage).

If any GPIB command is encountered while a macro is running, the macro is stopped. The RUN command (or RUN/STOP from the front panel) will restart the macro. A GPIB query has no effect on macros.

There are 8k bytes of memory dedicated for macro use. Although there is no set limit for each macro, it is important that you know the number of bytes used for each command and keep this in mind while preparing macros. The number of bytes used for each command is included with the commands. Most GPIB commands are executable as macro commands.

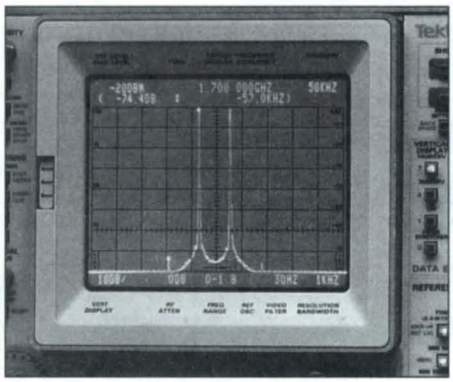
Signal Tracking

Signal tracking automatically keeps drifting or sweeping signals in the center of the screen. If track is lost, the analyzers frequency will not wander aimlessly—it will idle at the last tracked frequency and "Signal Track Idle" is displayed on the screen.

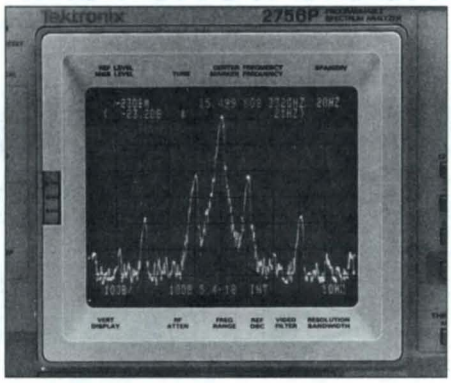
Noise Normalization

Noise Normalization in the analyzers allows you to normalize noise to a 1 Hz bandwidth.

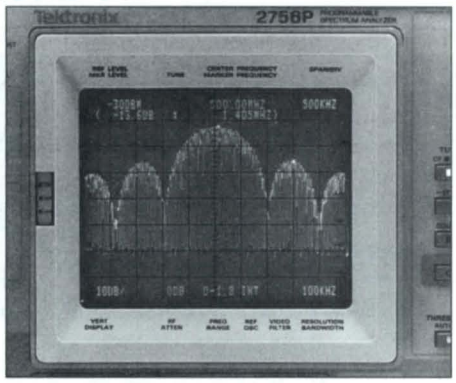
SUMMARY OF MARKER FUNCTIONS AND SIGNAL PROCESSING FOR 275X AND 49X PRODUCTS



Intermodulation measurement using the new standard CRT.



Close-in sidebands using 10 Hz Resolution Bandwidth.



Marker measurement on Pulsed RF using Pulsed Signal processing mode.

Marker Key Pad Functions

Assign Menu Functions (490 Series only): Marker Functions that are assignable to nonvolatile front-panel pushbuttons ASSIGN 1 and ASSIGN 2 listed as follows:

PEAK FIND: Locates and marks the highest displayed signal on the CRT.

RIGHT NEXT: Moves marker to the right next signal defined by "SIGNAL TYPE" in frequency.

LEFT NEXT: Moves marker to the left next signal defined by "SIGNAL TYPE" in frequency.

NEXT LOWER: Moves marker to the next lower signal defined by "SIGNAL TYPE" in amplitude.

NEXT HIGHER: Moves marker to the next higher signal defined by "SIGNAL TYPE" in amplitude.

MOVE RIGHT "X" dB: Moves marker to the right "X" dB (X can be + or −) in signal amplitude from its current position.

MOVE LEFT "X" dB: Moves marker to the left "X" dB (X can be + or −) in signal amplitude from its current position.

FIND PEAK AND CENTER: Marks the highest displayed signal and moves it to the center of the CRT screen.

Signal Type Menu

Sets the signal processor pattern recognition from a selection of three routines. Chosen signal type remains in memory until overwritten by new selection, RESET (which defaults to CW), or power down:

CW: Recognizes signals with CW characteristics—ignores all others (instrument selects this mode at power-up).

PULSE: Recognizes pulsed RF lobe patterns for line and dense spectrums—places marker at peaks—easy location of carrier spectral line.

SPUR: Recognizes *ALL* signals including impulses above the assigned Threshold.

Noise Normalization (dB/Hz)— Normalizes the noise measured at the marked position to one Hertz—Simplifies Phase Noise and Signal/Noise Ratio tests.

Signal Track—Locates, marks, and centers on the highest signal on screen above the Threshold. If track is lost, or if the signal drops below Threshold value, "SIGNAL TRACK IDLE" will be displayed on the CRT below the last "tracked" frequency and the instrument will "idle" there until track is regained.

Bandwidth—Places the markers the assigned number (from memory) of dB below, left, and right of the desired signal peak automatically after each sweep.

Marker to Reference Level—Changes reference level to the marker amplitude value.

Marker to Center—Changes center frequency to equal marker frequency.

Marker Start/Stop—Frequency start/stop sweep is matched to the current Δ marker position.

Step Size—Assigns either the center, marker, or Δ marker frequency to the ± STEP frequency functions.

Macro Menu (492BP, 2755AP, 495P, 2753P, 494AP, 2756P only)—Allows the selection from up to eight stored user-defined programs to be executed.

Run/Stop (492BP, 2755AP, 495P, 2753P, 494AP, 2756P only)—Starts and stops execution of the selected Macro program.

Settings Store/Recall—Allows up to nine full front-panel set-ups, plus a power-down last instrument state, to be stored and recalled from nonvolatile memory.

Zoom (IEEE-488 function only)—Moves the marked signal to center screen and decrements the span.

Built-in Microwave Counters

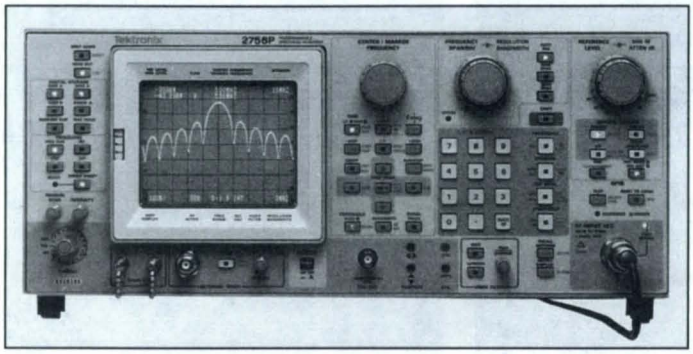
The past few years have seen a remarkable increase in spectrum analyzer capabilities. Most noteworthy are the advancements in frequency measurement accuracy and built-in processing intelligence. These two advances, in turn, serve as a basis for a third noteworthy spectrum analyzer advance—the addition of built-in microwave counters.

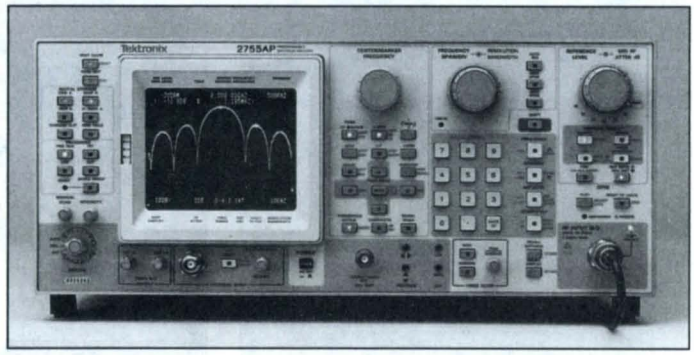
A built-in counter linked to a spectrum analyzer marker system offers several unique measurement capabilities versus those of stand-alone general-purpose counters. These spectrum analyzer counter capabilities include:

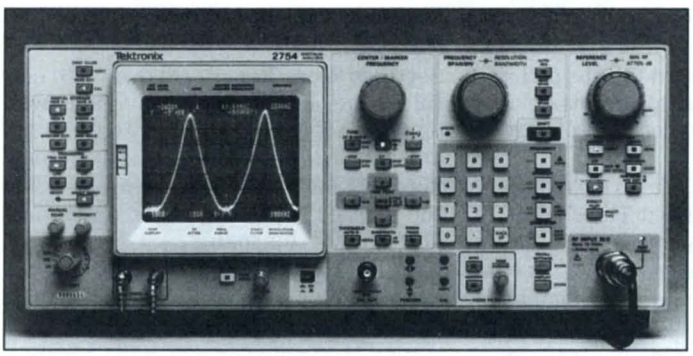
- Orders of magnitude better sensitivity, to −104 dBm for example, for low amplitude signal measurement.
- High selectivity for measuring desired signals in multi-signal environment (e.g., one satellite transponder out of a group of transponders).
- Wider frequency range (e.g., 100 Hz to 325 GHz), and
- The ability to view the spectrum and the actual signal being counted.

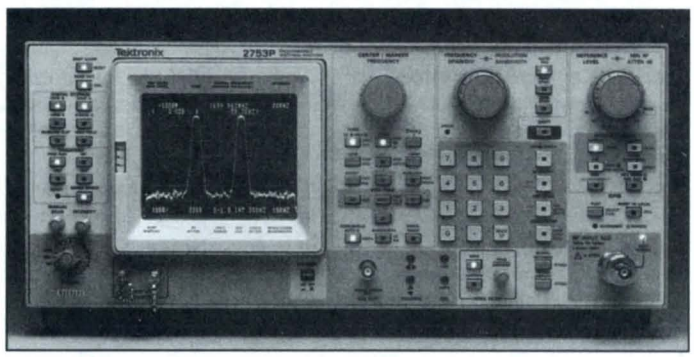
The ability to see and select what is being counted offers substantial advantages over the "blind" operation of stand-alone counters. For more information on how a built-in counter can benefit you, contact your local Tektronix office.

2750 SERIES SPECTRUM ANALYZERS FOR LABORATORY PERFORMANCE









- **Frequency Coverage from 100 Hz to 325 GHz**
- **Large, Easy-to-Use, Front-Panel Controls**
- **Built-in Signal Processing/Marker Functions Using Unique Marker Keypad**
- **Many Application-Specific Performance Enhancement Options**
- **Plot Data Directly without a Controller**

Menu-Selected, Intelligent Markers and Signal Processing

Dynamic markers (see pages 102–103 for description) automatically update frequency and amplitude data with every sweep.

The 2750 Series also offers hands-off convenience for measuring the bandwidths of filters, amplifiers and other networks.

Nonvolatile memory lets you store up to ten front-panel settings and nine waveforms, simplifying setup and making measurements easier. A permanent record of CRT displays can be obtained at the push of a button, without a controller, using the direct plot capability.

For more information on specific 2750 Series instruments, please refer to the table below to locate the appropriate page.

MICROWAVE SPECTRUM ANALYZERS

Model	Counter	Frequency Range		Frequency Accuracy	Ref Accuracy	Resolution Bandwidth	Average Noise Level (Min RBW)	Amplitude Meas. Range	GPIB	Config.	Page
		Coaxial Input	w/Exter. Mixers								
2756P	Y	10 kHz to 21 GHz	325 GHz	Freq X Ref Accuracy +0.2 X (Span/div or Resolution Bandwidth) +(2N+25) Hz	10^{-9}/day 10^{-9}/day	10 Hz min to 3 MHz max	−131 dBm	+30 dBm to −131 dBm	Yes	Lab	106
NEW 2755AP	Y				5×10^{-7}/year 10^{-6} @ 25° within 30 minutes	100 Hz min to 3 MHz max	−120 dBm	+30 dBm to −120 dBm	Yes	Lab	108
2754	N	50 kHz to 21 GHz	N/A		10^{-5}	1 kHz min to 1 MHz max	−110 dBm	+30 dBm to −110 dBm	Plot	Lab	110
2754P	N								Yes		110

VHF/UHF SPECTRUM ANALYZERS

2753P	Y	100 Hz to 1800 MHz	Freq X Ref Accuracy +0.2 X (Span/div or Resolution Bandwidth) +15 Hz	10^{-9}/day 10^{-7}/year	10 Hz min to 3 MHz max	−131 dBm	+30 dBm to −131 dBm	Yes	Lab	112

2750 SERIES COMMON CHARACTERISTICS

The following characteristics apply after a 30 minute warm-up period unless otherwise noted.

FREQUENCY RELATED

Frequency Drift (after 1 hour warm-up)—Span/Div ≤200 kHz (phase locked): Drift rate ≤50 Hz/min. Correction will occur at the end of sweep or as often as needed for sweep times ≥5 s/Div. (Drift rate is typically <20 Hz/min after 1 hour warm-up from 25 °C storage). Span/Div >200 kHz (unlocked): Drift rate typically ≤5 kHz/min (typically <25 kHz/min after 30 minute warm-up).

Frequency Readout Resolution—≤10% of Span/Div to 1 Hz minimum in 2753P and 2756P; to 1 kHz in 2754/2754P (100 Hz in Delta Marker mode.

Counter Sensitivity (except 2754/2754P)—Signal level must be >20 dB above the average noise level and within 60 dB of the reference level.

Counter Readout Resolution—Selectable from 1 Hz to 100 MHz in decade steps.

Delta Marker Frequency Accuracy—±1% of total span.

AMPLITUDE RELATED

Vertical Display Modes—10 dB/div, 2 dB/div and linear via pushbutton; any integer from 1 to 15 dB/div via Data Entry keypad.

Display Amplitude Accuracy—±1.0 dB/10 dB to a maximum of ± dB over 80 dB; ±4 dB over 90 dB for the 2756P/2753P (12 dB Log); ±0.4 dB/2 dB to a maximum of ±1.0 dB over 16 dB (2 dB Log); ±5% of full scale in linear mode.

Video Filter Range—0.3 Hz to 30 kHz (coupled to resolution filter by front-panel pushbuttons).

Reference Level Accuracy—Accuracy is dependent on a combination of RF Attenuator Accuracy, IF Gain Accuracy, Resolution Bandwidth, Display Mode, Calibrator Accuracy, Frequency Band, Frequency Response and Temperature Change (±0.15 dB/ °C maximum).

Reference Level Steps—10 dB coarse, 1 dB fine in 10 dB log; a dB coarse, 0.25 dB fine in 2 dB log. 1-2-5 sequence coarse, 1 dB equivalent fine in linear; coarse step=log/div, fine is 1 dB for 5 dB/div or greater, 0.25 dB for 4 dB/div or less set via Data Entry keypad.

Marker/s Accuracy—Equal to Reference Level Accuracy plus Display Amplitude Accuracy.

RF Attenuator Range—0 to 60 dB in 10 dB steps.

RF Attenuator Accuracy, Step, 60 dB Range—DC to 1.8 GHz: 0.5 dB/10 dB, 1 dB maximum. 1.8 to 18 GHz: 1.5 dB/10 dB, 3 dB maximum. 18 to 21 GHz: 3 dB/10 dB, 6 dB maximum.

LO Emissions—≤ −70 dBm.

IF Gain Accuracy—≤0.2 dB/dB to maximum of 0.5 dB/9 dB except at the decade transitions: −19 to −20 dBm, −29 to −30 dBm; −39 to −40 dBm, −49 to −50 dBm, −59 to −60 dBm; an additional ≤0.5 dB for a maximum cumulative error of 1 dB over 10 dB; ±2 dB maximum deviation over the 97 dB range.

Resolution Bandwidth Gain Variation—±0.4 dB (after CAL with respect to widest filter).

Spurious Responses (Residual)—≤ −100 dBm; ≤95 dBm in 2754P.

Third Order Intermodulation Distortion—≤ −70 dBc for any two on-screen CW signals within any frequency span in MIN DISTORTION mode; ≤ −100 dBc for signals spaced ≥ −100 MHz in bands 2-5.

INPUT

RF Input—Type "N" female, 50 Ω nominal impedance.

Maximum Safe Input (0 dB RF attenuation)—+30 dBm (1 W) continuous, 75 W peak, 1 μsec pulsewidth, 0.001 duty; 0 V dc.

OUTPUT

Calibrator (Cal Out)—−20 dBm ±0.3 dB at 100 MHz × (1±REF).

1st and 2nd LO—Provides access to the output of the respective local oscillators (1st LO +6.0 dBm minimum to a maximum of +15 dBm, 2nd LO −22 dBm minimum to maximum of +15 dBm). These ports must be terminated in 50 Ω at all times.

Vertical Output—Provides 0.5 V ±5% of signal per division of video above and below the centerline. 1 kΩ source impedance.

Horizontal Output—Provides 0.5 V/Div either side of center. Full range −2.5 to +2.5 V ±10%. 1 kΩ source impedance.

Pen Lift—TTL, 5 V nominal to lift pen.

10 MHz IF Output—Output level is approximately −5 dBm for a full screen signal at −30 dBm input reference level. Nominal impedance 50 Ω.

110 MHz IF Output—(Option 42) Center frequency from 108.5 to 111.5 MHz; 3 dB bandwidth ≥4.5 MHz; bandpass ripple ≤0.5 dB; power out with −30 dBm reference level and a full screen signal ≤0 dBm; 1 dB compression at ≥0 dBm output, MIN DISTORTION: 50 Ω nominal impedance.

Probe Power—Provides operating voltages for active probes.

Pin 1: +5 V at 100 mA maximum
Pin 2: Ground
Pin 3: −15 V at 100 mA maximum
Pin 4: +15 V at 100 mA maximum

IEEE STANDARD 488 (GPIB)

P Versions—In accordance with IEEE Standard 488.1-1987 implemented as SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0.

Non-P Versions (Plotter Output)—Implemented as SH1, AH0, T3, L0, SR0, RL0, PP0, DC0, DT0, and C0.

DISPLAY

CRT—8×10 cm, GH (P31) Phosphor.

CRT Readout—Displays: Reference level, center frequency, marker frequency and amplitude, frequency range, vertical display mode, frequency Span/Div, resolution bandwidth, RF attenuation, video filter, and text.

Digital Storage—1000 points horizontal, 250 points vertical; A and B Views; Save A; Max Hold; B-Save A; digital averaging (peak/average); Pulse Stretcher.

Nonvolatile Display Memory—Store and recall up to nine full waveforms complete with CRT readouts and instrument settings.

GENERAL

Battery-Powered Memory—Nine instrument settings plus power-down settings, Nine full waveforms plus readouts. Eight macros, frequency and amplitude calibration factors, 39 preselector peaks and 12 external band peaks are stored in nonvolatile RAM. Battery life ≥5 years at 25 °C, >1 year at 55 °C.

Power—210 W max with all options, at 115 V and 60 Hz.

Input Voltage—90 to 132 V ac, 48 to 448 Hz, or 180 to 250 V ac, 48 to 440 Hz.

Configuration—Bench/Rackmount. Approx. 27 kg (61 lb.) 177.8×431.8×609.6 mm (7×17×24 in.).

SWEEP/TRIGGERING

Sweep Modes—Triggered, auto, manual, single sweep, and external manual scan.

Sweep Time—20 μs to 5 s/div (10 s/div in auto) in a 1-2-5 sequence; accuracy ±5% over center 8 divisions.

Triggering—Internal, External, Line, and Free Run; internal trigger level ≥2 divisions of signal; external level ≥1 V peak, 15 Hz to 500 kHz, 50 V maximum (dc+ac peak).

ENVIRONMENTAL

Per MIL-T-28800C Type III, Class 5, Style E.

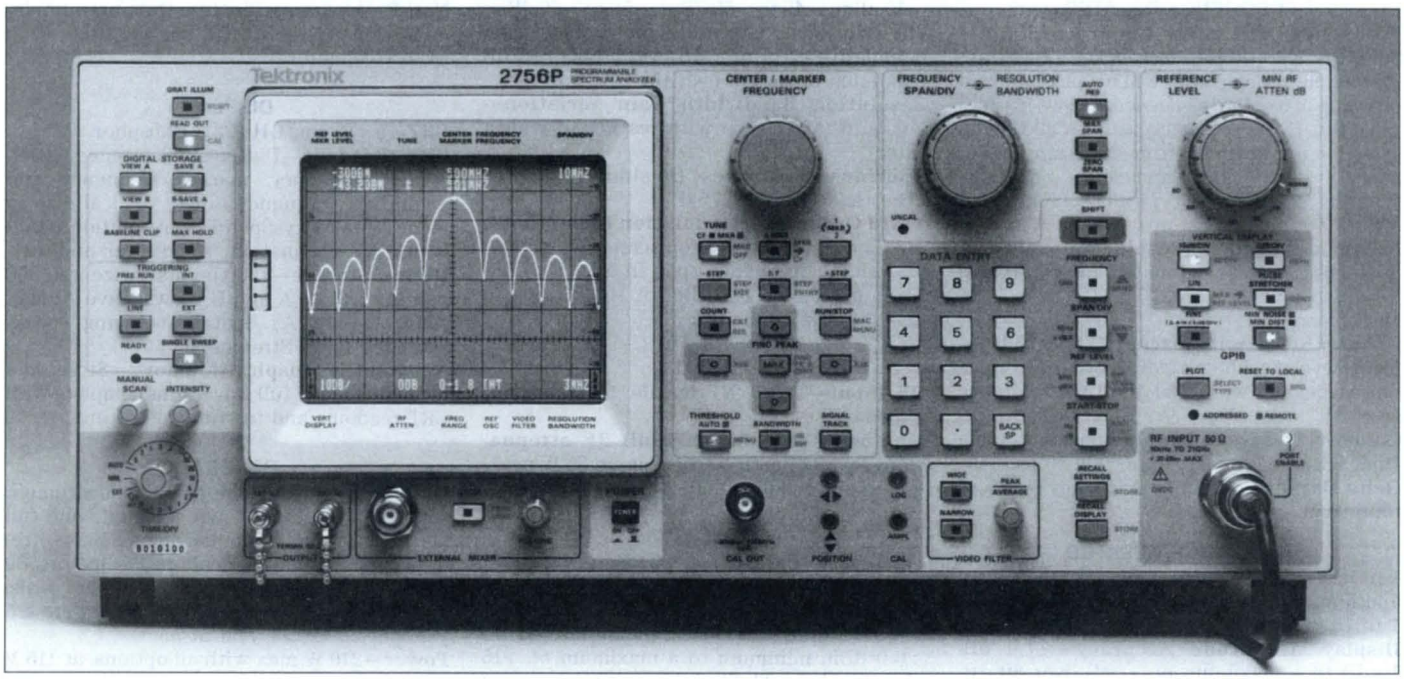
Temperature—Operating: 0 to +50 °C. Nonoperating: −40 to +75 °C.

Humidity—95% below +30 °C, 75% above +30 °C, 45% above +40 °C.

Altitude—Operating: 10,000 feet. Nonoperating: 40,000 feet.

Electromagnetic Compatibility—The 2750/P Series Spectrum Analyzers meet the requirements of MIL-STD-461B with some exceptions.

2756P LABORATORY SPECTRUM ANALYZER TOP-OF-THE-LINE PERFORMANCE AT AN AFFORDABLE PRICE



TYPICAL APPLICATIONS

- Satellite Communications
- Broadcasting
- Cellular Radio
- EMI/RFI
- Terrestrial Microwave
- EW
- Millimeter Wave
- ATE
- Nuclear Physics
- Radio Astronomy
- Microwave Landing Systems
- Carrier/Noise
- Spur Searches
- Spectral Monitoring
- Carrier On/Off Ratios
- Harmonic Distortion
- Frequency Counting
- Carrier Level Monitoring
- Pulse Analysis

BENEFITS

- Large, Easy-to-Use Controls
- Plot Data Directly Without a Controller
- Fully GPIB Programmable
- Optional MATE/CIIL Compatibility for System Integration

FEATURES

- Covers 10 kHz to 325 GHz, −131 dBm Sensitivity, and 10 Hz to 3 MHz Resolution
- 90 dB Display Dynamic Range
- Built-in High Performance Microwave Frequency Counter
- Excellent Marker and Center Frequency Accuracy (Up to 10^{-9}/day) and External Reference Input for Locking to a System Clock
- Macro Programming Saves Frequently-Used Measurement Programs in Nonvolatile Instrument Memory
- Intelligent Markers with Signal Processing Functions Using Unique Marker Keypad
- Dedicated Data Keypad for Entry of Key Control Parameters
- Internal Preselection
- Push-button Occupied Bandwidth and Noise Normalization Functions
- Nonvolatile Memory for Up to Nine Waveforms and Ten Front Panel Settings

CHARACTERISTICS*

The following characteristics apply after a 30 minute warmup period unless otherwise noted.

FREQUENCY RELATED

Frequency Range—10 kHz to 21 GHz coaxial input, to 325 GHz with external mixer input (specified from 18 to 325 GHz with Tektronix WM490 Series Waveguide Mixers).

Center and Marker Frequency Accuracy—±[20% D + (F×REF) + (2N+25) Hz] with Span/Div ≤200 kHz for Bands 1 & 5-12 or Span/Div ≤100 kHz for Bands 2-4 (Phase locked); Otherwise (unlocked) ± [20% D + (F×REF) + (15N) kHz].
Where: D = Span/Div or Resolution BW, whichever is greater.
F = Center or Marker Frequency.
N = Harmonic Mixing Number.
REF = Reference Frequency Error.

Reference Frequency Error (REF)—Internal: $\leq 1\times10^{-9}$ per day; $\leq 1\times10^{-7}$ in the first six months, $\leq 1\times10^{-7}$ per year thereafter; Accuracy 30 minutes after power on within 5×10^{-8} of the frequency after 24 hours; Within 2×10^{-8} over the temperature range of −15 to +55 °C.

Counter Readout Resolution—Selectable from 1 Hz to 1 GHz in decade steps.

Signal Counter Accuracy—±[(F×REF) + (5+N) Hz + 1 LSD].

Delta Counter Accuracy—±[(ΔF×REF) + (10+2N) Hz + 1 LSD].
Where: ΔF = Delta Frequency.
REF = Reference Frequency Error.
N = Harmonic Mixing Number.
LSD = Least Significant Digit.

Residual FM—≤(5+N) Hz peak-to-peak in 20 msec, Span/Div ≤200 kHz for Bands 1 & 5-12 or Span/Div ≤100 kHz for Bands 2-4 (Phase locked); Otherwise (unlocked) ≤(7 kHz) N peak to peak in 20 msec.

Resolution Filters—10 Hz to 1 MHz in decade steps and 3 MHz; 6 dB bandwidth ±20% except 10 Hz; Shape factor ≤7.5:1 except 10 Hz where 60 dB BW ≤150 Hz.

Frequency Span/Division—0 Hz; 10 Hz to 10 GHz (in a 1-2-5 sequence).

Noise Sidebands:

dBc/Hz	Offset from Carrier
−80	300 Hz
−90	3 kHz
−105	30 kHz
−115	300 kHz
−125	3 MHz

AMPLITUDE RELATED

Display Dynamic Range—90 dB Log mode; 8 divisions Linear mode.

Reference Level Range—Log Mode: −117 to +50 dBm, (+30 dBm*[1]);
−130 to +37 dBV, (+17 dBV*[1]);
−70 to +97 dBmV, (+77 dBmV*[1]);
−10 to +157 dBμV, (+137 dBμV*[1]).
Linear Mode: 39.6 nV/Div to 2.8 V/Div, (7.1 V*[1]).

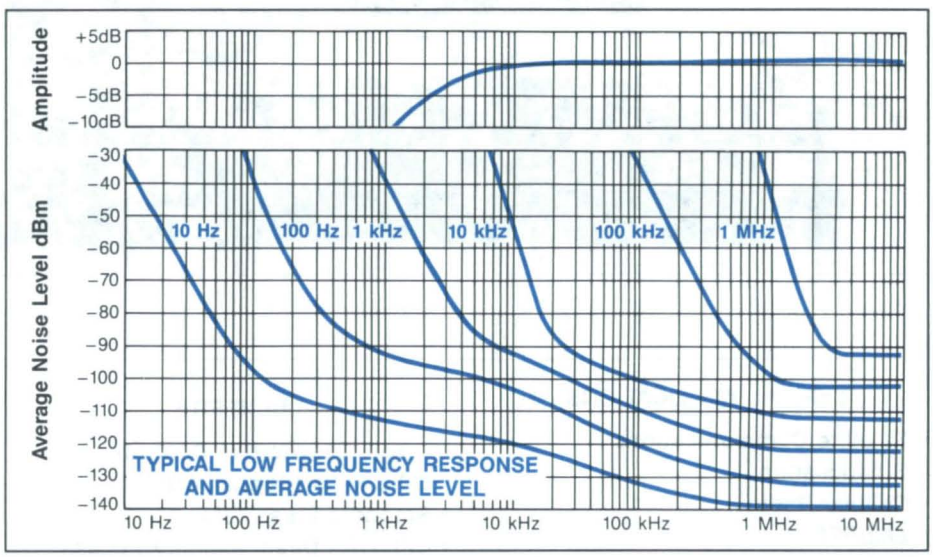
*[1] *Maximum safe input level (1 Watt).*

IF Gain Range—87 dB increase, 20 dB decrease in MIN NOISE and Reduced Gain Mode, 10 dB and 1 dB steps; 57.75 dB in 0.25 dB steps (ΔA Mode).

SENSITIVITY AND FREQUENCY RESPONSE

Band and Frequency Range	Harmonic Number	Sensitivity (dBm) at Minimum Resolution	Frequency Response (dB)*[1]
1 (10 kHz–1.8 GHz)	1	−131	±1.5
2 (1.7–5.5 GHz)	1	−125	±2.5
3 (3–7.1 GHz)	1	−125	±2.5
4 (5.4–12 GHz) (12–18 GHz)	3	−111 −107	±3.5
5 (15–21 GHz)	3	−106	±5.0
6 (18–27 GHz)	6	−116	±2.0
7 (26–40 GHz)	10	−111	±2.0
8 (33–50 GHz) (40–60 GHz)	10	−111	±2.0 ±2.5
9 (50–90 GHz)	15	−105 at 50 GHz −95 at 90 GHz	±3.0*[2]
10 (75–140 GHz)	23	−100 at 75 GHz −85 at 140 GHz	±3.0*[2]
11 (110–220 GHz)	37	−90 at 110 GHz −75 at 220 GHz	±3.0*[2]
12 (170–325 GHz)	56	−70 at 170 GHz −55 at 325 GHz	±3.0*[2]

*[1] *Measured with 10 dB RF Attenuation and peaking optimized. Frequency response is within ±4.5 dB from 10 kHz to 18 GHz.*
*[2] *Frequency response for any 5 GHz band. Response is within ±6 dB referenced to 100 MHz.*



Power Line Related Sidebands—≤ −55 dBc for line frequencies from 47 to 440 Hz.

Harmonic Distortion—≤ −60 dBc, ≤ −100 dBc for Bands 2-5, for a −40 dBm CW signal with 0 dB RF Attentuation in MIN DISTORTION mode and without Reduced Gain Mode.

1 dB Gain Compressioon— −10 dBm in MIN NOISE, −20 dBm MIN DISTORTION, 0 dB RF attenuation.

INPUT

External Reference Input—1,2,5 or 10 MHz ±5 PPM; −15 dBm to +15 dBm; 50 Ω; Sine, ECL, TTL, 50% ±10% Duty Factor.
Input Impedance: 50 Ω ac; rear-panel BNC input.

50 Ω/75 Ω OPTION 07

Provides 75 Ω input and dBmV calibration in addition to the normal 50 Ω input and dBm calibration. The 100 kHz resolution filter is replaced by 300 kHz to optimize the instrument for broadcast and CATV uses.

Center Frequency Range—1 MHz to 1000 MHz.

ORDERING INFORMATION

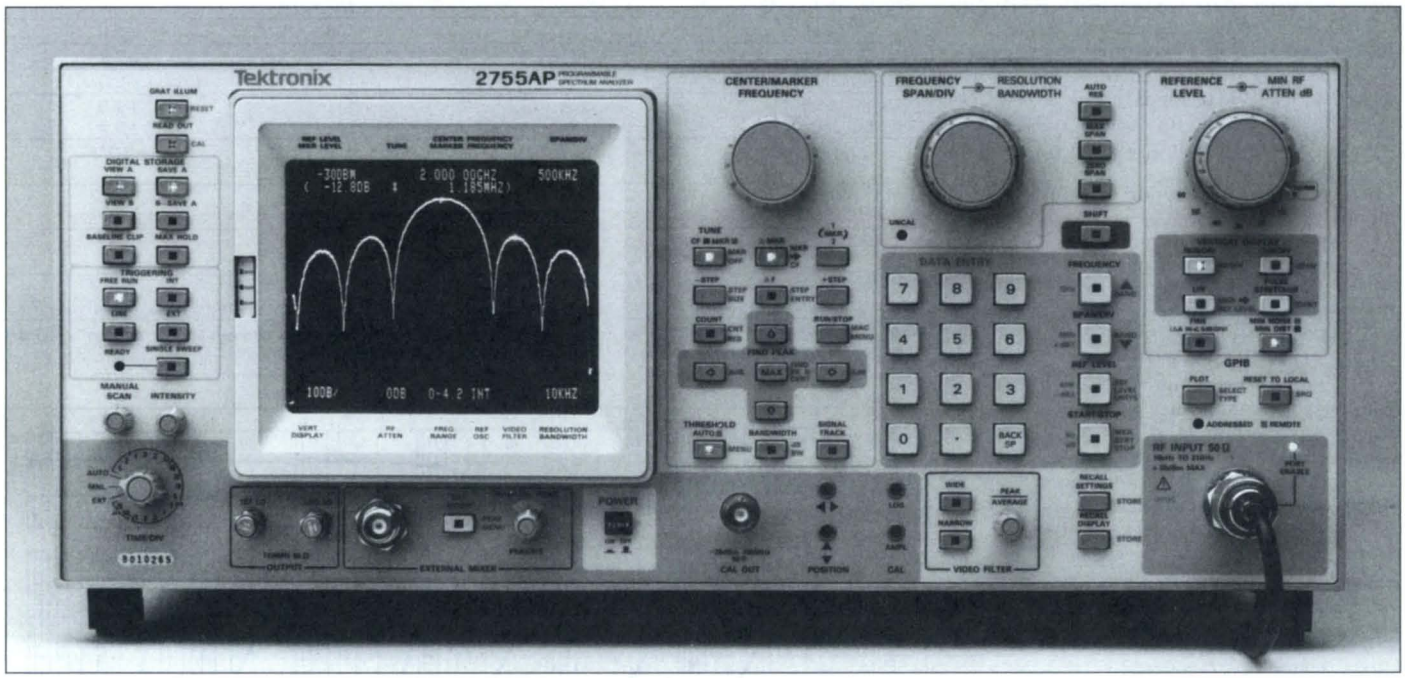
2756P Programmable Spectrum Analyzer. **$41,995**
Includes: 6 ft, N to N connector, 50 Ω coax cable (012-0114-00); 18-in., BNC-to-BNC connector, 50 Ω coax cable (012-0076-00); N male-to-female adapter (103-0045-00); 4-A fast-blow fuses (159-0017-00); power cord (161-0104-00); blue CRT filter (378-0115-00); amber CRT light filter (378-0115-01); CRT mesh filter (378-0227-01); operator's manual (070-6317-00); programmer's manual (070-6320-00).

***WARRANTY-PLUS* SERVICE PLANS**

Option M1—Available. **+$2,120**
Option M2—Available. **+$3,770**
Option M3—Available. **+$4,240**
See page 562 for description.

*Common Series Characteristics are listed on page 105.
For complete option and accessory information refer to pages 100, 101, and 135.
For more detailed specification information contact your local Sales Engineer (see pages 568–571) for a product-specific data sheet.

EASY TO USE...
LAB PERFORMANCE PACKAGED...
NEW 2755AP SPECTRUM ANALYZER



TYPICAL APPLICATIONS

- Satellite Communications
- Broadcasting
- Cellular Radio
- EMI/RFI
- Terrestrial Microwave
- EW
- Millimeter Wave
- ATE
- Nuclear Physics
- Radio Astronomy
- Microwave Landing Systems
- Carrier/Noise
- Spur Searches
- Spectral Monitoring
- Carrier On/Off Ratios
- Harmonic Distortion
- Frequency Counting
- Carrier Level Monitoring
- Pulse Analysis

BENEFITS

- Large, Easy-to-Use Controls
- GPIB/Fully Programmable
- Standard Preselector
- CIIL with Direct Memory Access (Option 45)
- Macro Capability

FEATURES

- Lab Performance Packaged for Engineering and Manufacturing Use
- Built-in Signal Counter with External Reference Input for Higher Accuracy if Needed
- Frequency Accurate to 10^{-6}
- 2×10^{-9}/day Reference Accuracy
- Frequency Range from 10 kHz to 325 GHz
- Multiband Sweep with 3 MHz Bandwidth for More Information Content
- CW, Pulse and Spurious Signal Processing Modes
- Keypad Entry of Frequency, Span/Div, Reference Level and Vertical Scale Factors
- Environmentalized per MIL-T-28800C Type III, Class 5, Style E
- Direct Plot Without Controller for All Configurations

CHARACTERISTICS*

The following characteristics apply after a 30 minute warmup period unless otherwise noted.

FREQUENCY RELATED

Frequency Range—10 kHz to 21 GHz coaxial input; to 325 GHz with external mixer input (specified from 18 to 325 GHz with Tektronix WM490 Series Waveguide Mixers).

Center and Marker Frequency Accuracy—$\pm$[20% D + (F×REF) + (2N+25)] Hz, Bands 1 and 5–12 with Span/Div $\leq$200 kHz, and Bands 2–4 with Span/Div $\leq$100 kHz (Phase locked); $\pm$[20% D + (F×REF) + 15N kHz] (unlocked).

Where: D = Span/Div or Resolution BW, whichever is greater.
F = Center or Marker Frequency.
N = Harmonic Mixing Number.
REF = Reference Frequency Error.

Reference Frequency Error (REF)—$\leq 2\times10^{-9}$ per day; $\leq 1.4\times10^{-8}$ per week, $\leq 3.5\times10^{-7}$ first six months, $\leq 5\times10^{-7}$ per year, $\leq 10^{-6}$ @ 25 °C and 30 minutes after power-up, $\leq 1.5\times10^{-5}$ over operating temperature range.

Counter Readout Resolution—Selectable from 1 Hz to 1 GHz in decade steps.

Signal Counter Accuracy—$\pm$[(F×REF) + (10+N) Hz +1 LSD].

Delta Counter Accuracy—$\pm$[(ΔF×REF) + (20+2N) Hz +1 LSD].

Where: ΔF = Delta Frequency.
REF = Reference Frequency Error.
N = Harmonic Mixing Number.
LSD = Least Significant Digit.

Residual FM—$\leq$(10+2N) Hz peak-to-peak in 20 ms, Bands 1 and 5–12 with Span/Div $\leq$200 kHz, and Bands 2–4 with Span/Div $\leq$100 kHz (Phase locked); $\leq$(7 kHz) N peak-to-peak in 20 ms unlocked.

Resolution Filters—100 Hz to 1 MHz in decade steps and 3 MHz (6 dB bandwidth ±20%). Shape factor $\leq$7.5:1 (60 dB/6 dB).

Frequency Span/Division—0 Hz, 100 Hz to 10 GHz (in a 1-2-5 sequence).

AMPLITUDE RELATED

Display Dynamic Range—90 dB Log mode $\leq$12 dB/Div; 8 divisions Linear.

Reference Level Range—Log Mode:
−117 to +50 dBm, (+30 dBm*1);
−130 to +37 dBV, (+17 dBV*1);
−70 to +97 dBmV, (+77 dBmV*1);
−10 to +157 dBμV, (+137 dBμV*1).
Linear Mode: 39.6 nV/Div to 2.8 V/Div, (7.1 V*1).

*1 *Maximum safe input level (1 watt).*

Noise Sidebands:

dBc/Hz	Offset From Center
$\leq$−90	3 kHz
$\leq$−105	30 kHz
$\leq$−115	300 kHz

Harmonic Distortion—$\leq$ −60 dBc for a −40 dBm input 10 kHz to 21 GHz in MIN Distortion mode. Not discernible above the noise (typically −100 dBc) for preselected bands.

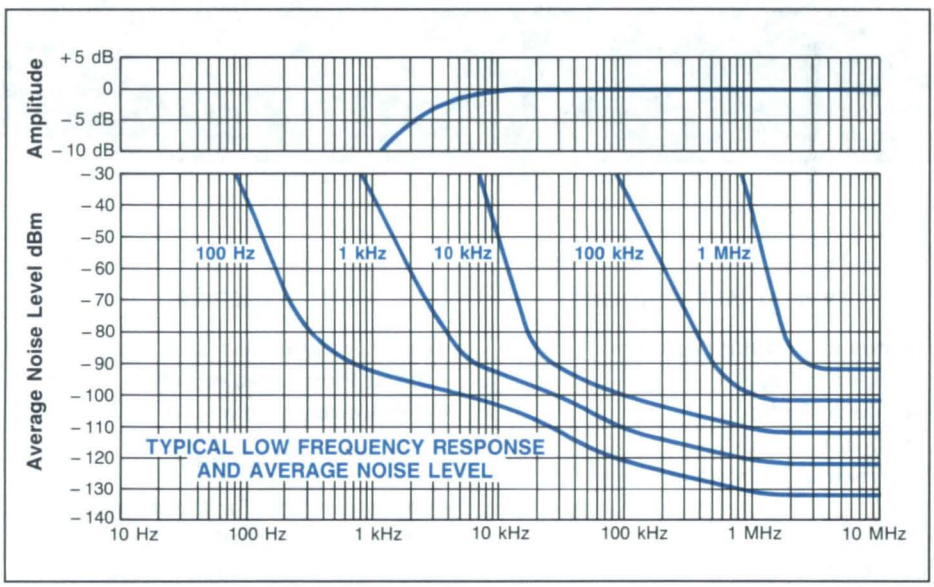
SENSITIVITY AND FREQUENCY RESPONSE

Band and Frequency Range	Harmonic Number	Sensitivity at (dBm) Minimum Resolution	Frequency Response (dB)*2
1 (10 kHz–1.8 GHz)	1	−120	±1.5
2 (1.7–5.5 GHz)	1	−120	±2.5
3 (3–7.1 GHz)	1	−119	±2.5
4 (5.4–12 GHz) (12–18 GHz)	3 3	−105 −100	±3.5
5 (15–21 GHz)	3	− 99	±5.0
6 (18–27 GHz)	6	−108	±2.0
7 (26–40 GHz)	10	−103	±2.0
8 (33–60 GHz)	10	−103	±2.0 33 to 50 GHz ±2.5 40 to 60 GHz
9 (50–90 GHz)	15	−95 at 50 GHz*3 −85 at 90 GHz*3	±3.0*1
10 (75–140 GHz)	23	−90 at 75 GHz*3 −75 at 140 GHz*3	±3.0*1
11 (110–220 GHz)	37	−80 at 110 GHz*3 −65 at 220 GHz*3	±3.0*1
12 (170–325 GHz)	56	−70 at 170 GHz*3 −55 at 325 GHz*3	±3.0*1

*1 *Typical frequency response for any 5 GHz band. Response is typically within ±6 dB referenced to 100 MHz.*

*2 *Measured with 10 dB RF Attenuation and peaking optimized (when applicable). Frequency response within ±4.5 dB from 10 kHz to 18 GHz referenced to 100 MHz.*

*3 *Typical sensitivity.*



INPUT

1 dB Gain Compression—−23 dBm in MIN Distortion Mode, −13 dBm in MIN NOISE Mode, 0 dB attenuation.

Maximum Safe Input—+30 dBm (1 W) CW; 75 W peak, 1 μs pulse width, 0.001 duty, 0 dlB attenuation. Do not apply dc.

ORDERING INFORMATION

2755AP Spectrum Analyzer. **$29,995**
Includes: 50 Ω coax cable, N to N connector, 6 ft (012-0114-00); 50 Ω coax cable, BNC to BNC connector, 18 in. (012-0076-00); N male to BNC female adapter (103-0045-00); 2 Fast-Blo, 4A fuses (159-0017-00); power cord (161-0104-00); CRT amber light filter (378-0115-01); blue CRT filter (378-0115-00); CRT mesh filter (378-0227-01); operator's manual (070-6031-01); programmer's manual (070-6034-01).

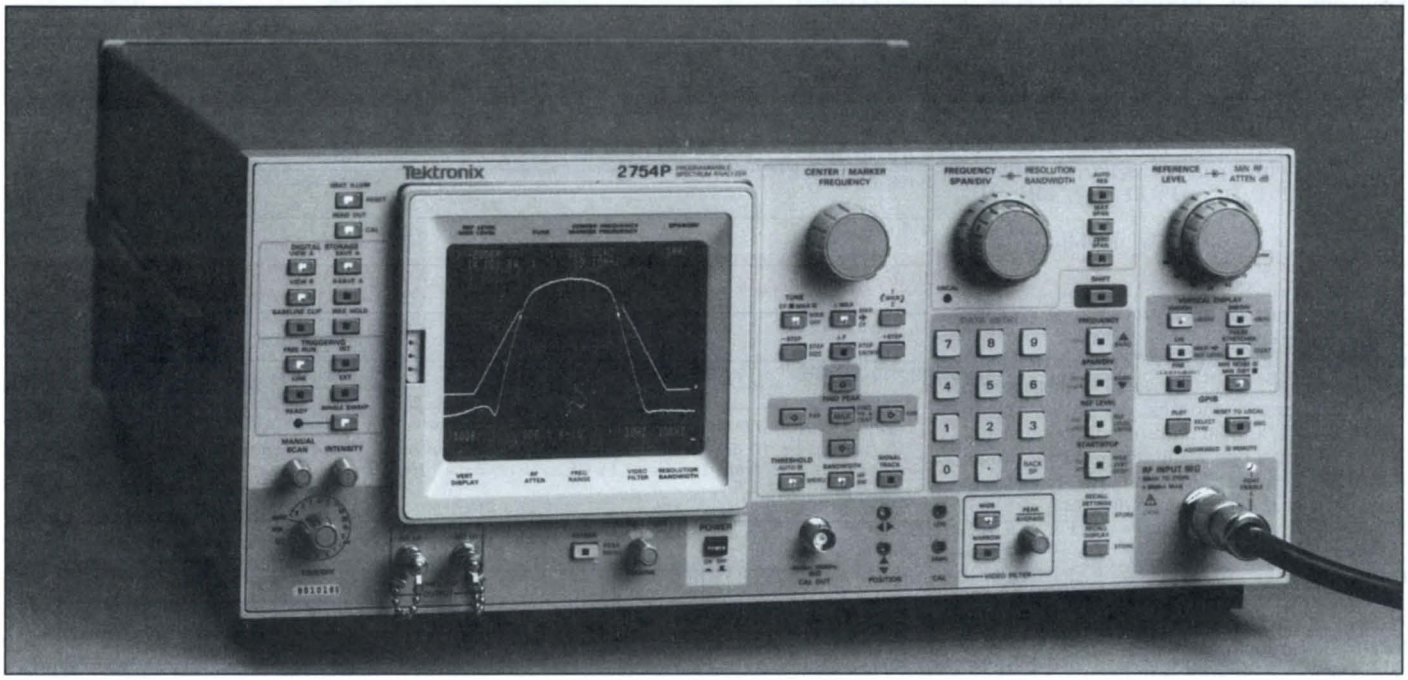
***WARRANTY-PLUS* SERVICE PLANS**

Option M1—Available. **+$1,995**
Option M2—Available. **+$3,380**
Option M3—Available. **+$3,995**

See page 562 for description.

*Common Series Characteristics are listed on page 105.
For complete option and accessory information refer to pages 100, 101, and 135.
For more detailed specification information contact your local Sales Engineer (see pages 568–571) for a product-specific data sheet.

LOW COST, AUTOMATED, MICROWAVE 2754/2754P SPECTRUM ANALYZERS



TYPICAL APPLICATIONS

- Satellite Communications
- Broadcasting
- Cellular Radio
- EMI/RFI
- Terrestrial Microwave
- EW
- ATE
- Carrier/Noise
- Spur Searches
- Spectral Monitoring
- Carrier On/Off Ratios
- Harmonic Distortion
- Carrier Level Monitoring
- Pulse Analysis

BENEFITS

- Large, Easy-to-Use Controls
- Direct Plot Capability (all versions)
- Microwave Preselection

FEATURES

- Rackmountable for Engineering and Manufacturing System Use
- 50 kHz to 21 GHz Frequency Range
- Marker and Center Frequency Accuracy of 10^{-5}
- Built-in Signal Processing Intelligence
  - Search, Sort and Mark CW, Pulse or Spurious Signals
  - Exclusive Occupied Bandwidth Mode
  - Signal Tracking
  - Noise Normalization to 1 Hz
- Nonvolatile Memory for Storage of Up to Nine Waveforms and Nine Front Panel Displays
- Direct Keypad Entry of Control Parameters
- 1 kHz Resolution Bandwidth

CHARACTERISTICS*

The following characteristics apply after a 30 minute warmup period unless otherwise noted.

FREQUENCY RELATED

Frequency Range—50 kHz to 21 GHz in coaxial input.

Center and Marker Frequency Accuracy*[1]—$\pm[20\%\ D + (F\times10^{-5}) + (2N+25)]$ Hz. Bands 1 & 5 with Span/Div ≤200 kHz, and Bands 2–4 with Span/Div ≤100 kHz (Phase locked); $\pm[20\%\ D + (F\times10^{-5}) + 15N$ kHz] (unlocked).

Where: D = Span/Div or Res BW, whichever is greater.
F = Center or Marker Frequency.
N = Harmonic Mixing Number.

*[1] *Over the operating temperature extremes of 0 to +50°C, 1.5×10^{-5}.*

Residual FM—≤(10+2N) Hz peak to peak in 20 ms, Bands 1 and 5 with Span/div ≤200 kHz, and Bands 2–4 with Span/div ≤100 kHz (Phase locked); ≤(7 kHz) N peak-to-peak in 20 ms (unlocked).

Resolution Filters—1 kHz to 1 MHz (6 dB bandwidth ±20%) in decade steps. Shape factor ≤7.5:1 (60 dB/6 dB).

Frequency Span/Division—0 Hz; 200 Hz to 1 GHz (in a 1-2-5 sequence).

Noise Sidebands:

dBc/Hz	Offset From Center
≤−103	30 kHz
≤−113	300 kHz

AMPLITUDE RELATED

Display Dynamic Range—80 dB log mode; 8 divisions linear.

Reference Level Range—Log Mode:
−117 to +40 dBm, (+30 dBm*[1]);
−130 to +27 dBV, (+17 dBV*[1]);
−70 to +87 dBmV, (+77 dBmV*[1]);
−10 to +147 dBμV, (+137 dBμV*[1]).
Linear Mode: 39.6 nV/Div to 2.8 V/Div, (7.1 V*[1]).

*[1] *Maximum safe input level (1 Watt).*

Harmonic Distortion—≤ −60 dBc for a −40 dBm input 50 kHz to 21 GHz in MIN Distortion mode. Not discernible above the noise (typically −100 dBc) for preselected bands.

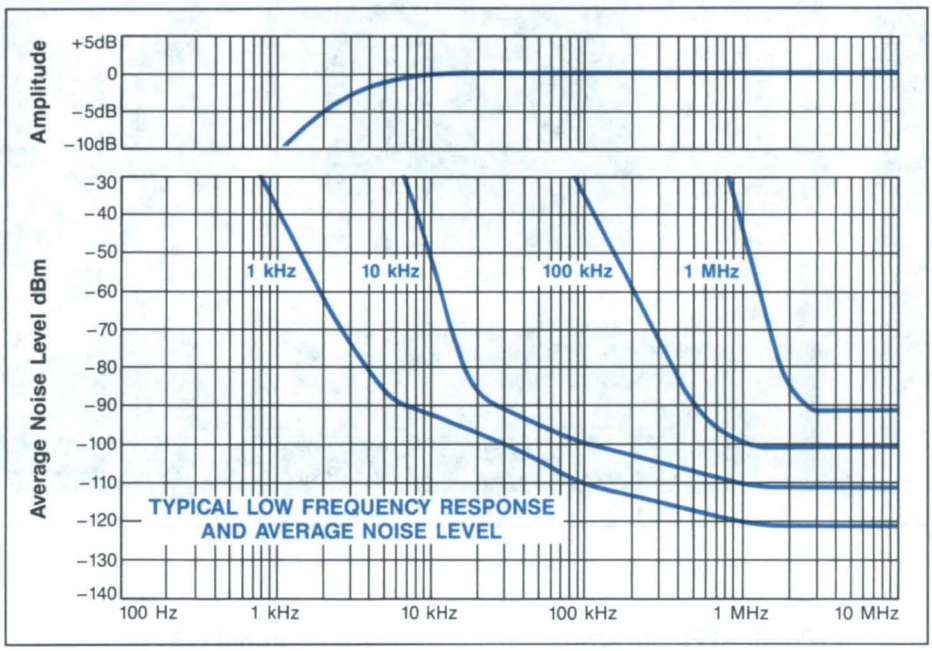
INPUT

1 dB Gain Compression—−13 dBm in MIN NOISE, −23 dBm in MIN DISTORTION, 0 dB RF attenuation (no gain compression can be observed on screen).

SENSITIVITY AND FREQUENCY RESPONSE

Band and Frequency Range	Harmonic Number	Sensitivity at (dBm) Minimum Resolution	Frequency Response (dB)*[1]	Frequency Response Ref to 100 MHz
1 (50 kHz–1.8 GHz)	1	−110	±2.0	±3.0 dB
2 (1.7–5.5 GHz)	1	−108	±3.0	±4.0 dB
3 (3.0–7.1 GHz)	1	−108	±3.0	±4.0 dB
4 (5.4–12 GHz)	3	−94	±4.0	±5.0 dB
(12-18 GHz)	3	−89	±4.0	±5.0 dB
5 (15–21 GHz)	3	−88	±5.5	±7.0 dB

*[1] *Measured with 10 dB RF Attenuation and peaking optimized (when applicable).*



50 Ω/75 Ω OPTION 07
50 Ω INPUT RELATED

300 kHz Resolution Filter—Replaces 100 kHz Filter.

Sensitivity—Average Noise level is −85 dBm in 300 kHz BW.

75 Ω INPUT RELATED

Center Frequency Range—1 MHz to 1 GHz.

RF Input—Type BNC Female Connector.

Input Coupling—100 V dc Maximum (dc + ac peak).

ORDERING INFORMATION

2754 Spectrum Analyzer. **$19,900**
Includes: 50 Ω coax cable, N to N connector, 6 ft; (012-0114-00); 50 Ω coax cable, BNC to BNC connector, 18 in. (012-0076-00); operator's manual (070-6096-00); N male to BNC female adapter (103-0045-00); 2 Fast-Blo, 4A fuses (159-0017-00); power cord (161-0104-00); amber CRT light filter (378-0115-01); blue CRT filter (378-0115-00).

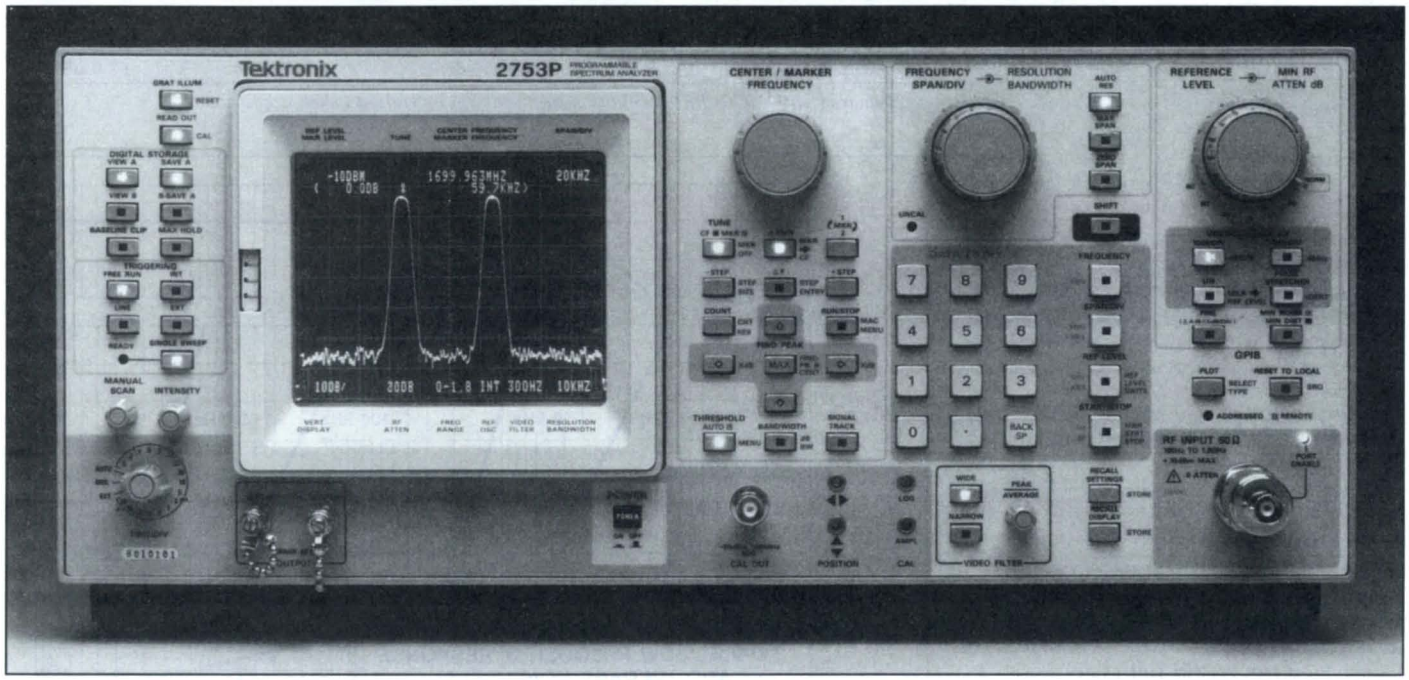
2754P Programmable Spectrum Analyzer **$19,900**
Includes: Same as 2754 plus programming manual (070-6099-00).

WARRANTY-PLUS SERVICE PLANS

Option M1—Available.
(2754) **+$2,025**
(2754P) **+$1,995**
M2—Available.
(2754) **+$3,510**
(2754P) **+$3,380**
M3—Available.
(2754) **+$4,045**
(2754P) **+$3,995**
See page 562 for description.

*Common Series Characteristics are listed on page 105.
For complete option and accessory information refer to pages 100, 101, and 135.
For more detailed specification information contact your local Sales Engineer (see pages 568–571) for a product-specific data sheet.

SETTING STANDARDS FOR VHF/UHF PERFORMANCE FOR THE LAB 2753P SPECTRUM ANALYZER



TYPICAL APPLICATIONS

- Baseband Measurements
- ATE
- Two-Way Radio
- LAN
- Broadcasting
- CATV
- Cellular Radio
- Avionics
- EMI/RFI
- EW
- Carrier/Noise
- Spur Searches
- Spectral Monitoring
- Carrier On/Off Ratios
- Harmonic Distortion
- IF Amplifier Adjustments
- Frequency Counting
- Carrier Level Monitoring
- Modulation Adjustments

BENEFITS

- Large Easy-To-Use Controls
- Superior Rack Profile
- Nonvolatile Memory for Up to Nine Waveforms and Ten Front Panel Settings
- Optional MATE/CIIL Compatibility for Military System Integration
- Plot Data Directly Without a Controller

FEATURES

- Covers 100 Hz to 1800 MHz With −131 dBm Sensitivity and ±1.0 dB Frequency Response
- 10 Hz to 3 MHz Resolution Bandwidth
- 10^{-9} /day Marker and Center Frequency Accuracy
- External Reference Input Provides Flexibility of Tying in With a System Clock
- Built-in Signal Counter—Count at Any Point Marked or Between Any Two Marked Points
- Macro Programming Saves Frequently Used Measurement Programs In Nonvolatile Instrument Memory
- Intelligent Markers With Signal Processing Functions
- Push-Button Occupied Bandwidth and Noise Normalization Functions
- Switch Selectable 50 Ω and 75 Ω Impedances (Option 07) for IF, CATV and Local Area Network Applications
- Dedicated Keypad Entry of Control Parameters

CHARACTERISTICS*

The following characteristics apply after a 30 minute warmup period unless otherwise noted.

FREQUENCY RELATED

Frequency Range—100 Mz to 1800 MHz.

Center and Marker Frequency Accuracy—$\pm$[20%D + (F×REF) + 15 Hz] with Span/Div ≤200 kHz (phase locked); $\pm$[20%D + (F×REF) +15 kHz] with Span/Div >200 kHz (unlocked). Where: D = Span/Div or Resolution BW, whichever is greater.
F = Center or Marker Frequency.
REF = Reference Frequency Error.

Reference Frequency Error (REF)—Using internal standard: $\leq 10^{-9}$ per day. $\leq 10^{-7}$ first six months. $\leq 10^{-7}$ per year thereafter. Within 2×10^{-8} over temperature range of −15 °C to +55 °C.

Counter Readout Resolution—Selectable from 1 Hz to 100 MHz in decade steps.

Signal Counter Accuracy—$\pm$[(F×REF) +5 Hz +1 LSD].
Where: F = Center, Marker, or Delta Marker Frequency.
LSD = Least Significant Digit.
REF = Reference Frequency Error.

Delta Counter Accuracy—$\pm$[(ΔF×REF) + (10+2N) Hz+1 LSD].
Where: ΔF = Delta Frequency.
REF = Reference Frequency Error.
N = Harmonic Mixing Number.
LSD = Least Significant Digit.

Residual FM—≤5 Hz peak-to-peak in 20 msec, Span/Div ≤200 kHz (phase locked); ≤7 kHz peak-to-peak in 20 msec, Span/Div >200 kHz (unlocked).

Resolution Filters—3 MHz, then 1 MHz to 10 Hz in decade steps (6 dB bandwidth ±20% except 10 Hz); Shape factor (60:6 dB) ≤7.5:1; 10 Hz Bandwidth, ≤150 Hz @ 60 dB down.

Frequency Span/Division—0 Hz; 10 Hz to 100 MHz (in a 1-2-5 sequence); 180 MHz MAX SPAN.

Frequency Response—±1.0 dB (measured with 10 dB RF attenuation).

Noise Sidebands:

dBc/Hz	Offset From Carrier
− 80	300 Hz
− 90	3 kHz
−105	30 kHz
−115	330 kHz
−125	3 MHz

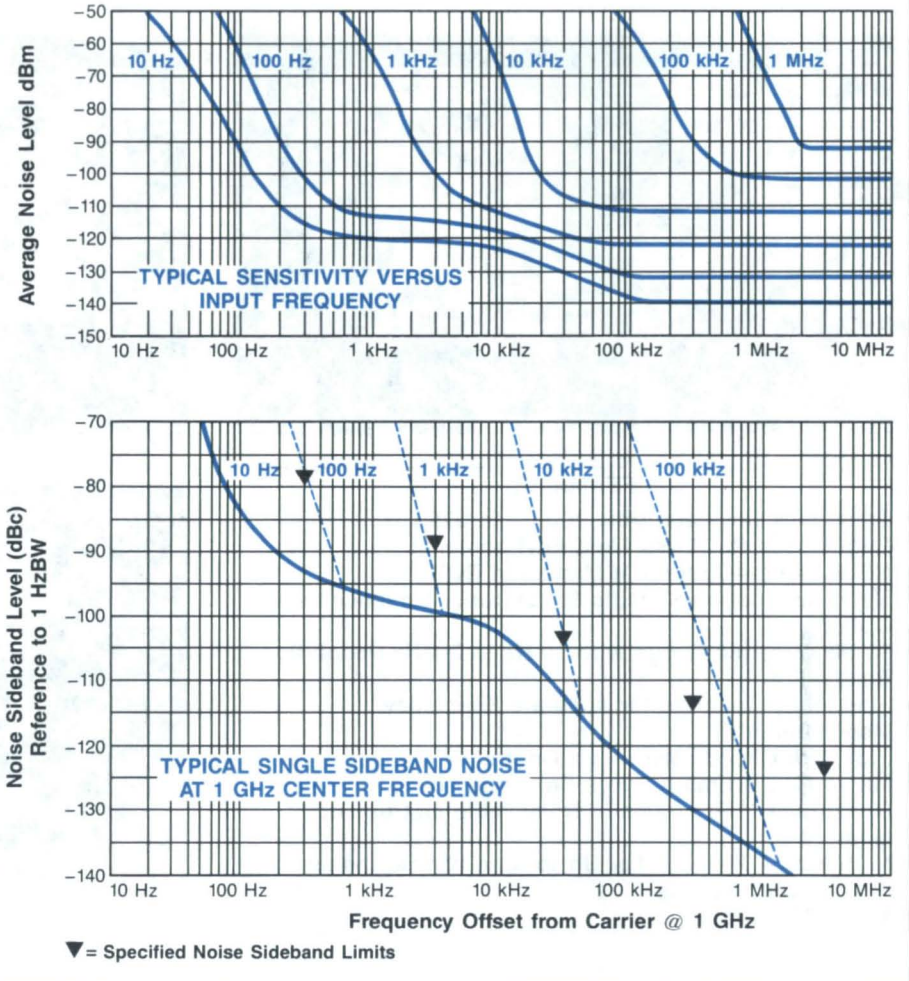
AMPLITUDE RELATED

Display Dynamic Range—90 dB LOG mode; 8 divisions LINEAR mode.

Reference Level Range—Log Mode:
−117 to +50 dBm, (+30 dBm*[1]);
−130 to +37 dBV, (+17 dBV*[1]);
−70 to +97 dBmV, (+77 dBmV*[1]);
−10 to +157 dBμV, (+137 dBμV*[1]).
Linear Mode: 39.6 nV/Div to 2.8 V/Div, (7.1 V*[1]).

*[1] *Maximum safe input level (1 Watt).*

Harmonic Distortion—≤ −60 dBc for a −30 dBm CW signal with 0 dB RF attenuation in MIN DISTORTION mode.



Sensitivity (Equivalent Input Noise):

Sensitivity dBm	Resolution BW
−131	10 Hz
−125	100 Hz
−115	1 kHz
−105	10 kHz
− 95	100 kHz
− 85	1 MHz
− 80	3 MHz

INPUT

1 dB Gain Compression—−13 dBm with 0 dB RF attenuation in Min Noise; −23 dBm with 0 dB RF attenuation in MIN DISTORTION; (No gain compression can be observed on screen).

External Reference Input—1,2,5 or 10 MHz ±PPM; −15 dBm to +15 dBM; 50 Ω; Sine, ECL, TTL, 50% ±10% Duty Factor. Input Impedance: 50 Ω ac, 500 Ω dc; rear-panel BNC input.

OPTION 07 (50 Ω/75 Ω)

Provides 75 Ω input and dBmV calibration in addition to the normal 50 Ω input and dBm calibration. The 100 kHz resolution filter is replaced by 300 kHz to optimize the instrument for broadcast and CATV uses.

Center Frequency Range—1 to 1000 MHz.

Frequency Response—±2.0 dB from 5 to 1000 MHz; typical response for the 1 to 5 MHz frequency range is <3 dB down from the 5 MHz response.

ORDERING INFORMATION

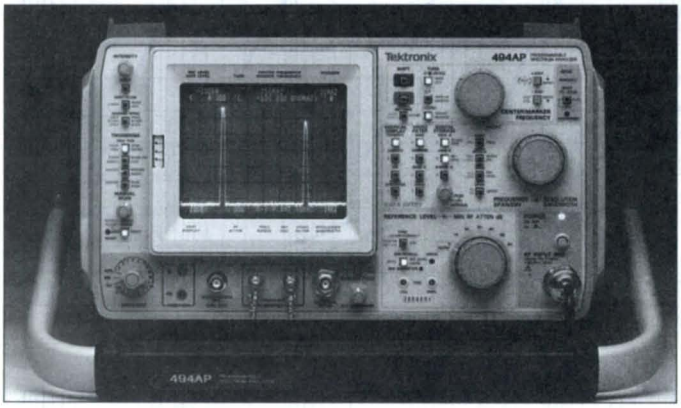
2753P Programmable Spectrum Analyzer. **$27,250**
Includes: 6 ft, N to N connector, 50 Ω coax cable (012-0114-00); 18-in., BNC-to-BNC connector, 50 Ω coax cable (012-0076-00); N male-to-BNC female adapter (103-0045-00); 4-A fast-blow fuses (159-0017-00); power cord (161-0104-00); blue CRT filter (378-0115-00); amber CRT light filter (378-0115-01); CRT mesh filter (378-0227-01); operator's manual (070-6305-00); programmer's manual (070-6308-00).

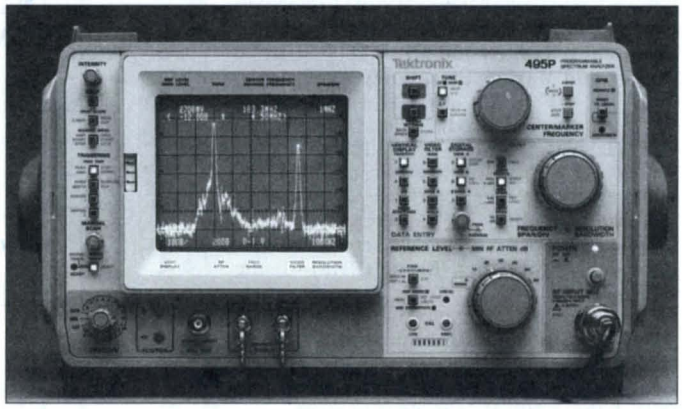
WARRANTY-PLUS SERVICE PLANS

Option M1—Available. **+$1,810**
Option M2—Available. **+$3,015**
Option M3—Available. **+$3,620**
See page 562 for description.

*Common Series Characteristics are listed on page 105.
For complete option and accessory information refer to pages 100, 101, and 135.
For more detailed specification information contact your local Sales Engineer (see pages 568–571) for a product-specific data sheet.

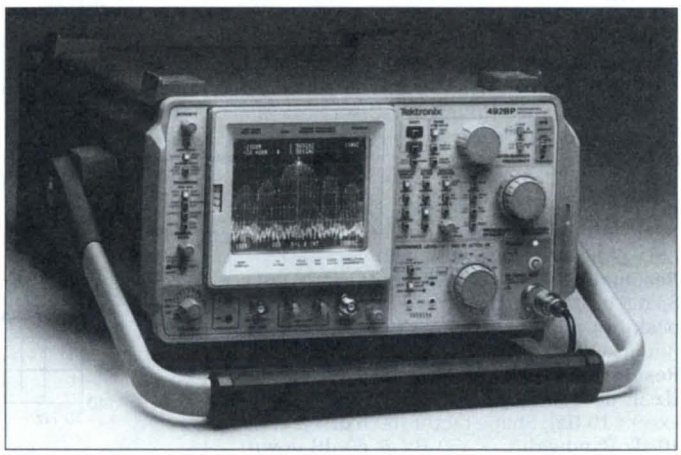
PACE-SETTING, HIGH PERFORMANCE PORTABLES





FEATURES

- **Frequency Coverage from 100 Hz to 325 GHz**
- **Ruggedized for Harsh Field Environments**
- **HELP Mode—Operator's Manual in ROM**
- **Many Application-Specific Performance Enhancement Options**
- **90 dB Dynamic Range with 10 Hz to 3 MHz Resolution Bandwidth**
- **Frequency Counters for Accurate Frequency Measurements**
- **Plot Data Directly Without a Controller**
- **Macro Programming Saves Frequently-Used Measurement Programs in Nonvolatile Instrument Memory**
- **Non-Volatile Memory For Up to Nine Waveforms and Ten Front Panel Settings**
- **MATE/CIIL Compatibility**



MICROWAVE SPECTRUM ANALYZERS

Model	Counter	Frequency Range		Frequency Accuracy	Ref Accuracy	Resolution Bandwidth	Average Noise Level (Min RBW)	Amplitude Meas. Range	GPIB	Config.	Page
		Coaxial Input	w/External Mixers								
494AP	Y	10 kHz to 21 GHz	325 GHz	Freq X Ref Accuracy +0.2 X (Span/div or Resolution Bandwidth) +(2N+25) Hz	10^{-9} /day 10^{-7}/year	10 Hz min to 3 MHz max	−131 dBm	+30 dBm to −131 dBm	Yes	Portable	116
NEW 492BP	Y				5×10^{-7} /year 10^{-6} @ 25°C within 30 minutes	100 Hz min to 3 MHz max	−120 dBm	+30 dBm to −120 dBm	Yes	Portable	118

VHF/UHF SPECTRUM ANALYZERS

495	Y	100 Hz to 1800 MHz	Freq X Ref Accuracy +0.2 X (Span/div or Resolution Bandwidth) +15 Hz	10^{-9} /day 10^{-7} /year	10 Hz min to 3 MHz max	−131 dBm	+30 dBm to −131 dBm	Plot	Portable	120
495P	Y							Yes		120

* *Option 05 only.*

490 SERIES COMMON CHARACTERISTICS

FREQUENCY RELATED

The following characteristics apply after a 30 minute warmup period unless otherwise noted.

Frequency Drift (after 1 hour warmup)—Span/Div ≤200 kHz (phase locked): Drift rate ≤50 Hz/min. Correction will occur every 30 seconds or as often as needed for sweep times ≥5 s/Div. (Drift rate is typically <20 Hz/min after 1 hour warm-up from 25 °C storage).
Span/Div >200 kHz (unlocked): Drift rate typically ≤5 kHz/min (typically <25 kHz/min after 30 minute warmup).

Frequency Readout Resolution—≤10% of Span/Div.

Counter Sensitivity— Signal level must be ≥20 dB above the average noise level and within 60 dB of the reference level.

Power Line Related Sidebands—≤ −55 dBc for line frequencies from 47 to 440 Hz.

Delta Marker Frequency Accuracy—±1% of total span.

AMPLITUDE RELATED

Vertical Display Modes—10 dB/div, 2 dB/div and linear via pushbutton; any integer from 1 to 15 dB/div via Data Entry keypad.

Display Dynamic Range—90 dB LOG mode ≥12 dB/div; 8 divisions LINEAR mode.

Display Amplitude Accuracy—±1.0 dB/10 dB to a maximum cumulative error of ±2.0 dB over 80 dB, ±4 dB over 90 dB ±0.4 dB/2 dB to a maximum cumulative error of ±1.0 dB over 16 dB range in 2 dB Log Mode; ±5% of full scale in LIN Mode.

Video Filter Range—0.3 Hz to 30 kHz (coupled to resolution filter by front panel pushbuttons).

Pulse Stretcher Fall Time—30 μs/div of pulse amplitude (typical).

Reference Level Range—Log Mode:
−117 to +50 dBm (+30 dBm*[1]);
−130 to +37 dBV (+17 dBV*[1]);
−70 to +97 dBmV (+77 dBmV*[1]);
−10 to +157 dBμV (+137 dBμV*[1]).
Linear Mode: 39.6 nV/Div to 2.8 V/Div (7.1 V*[1]).
*[1] *Maximum safe input level (1 Watt).*

Reference Level Accuracy—Accuracy is dependent on a combination of RF Atenuator Accuracy, IF Gain Accuracy, Resolution Bandwidth, Display Mode, Calibrator Accuracy, Frequency Response, Temperature Change (±0.15% dB/°C maximum), and Frequency Band (not in 495/495P).

Reference Level Steps—10 dB coarse, 1 dB fine in 10 dB log; 1 dB coarse, 0.25 dB fine in 2 dB log; 1-2-5 sequence coarse, 1 dB equivalent fine in linear; coarse step=Log/Div (except 1 dB for 2 dB/Div), fine is 1 dB for ≥5 dB/Div or 0.25 dB for ≤4 dB/Div, set via Data Entry keypad.

Marker/s Accuracy—Equal to Reference Level Accuracy plus cumulative error of Display Amplitude Accuracy.

RF Attenuator Range—0 to 60 dB in 10 dB steps.

RF Attenuator Accuracy, Step, 60 dB Range—DC to 1.8 GHz: 0.5 dB/10 dB, 1.0 dB maximum. 1.8 to 18 GHz: 1.5 dB/10 dB, 3.0 dB maximum. 18 to 21 GHz: 3.0 dB/10 dB, 6.0 dB maximum.

LO Emissions—≤ −70 dBm with 0 dB attenuation.

IF Gain Range—87 dB of gain increase, 20 dB of gain decrease (MIN NOISE and Reduced Gain mode), in 10 dB and 1 dB steps.

IF Gain Accuracy—≤0.2 dB/dB to a maximum of 0.5 dB/9 dB except at the decade transitions −29 to −30 dBm, −39 to −40 dBm, −49 to −50 dBm, and −59 to −60 dBm which add an additional 0.5 dB for a maximum cumulative error of 1 dB/10 dB; ±2.0 dB maximum deviation over the 107 dB range.

Resolution Bandwidth Gain Variation—≤0.4 dB after CAL with respect to 3 MHz filter.

Spurious Responses (Residual)—≤ −100 dBm with input terminated and 0 dB RF attenuation.

Third Order Intermodulation Distortion—≤ −70 dBc for CW signal (MIN Distortion Mode). Any two on-screen signals within any frequency span (10 kHz to 21 GHz); ≤ −100 dBc for signals spaced ≥100 MHz for preselected bands.

INPUT

RF Input—Type "N" female, 50 Ω nominal impedance.

1 dB Gain Compression—−13 dBm with 0 dB RF attenuation in Min Noise: −23 dBm with 0 dB RF attenuation in MIN DISTORTION; (No gain compression can be observed on screen).

External Reference Input—1,2,5 or 10 MHz ±5 PPM; −15 dBm to +15 dBm; 50 Ω; Sine, ECL, TTL, 50% ±10% Duty Factor.
Input Impedance: 50 Ω ac; rear-panel BNC input.

OUTPUT

Calibrator (Cal Out)—−20 dBm ±0.3 dB at 100 MHz ×(1±REF).

Vertical Output—Provides 0.5 V ±5% of signal/div of video above and below the CRT centerline. Full range −2.0 V to +2.0 V. 1 kΩ source impedance.

Horizontal Output—Provides 0.5 V/Div either side of the CRT centerline. Full range ±2.5 V ±10%. 1 kΩ source impedance.

Pen Lift—TTL compatible, +5 V nominal to lift pen.

10 MHz IF Output—Output level is −5 dBm for a full screen signal at −30 dBm reference level; 50 Ω nominal impedance.

110 MHz IF Output (Option 42)—Center frequency from 108.5 MHz to 111.5 MHz; 3 dB bandwidth ≥4.5 MHz; Bandpass ripple ≤0.5 dB; power out with −30 dBm reference level and a full screen signal ≤0 dBm; 1 dB compression at ≥0 dBm output, MIN DISTORTION; 50 Ω nominal impedance.

Probe Power—Provides operating voltages for active probes.
Pin 1: +5 V at 100 mA maximum.
Pin 2: Ground.
Pin 3: −15 V at 100 mA maximum.
Pin 4: +15 V at 100 mA maximum.

IEEE STANDARD 488 (GPIB)

P Versions—In accordance with IEEE Standard 488.1-1987 implemented as SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0.

Non-P Versions (Plotter Output)—Implemented as SH1, AH0, T3, L0, SR0, RL0, PP0, DC0, DT0, and C0.

DISPLAY

CRT—8×10 cm, GH (P31) phosphor.

CRT Readout—Displays: Reference level, center frequency, marker frequency and amplitude, frequency range, vertical display mode, frequency span/div, resolution bandwidth, RF attenuation, video filter, reference oscillator, macros, special modes, and text.

Digital Storage—1000 points horizontal, 250 points vertical; A and B Views; Save A; Max Hold; B-Save A; digital averaging (Peak/Average); Pulse Stretcher.

Nonvolatile Display Memory—Store and recall up to 9 full waveforms complete with CRT readouts and instrument settings.

GENERAL

Input Voltage—90 to 132 V ac or 180 to 250 V ac, 47 to 440 Hz.

Power—210 W maximum with all options, at 115 V and 60 Hz.

Configuration—Portable: 6.9×12.87×19.65 inches (175×327×499 mm) without front cover, handle, or feet. Weight: 47 lbs. 14 ozs. (21.8 kg) including cover and standard accessories, except manuals.

SWEEP/TRIGGERING

Sweep Modes—Triggered, auto, manual, single sweep, and external.

Sweep Time—20 μs to 5 s/div (10 s/div in Auto) in a 1-2-5 sequence; accuracy ±5% over center 8 divisions.

Triggering—Internal, External, Line, and Free Run; Internal Trigger Level ≥2 div of signal; external level ≥1 V peak, 15 Hz to 500 kHz, 50 V maximum (dc + ac peak).

ENVIRONMENTAL

Meets MIL-T-28800C, Type III, Class 3, Style C specifications as follows.

Temperature—Operating: −15 to +55 °C. Nonoperating: −62 to +85 °C.

Humidity—Operating: 95% (+5%, −0%) relative humidity. Nonoperating: Five cycles (120 hours) in accordance with MIL-STD-810D Procedure 3 (modified).

Altitude—Operating: 15,000 feet (tested to 25,000 feet). Nonoperating: 40,000 feet (tested to 50,000 feet).

Vibration—Operating: 15 to 55 Hz at 4 g maximum per MIL-STD-810D, Method 514, Procedure I (modified).

Shock—Operating: 30 g, one-half sine, 11 ms (tested to 50 g).

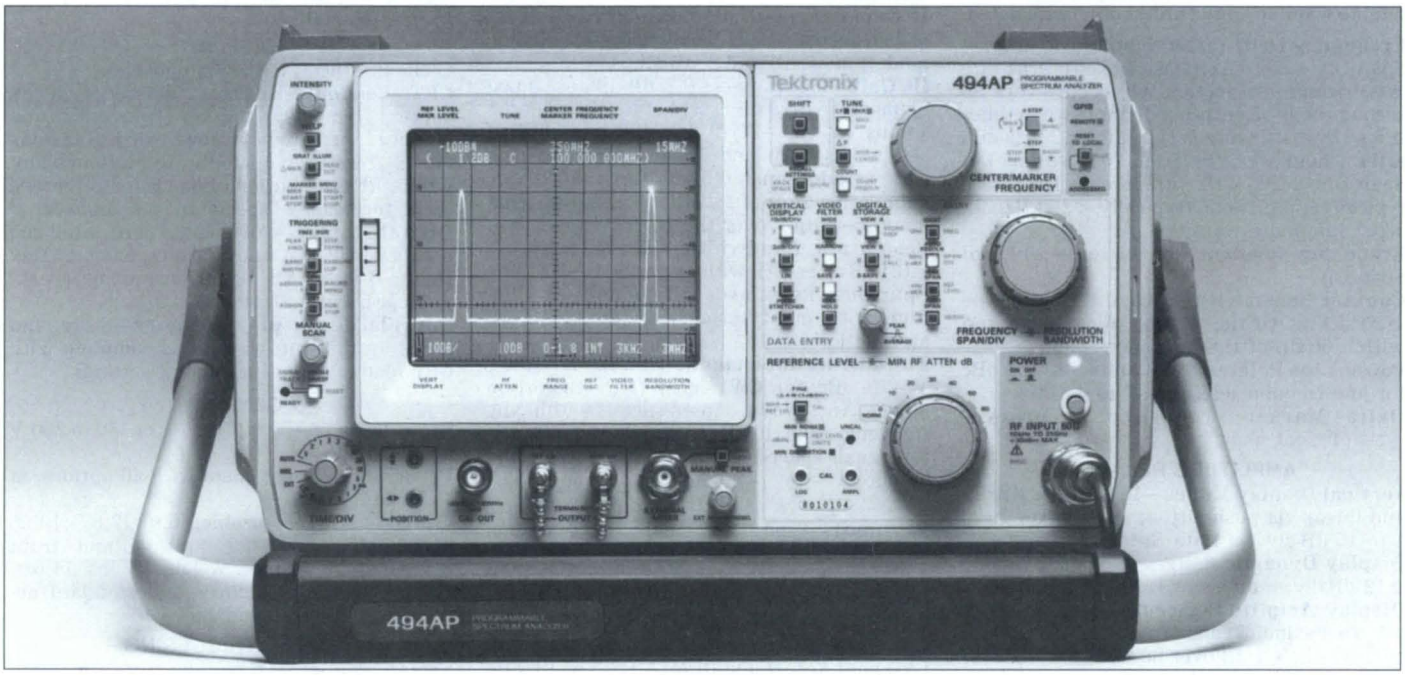
Transit Drop—Free fall, 12 inches, one per each of six faces and eight corners.

Electromagnetic Compatibility—Meets requirements of MIL-STD-461B Part 4 with some exceptions.

PORTABLE TO RACK ADAPTOR

Those needing the utility of a rackmounted instrument and desiring easy convertibility to a rugged portable should order the rack adaptor P/N 016-0844-01.

TOP-OF-THE-LINE PERFORMANCE IN THE 494AP PORTABLE SPECTRUM ANALYZER



TYPICAL APPLICATIONS

- Satellite Communications
- Broadcasting
- Cellular Radio
- EMI/RFI
- Terrestrial Microwave
- EW
- Millimeter Wave
- ATE
- Nuclear Physics
- Radio Astronomy
- Microwave Landing Systems
- Carrier/Noise
- Spur Searches
- Spectral Monitoring
- Carrier On/Off Ratios
- Harmonic Distortion
- Frequency Counting
- Carrier Level Monitoring
- Pulse Analysis

BENEFITS

- Optional MATE/CIIL Compatibility For Air Force System Integration
- Switch Selectable 50 and 75 Ω Impedances (Option 07) For IF, CATV, and Local Area Network Applications
- Plot Data Directly Without a Controller

FEATURES

- Covers 10 kHz to 325 GHz, −131 dBm Sensitivity
- 90 dB Dynamic Range with 10 Hz to 3 MHz Resolution
- Marker and Center Frequency Accuracy Up to 10^{-9}/day, Built-in Signal Counter and External Reference Input
- Macro Programming Saves Frequently-Used Measurement Programs in Nonvolatile Instrument Memory
- Intelligent Markers with Signal Processing Functions
- Push-button Occupied Bandwidth and Noise Normalization Functions
- Nonvolatile Memory For Up to Nine Waveforms and Nine Front Panel Settings
- Preselection and Multiband Sweep Coverage From 1.7 to 21 GHz
- HELP Mode Explains Front Panel Controls and Signal Processing Functions at the Touch of a Button

CHARACTERISTICS*

The following characteristics apply after a 30 minute warmup period unless otherwise noted.

FREQUENCY RELATED

Frequency Range—10 kHz to 21 GHz coaxial input, to 325 GHz with external mixer input (specified from 18 to 325 GHz with Tektronix WM490 Series Waveguide Mixers.)

Center and Marker Frequency Accuracy—$\pm$[20% D + (F×REF) + (2N+25)Hz] with Span/Div ≤200 kHz for Bands 1 & 5-12 or Span/Div ≤100 kHz for Bands 2-4 (Phase locked); Otherwise (unlocked) $\pm$[20% D + (F×REF) + (15N)kHz].
Where: D = Span/Div or Resolution BW, whichever is greater.
F = Center or Marker Frequency.
N = Harmonic Mixing Number.
REF = Reference Frequency Error.

Reference Frequency Error (REF)—Internal: $\leq 1\times10^{-9}$ per day; $\leq 1\times10^{-7}$ in the first six months, $\leq 1\times10^{-7}$ per year thereafter; Accuracy 30 minutes after power on within 5×10^{-8} of the frequency after 24 hours; Within 2×10^{-8} over the temperature range of −15 to +55 °C.

Counter Readout Resolution—Selectable from 1 Hz to 1 GHz in decade steps.

Signal Counter Accuracy—$\pm$ [(F×REF) + (5+N) Hz +1 LSD].

Delta Counter Accuracy—$\pm$[(ΔF×REF) + (10+2N) Hz +1 LSD].
Where: ΔF = Delta Frequency.
REF = Reference Frequency Error.
N = Harmonic Mixing Number.
LSD = Least Significant Digit.

Residual FM—≤(5+N) Hz peak-to-peak in 20 msec, Span/Div ≤200 kHz for Bands 1 & 5-12 or Span/Div ≤100 kHz for Bands 2-4 (Phase locked); Otherwise (unlocked) ≤(7 kHz) N peak to peak in 20 msec.

Resolution Filters—10 Hz to 1 MHz in decade steps and 3 MHz; 6 dB bandwidth ±20% except 10 Hz; Shape factor ≤7.5:1 except 10 Hz where 60 dB BW ≤150 Hz.

Frequency Span/Division—0 Hz; 10 Hz to 10 GHz (in a 1-2-5 sequence).

Noise Sidebands:

dBc/Hz	Offset From Carrier
− 80	300 Hz
− 90	3 kHz
−105	30 kHz
−115	300 kHz
−125	3 MHz

AMPLITUDE RELATED

Harmonic Distortion—≤ −60 dBc, ≤ −100 dBc for Bands 2-5, for a −40 dBm CW signal with 0 dB RF Attenuation in MIN DISTORTION mode and without Reduced Gain mode.

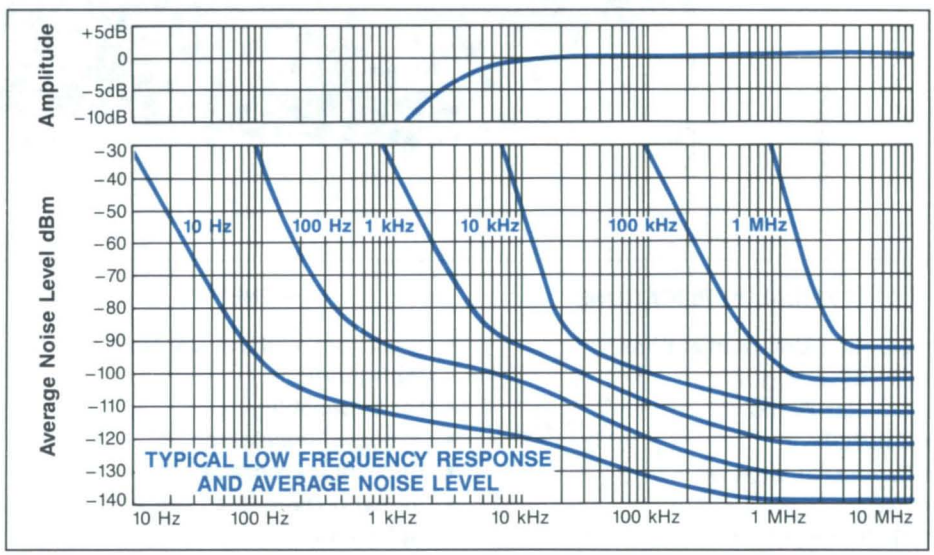
INPUT

Maximum Safe Input: (0 dB RF Attenuation)—+30 dBM (1 W) continuous, 75 W peak, 1 μsec pulsewidth, 0.001 duty; 0 V dc.

SENSITIVITY AND FREQUENCY RESPONSE

	Band and Frequency Range	Harmonic Number	Sensitivity (dBm) at Minimum Resolution	Frequency Response (dB)*1
1	(10 kHz-1.8 GHz)	1	−131	±1.5
2	(1.7-5.5 GHz)	1	−125	±2.5
3	(3-7.1 GHz)	1	−125	±2.5
4	(5.4-12 GHz) (12-18 GHz)	3	−111 −107	±3.5
5	(15-21 GHz)	3	−106	±5.0
6	(18-27 GHz)	6	−116	±2.0
7	(26-40 GHz)	10	−111	±2.0
8	(33-50 GHz) (40-60 GHz)	10	−111	±2.0 ±2.5
9	(50-90 GHz)	15	−105 at 50 GHz −95 at 90 GHz	±3.0*2
10	(75-140 GHz)	23	−100 at 75 GHz −85 at 140 GHz	±3.0*2
11	(110-220 GHz)	37	−90 at 110 GHz −75 at 220 GHz	±3.0*2
12	(170-325 GHz)	56	−70 at 170 GHz −55 at 325 GHz	±3.0*2

*1 *Measured with 10 dB RF Attenuation and peaking optimized. Frequency response is within ±4.5 dB from 10 kHz to 18 GHz.*
*2 *Frequency response for any 5 GHz band. Response is within ±6 dB referenced to 100 MHz.*



OUTPUT

1st LO—+7.5 dBm to +20 dBm.
2nd LO—−12 dBm to ±5 dB.
External Mixer—Bias Range: −+1.0 V to −2.0 V (default) or −1.0 V to +2.0 V (internally selectable).

50 Ω/75 Ω OPTION 07

Provides 75 Ω input and dBm V calibration in addition to the normal 50 Ω input and dBm calibration. The 100 kHz resolution filter is replaced by 300 kHz to optimize the instrument for broadcast and CATV uses.

ORDERING INFORMATION

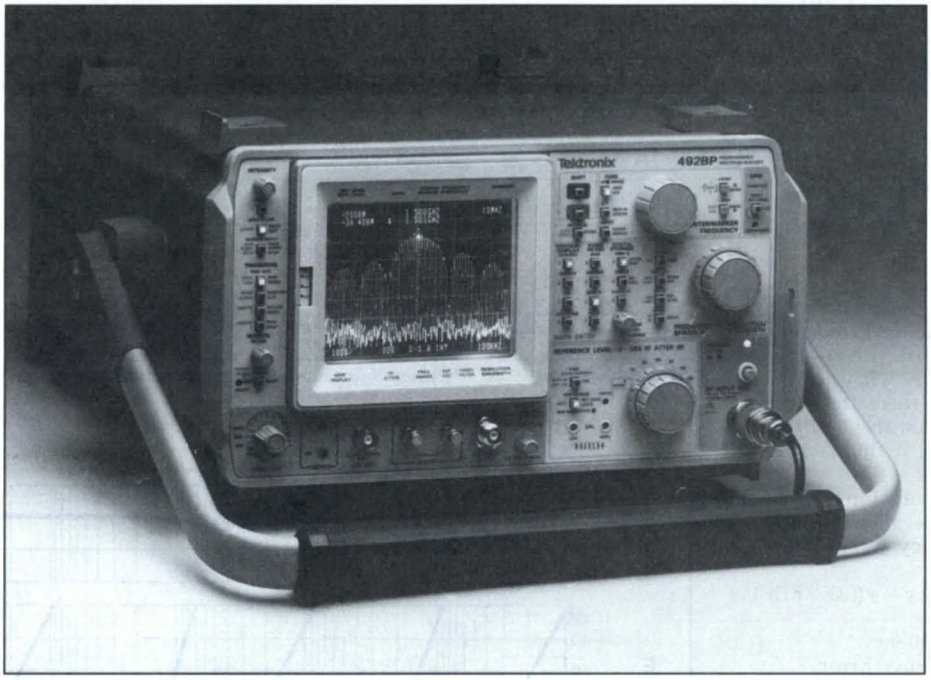
494AP Programmable Spectrum Analyzer. **$41,995**
Includes: 50 Ω coax cable, N-to-N Conn, 6 ft (012-0114-00); 50 Ω coax cable, BNC-to-BNC Conn, 18 in. (012-0076-00); N Male-to BNC female adaptor (103-0045-00); 4 A Fast Blow fuses (159-0017-00); power cord (161-0104-00); CRT light filters (amber 378-0115-01, gray 378-0115-02); CRT mesh filter (378-0227-01); rear connector shield (337-3274-00); operator's manual (070-5557-00); programmer's manual (070-5559-00).

***WARRANTY-PLUS* SERVICE PLANS**

Option M1—Available. **+$2,120**
Option M2—Available. **+$3,770**
Option M3—Available. **+$4,240**
See page 562 for description.

Common Series Characteristics are listed on page 115.
For complete option and accessory information refer to pages 100, 101, and 135.
For more detailed specification information contact your local Sales Engineer (see pages 568-571) for a product-specific data sheet.

NEW 492BP SPECTRUM ANALYZER WITH BUILT-IN MARKER INTELLIGENCE



TYPICAL APPLICATIONS

- Satellite Communications
- Broadcasting
- Cellular Radio
- EMI/RFI
- Terrestrial Microwave
- EW
- Millimeter Wave
- ATE
- Nuclear Physics
- Radio Astronomy
- Microwave Landing Systems
- Carrier/Noise
- Spur Searches
- Spectral Monitoring
- Carrier On/Off Ratios
- Harmonic Distortion
- Frequency Counting
- Carrier Level Monitoring
- Pulse Analysis

BENEFITS

- Direct Plot Without Controller for All Configurations
- Macro Capabiity
- Standard Preselector
- GPIB/Fully Programmable
- CIIL with Direct Memory Access (Option 45)

FEATURES

- Built-in Signal Counter with External Reference Input for Higher Accuracy
- Frequency Accurate to 10^{-6}
- Frequency Range From 10 kHz to 325 GHz
- Multiband Sweep with 3 MHz Bandwidth for More Information Content
- CW, Pulse and Spurious Signal Processing Modes
- Keypad Entry of Frequency, Span/Div, Reference Level and Vertical Scale Factors
- Environmentalized per MIL-T-28800C Type III, Class 3, Style C

CHARACTERISTICS*

The following characteristics apply after a 30 minute warmup period unless otherwise noted.

FREQUENCY RELATED

Frequency Range—10 kHz to 21 GHz coaxial input, to 325 GHz with external mixer input (specified from 18 to 325 GHz with Tektronix WM490 Series Waveguide Mixers).

Center and Marker Frequency Accuracy—±[20% D + (F×REF) + (2N+25)Hz] with Span/Div ≤200 kHz for Bands 1 and 5–12 or Span/Div ≤100 kHz for Bands 2–4 (Phase locked); otherwise (unlocked) ±[20% D + (F×REF) + (15 N)kHz].
Where: D = Span/div or Resolution BW, whichever is greater.
F = Center or Marker Frequency.
N = Harmonic Mixing Number.
REF = Reference Frequency Error.

Reference Frequency Error (REF)—$\leq 2\times10^{-9}$ per day, $\leq 1.4\times10^{-8}$ per week, $<3.5\times10^{-7}$ first six months, $<5\times10^{-7}$ per year, $\leq 10^{-6}$ @ 25 °C and 30 minutes after power-up. $\leq 1.5\times10^{-5}$ over operating temperature range.

Counter Readout Resolution—Selectable from 1 Hz to 1 GHz in decade steps.

Signal Counter Accuracy—±[(F×REF) + (10+N) Hz+1 LSD].

Delta Counter Accuracy—±[(ΔF×REF) + (20+2N) Hz+1 LSD].
Where: ΔF = Delta Frequency.
REF = Reference Frequency Error.
N = Harmonic Mixing Number.
LSD = Least Significant Digit.

Residual FM—≤(10+2N) Hz peak-to-peak in 20 ms, Bands 1 and 5–12 with Span/div ≤200 kHz, and Bands 2–4 with Span/div ≤100 kHz (Phase locked); ≤(7 kHz) ×N peak-to-peak in 20 ms (unlocked).

Resolution Filters—100 Hz to 1 MHz in decade steps and 3 MHz (6 dB bandwidth ±20%). Shape factor ≤7.5:1 (60 dB/6 dB).

Frequency Span/Division—0 Hz, 100 Hz to 10 GHz (in a 1-2-5 sequence).

Noise Sidebands

dBc/Hz	Offset From Carrier
≤ − 90	3 kHz
≤ −105	30 kHz
≤ −115	300 kHz

AMPLITUDE RELATED

Harmonic Distortion—−60 dBc for a −40 dBm input 10 kHz to 21 GHz in MIN Distortion mode. Not discernible above the noise (typically −100 dBc) for preselected bands.

INPUT

Maximum Safe Input—+30 dBm (1 W) CW; 75 W peak, 1 μs pulse width, 0.001 duty, 0 dB attenuation. Do not apply dc.

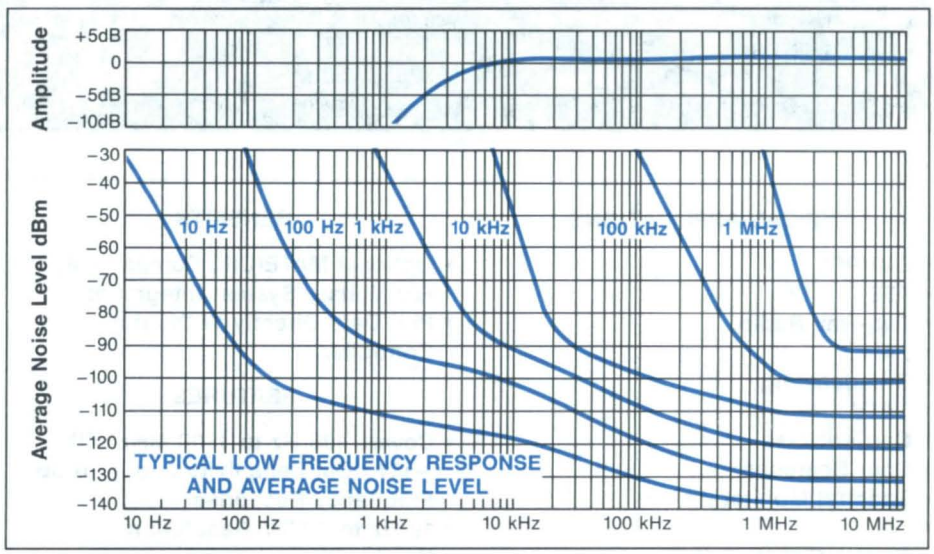
OUTPUT

1st LO—+7.5 dBm to +20 dBm.
2nd LO—−12 dBm to ±5 dB.
External Mixer—Bias Range: +1.0 V to −2.0 V (default) or −1.0 V to +2.0 V (internally selectable).

SENSITIVITY AND FREQUENCY RESPONSE

Band and Frequency Range	Harmonic Number	Sensitivity at (dBm) Minimum Resolution	Frequency Response (dB)*2
1 (10 kHz–1.8 GHz)	1	−120	±1.5
2 (1.7–5.5 GHz)	1	−120	±2.5
3 (3–7.1 GHz)	1	−119	±2.5
4 (5.4–12 GHz) (12–18 GHz)	3 3	−105 −100	±3.5
5 (15–21 GHz)	3	− 99	±5.0
6 (18–27 GHz)	6	−108	±2.0
7 (26–40 GHz)	10	−103	±2.0
8 (33–60 GHz)	10	−103	±2.0 33 to 50 GHz ±2.5 40 to 60 GHz
9 (50–90 GHz)	15	−95 at 50 GHz*3 −85 at 90 GHz*3	±3.0*1
10 (75–140 GHz)	23	−90 at 75 GHz*3 −75 at 140 GHz*3	±3.0*1
11 (110–220 GHz)	37	−80 at 110 GHz*3 −65 at 220 GHz*3	±3.0*1
12 (170–325 GHz)	56	−70 at 170 GHz*3 −55 at 325 GHz*3	±3.0*1

*1 *Typical frequency response for any 5 GHz band. Response is typically within ±6 dB referenced to 100 MHz.*
*2 *Measured with 10 dB RF Attenuation and peaking optimized (when applicable). Frequency response within ±4.5 dB from 10 kHz to 18 GHz referenced to 100 MHz.*
*3 *Typical sensitivity.*



50 Ω/75 Ω OPTION 07

Provides 75 Ω input and dBmV calibration in addition to the normal 50 Ω input and dBm calibration. The 100 kHz resolution filter is replaced by 300 kHz to optimize the instrument for broadcast and CATV uses.

ORDERING INFORMATION

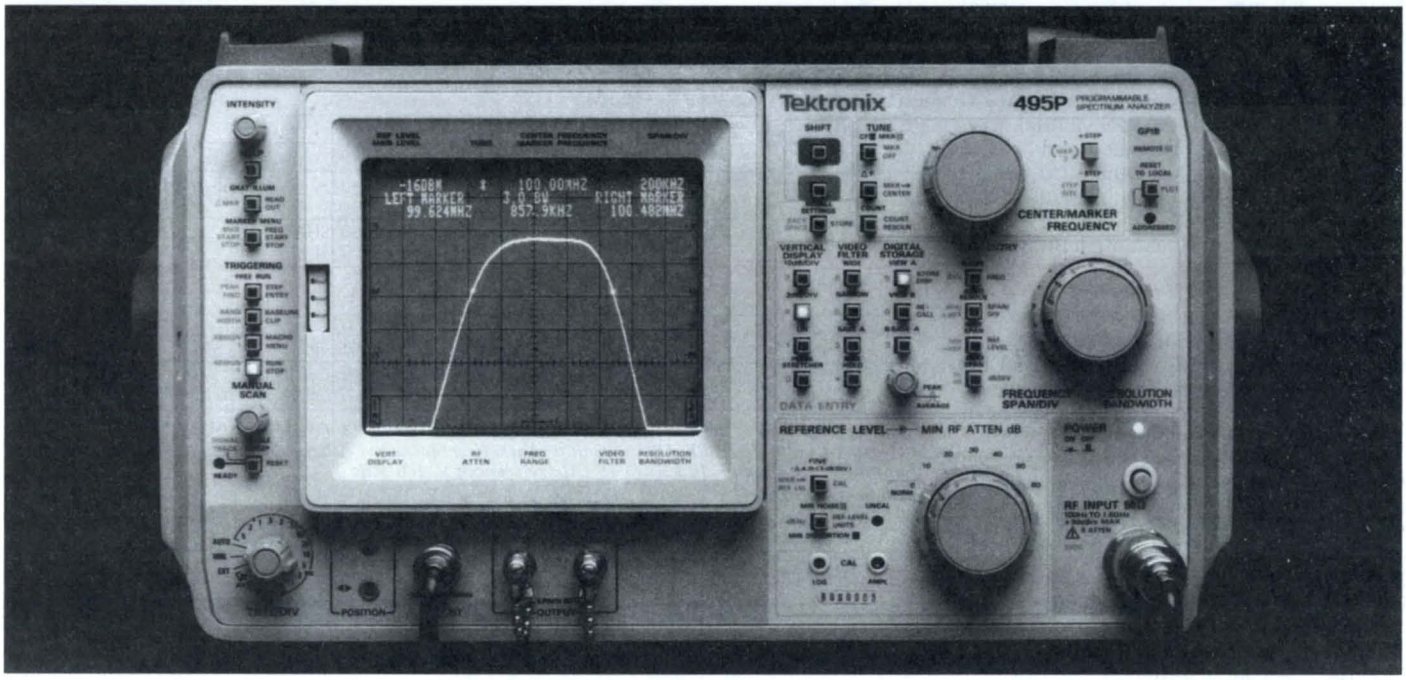
492BP Programmable Spectrum Analyzer. **$29,995**
Includes: 50 Ω coax cable, N-to-N connector, 6 ft (012-0114-00); 50 Ω coax cable, BNC-to-BNC connector, 18 in. (012-0076-00); N male-to-BNC female adaptor (103-0045-00); 2 Fast-Blo 4 A fuses (159-0017-00); power cord (161-0104-00); CRT light filters (amber 378-0115-01, gray 378-0115-02); CRT mesh filter (378-0227-01); Operator's manual (070-5562-01); programmer's manual (070-5564-01).

WARRANTY-PLUS SERVICE PLANS

Option M1—Available. **+$1,995**
Option M2—Available. **+$3,380**
Option M3—Available. **+$3,995**
See page 562 for description.

Common Series Characteristics are listed on page 115.
For complete option and accessory information refer to pages 100, 101, and 135.
For more detailed specification information contact your local Sales Engineer (see pages 568–571) for a product-specific data sheet.

EXCELLENT PERFORMANCE IN THE 495/495P PORTABLE SPECTRUM ANALYZERS



TYPICAL APPLICATIONS

- EMI/RFI
- ATE
- Two-Way Radio
- LAN
- Broadcasting
- CATV
- Carrier/Noise
- Spur Searches
- Spectral Monitoring
- EW
- Carrier On/Off Ratios
- Harmonic Distortion
- IF Amplifier Adjustments
- Frequency Counting
- Filter Ultimate Testing
- Carrier Level Monitoring
- Modulation Adjustments
- Baseband Measurements
- Cellular Radio
- Avionics

BENEFITS

- Optional MATE/CIIL Compatibility For Military System Integration
- Plot Data Directly Without a Controller

FEATURES

- Covers 100 Hz to 1800 MHz with −131 dBm Sensitivity and ±1.0 dB Frequency Response
- 10 Hz to 3 MHz Resolution Bandwidth
- 10^{-9}/day Marker and Center Frequency Accuracy
- External Reference Input Provides Flexibility of Tying in with a System Clock
- Built-in Signal Counter—Count at Any Point Marked or Between Any Two Marked Points
- Macro Programming Saves Frequently Used Measurement Programs in Nonvolatile Instrument Memory (495P)
- Intelligent Markers with Signal Processing Functions
- Push-Button Occupied Bandwidth and Noise Normalization Functions
- Switch Selectable 50 Ω and 75 Ω Impedances (Option 07) For IF, CATV and Local Area Network Applications
- Nonvolatile Memory For Up to Nine Waveforms and Nine Front Panel Settings
- Direct Keypad Entry of Control Parameters
- HELP Mode Explains Front Panel Controls and Signal Processing Functions at the Touch of a Button

CHARACTERISTICS*

The following characteristics apply after a 30 minute warmup period unless otherwise noted.

FREQUENCY RELATED

Frequency Range—100 Hz to 1800 MHz.

Center and Marker Frequency Accuracy—±[20% D + (F×REF) + 15 Hz] with Span/Div ≤200 kHz (phase locked); ±[20% D + (F×REF) + 15 kHz] with Span/Div >200 kHz (unlocked).
Where: D = Span/Div or Resolution BW, whichever is greater.
F = Center or Marker Frequency.
REF = Reference Frequency Error.

Reference Frequency Error (REF)—Internal standard: $\leq 10^{-9}$ per day, $\leq 10^{-7}$ first six months, $\leq 10^{-7}$ per year thereafter. Within 2×10^{-8} over temperature range of −15 to +55 °C.

Counter Readout Resolution—Selectable from 1 Hz to 100 MHz in decade steps.

Signal Counter Accuracy—±[(F×REF) + (5+N) Hz +1 LSD].
Where: F = Center or Marker Frequency.
REF = Reference Frequency Error.
N = Harmonic Mixing Number.
LSD = Least Significant Digit

Delta Counter Accuracy—±[(ΔF×REF) + (10+2N) Hz+1 LSD].
Where: ΔF = Delta Frequency.
REF = Reference Frequency Error.
N = Harmonic Mixing Number.
LSD = Least Significant Digit.

Residual FM—≤5 Hz peak-to-peak in 20 msec, Span/Div ≤200 kHz (phase locked); ≤7 kHz peak-to-peak in 20 msec, Span/Div >200 kHz (unlocked).

Resolution Filters—3 MHz then 1 MHz to 10 Hz in decade steps (6 dB bandwidth ±20% except 10 Hz); Shape factor (60:6 dB) ≤7.5:1; 10 Hz Bandwidth, ≤150 Hz @ 60 dB down.

Frequency Span/Division:0 Hz; 10 Hz to 100 MHz (in a 1-2-5 sequence); 180 MHz MAX SPAN.

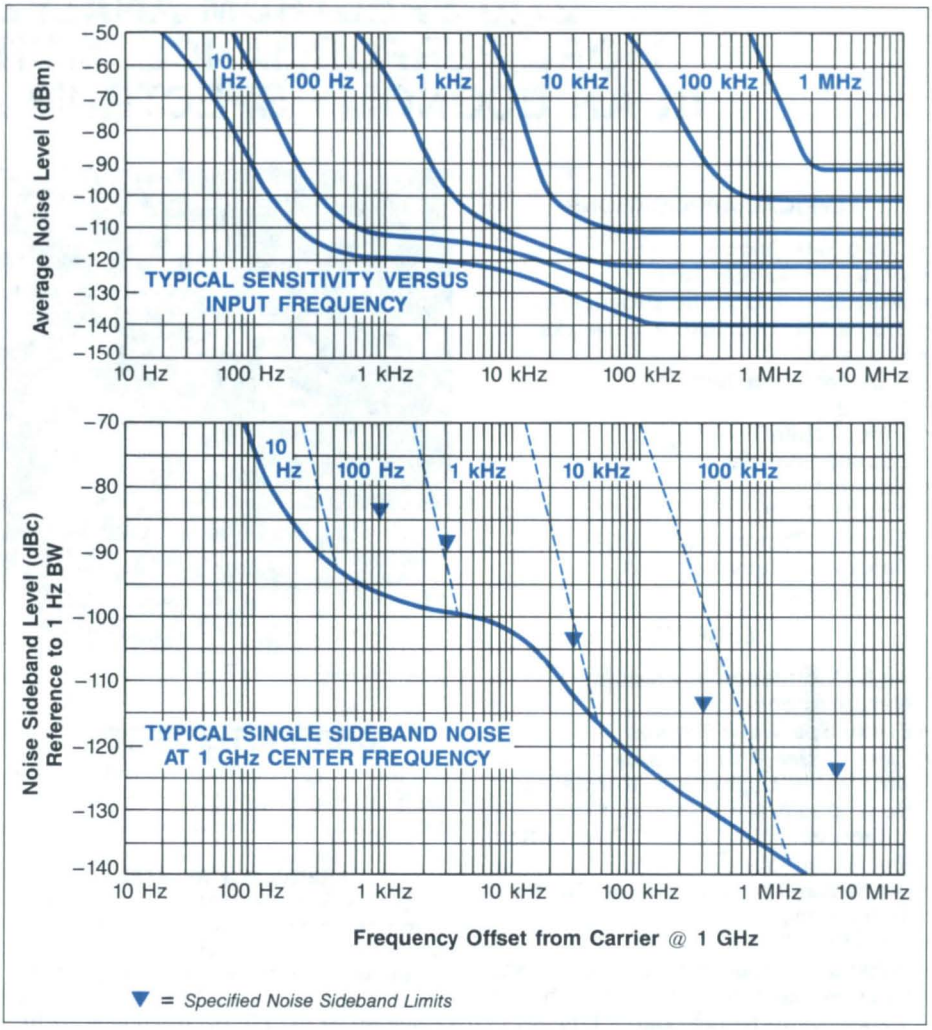
Noise Sidebands:

dBc/Hz	Offset From Carrier
− 80	300 Hz
− 90	3 kHz
−105	30 kHz
−115	300 kHz
−125	3 MHz

Frequency Response—±1.0 dB (measured with 10 dB RF attenuation).

AMPLITUDE RELATED

Harmonic Distortion—≤ −60 dBc for a −30 dBm CW signal with 0 dB RF attenuation in MIN DISTORTION mode.



Sensitivity (Equivalent Input Noise)

Sensitivity dBm	Resolution BW
−131	10 Hz
−125	100 Hz
−115	1 kHz
−105	10 kHz
− 95	100 kHz
− 85	1 MHz
− 80	3 MHz

INPUT

Maximum Safe Input (0 dB RF Attenuation)—+30 dBm (1 W) continuous, 75 W peak, 1 μsec pulsewidth, 0.001 duty factor; 0 V dc.

OUTPUT

1st LO—+6 dBm to +15 dBm.
2nd LO—−10 dBm to +20 dBm.

OPTION 07 (50/75 Ω)

Provides 75 Ω input and dBmV calibration in addition to the normal 50 Ω input and dBm calibration. The 100 kHz resolution filter is replaced by 300 kHz to optimize the instrument for broadcast and CATV uses.

Center Frequency Range—1 to 1000 MHz.

ORDERING INFORMATION

495 Spectrum Analyzer. **$26,500**
Includes: 50 Ω coax cable, N-to-N Conn, 6 ft (012-0114-00); 50 Ω coax cable, BNC-to-BNC Conn, 18 in. (012-0076-00); operator's manual (070-6888-00); N male-to-BNC female adaptor (103-0045-00); 4 A fast blow fuses (159-0017-00); power cord (161-0104-00); CRT light filters (amber 378-0115-01, gray 378-0115-01); CRT mesh filter (278-0227-01).

495P Programmable Spectrum Analyzer. **$29,950**
Includes: Same as 495 plus programmer's manual (070-6889-00).

WARRANTY-PLUS SERVICE PLANS

Option M1—Available.
(495) **+$1,735**
(495P) **+$1,810**

Option M2—Available.
(495) **+$2,875**
(495P) **+$3,015**

Option M3—Available.
(495) **+$3,470**
(495P) **+$3,620**

See page 562 for description.

Common Series Characteristics are listed on page 115.
For complete option and accessory information refer to pages 100, 101, and 135.
For more detailed specification information contact your local Sales Engineer (see pages 568–571) for a product-specific data sheet.

2710 SPECTRUM ANALYZER— MORE PERFORMANCE, MORE VALUE IN AN ECONOMY SPECTRUM ANALYZER

TYPICAL APPLICATIONS

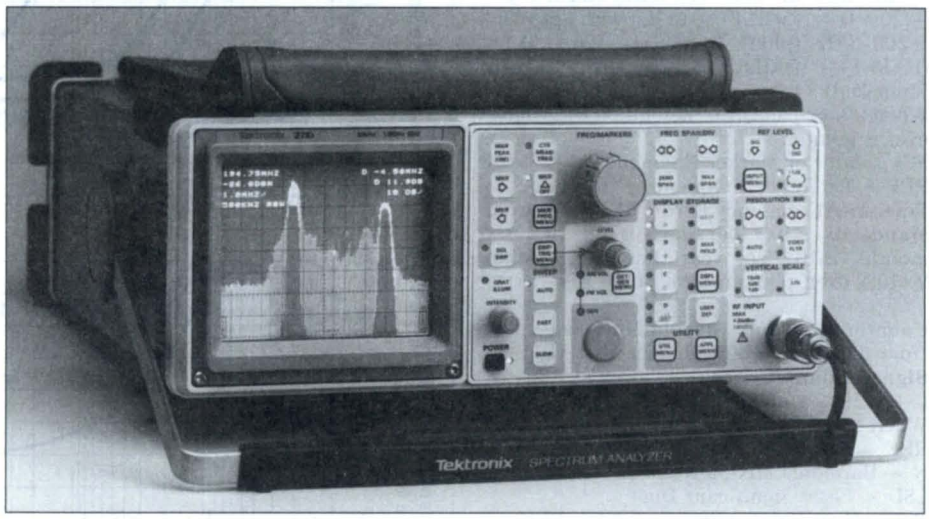
- Cable Television
- VTR/VCR Maintenance
- Television and Audio Broadcasting
- Broadband Local Area Networks
- Education
- Manufacturing Test
- EMI/RFI
- Land Mobile/Two-Way Communication
- Avionics
- Cellular Radio
- Satellite Communications
- Baseband Measurements
- RF Design

BENEFITS

- High Confidence in Frequency Measurements
- Easily See Weak Signals
- Ease of Use Enhanced by Automated Calibration (Normalization), Dedicated Function Keys, Microprocessor Control, Pushbutton Measurements
- Short Waiting Time Before Making Measurements
- High Portability
- Enhanced Measurement Comparisons
- Measurement Convenience with Full Marker/Delta Marker Capability
- See Modulation-Related Phenomena and Low Level Beats

FEATURES

- 10 kHz to 1800 MHz Frequency Range
- 1×10^{-5} or Optional 5×10^{-7} Frequency Accuracy
- 1 Hz Frequency Resolution at Wide Span/Div Using Optional Internal Frequency Counter
- Up to −127 dBm Sensitivity, or −139 dBm Sensitivity Using Built-in Preamp
- 9.5 Kg (21 lb.) Weight, Compact Size
- Fast Warmup, High Stability
- Full Display Area Usable With 80 dB Display Dynamic Range
- Four-Trace Digital Storage
- Direct-Reading 50 and 75 Ohm Operation Modes
- True Analog Display
- Signal Identification and Qualitative Analysis with Aural and Optional Video Demod



CHARACTERISTICS

The following specifications and features apply after a 15-minute warmup period unless otherwise noted.

FREQUENCY RELATED

Frequency Range—10 kHz to 1800 MHz.
Center Frequency Accuracy—$1\times10^{-5}\pm5$ kHz; Option 01: $5\times10^{-7}\pm700$ Hz.
Frequency Counter Accuracy (Opt. 02)—1×10^{-5} ±10 Hz, 0-50 °C; $3(10^{-6})$ ±10 Hz/year; Option 01: $5\times10^{-7}\pm10$ Hz, 0–50°C, at 2×10^{-6} ±10 Hz/year.
Dot Marker Frequency Accuracy—CF Accuracy plus 3% of span.
Frequency Counter Readout Resolution (Opt. 02)—1 Hz.
Typical Long-Term Drift—10 ppm/yr; Option 01: 2 ppm/yr.
Short-Term Drift—20 kHz maximum drift between correction cycles. Typical short-term drift between correction cycles is within 5 kHz. Option 01: ≤400 Hz maximum drift between correction cycles.
Residual FM—±2 kHz p-p/20 μsec; Option 01: ±100 Hz p-p/20 μsec at span/div ≤20 kHz/div; ±2 kHz p-p/20 μsec at span/div ≥50 kHz/div.
Resolution Bandwidth— (−6 dB) 5 MHz, 500 kHz, 30 kHz, 3 kHz; Option 01: add 300 Hz.
Resolution Bandwidth Shape Factor— ≤ 6:1.
Noise Sidebands—> −70 dBc at 30×RBW (Resolution Bandwidth).
Video Filter—Approx. 1/100 (Auto) of RBW. Manual Selection: 3 Hz to 300 kHz in 1-3 sequence.
Freq. Span/Div Range—180 MHz to 10 kHz; Option 01: add 1,2,5 kHz/div. Selected in 1,2,5 sequence or 2 significant digits via menu. Max span, zero span keys.
Span Accuracy—±3% measured over the center eight divisions.

AMPLITUDE RELATED

Flatness—±1.5 dB measured with 10 dB RF attenuation (preamp off).
Vertical Display Modes—10, 5, 1 dB/div, Linear.
Measurement Range— −129 (preamp on) to +20 dBm; Option 01: −139 (preamp on) to +20 dBm.
Display Dynamic Range—80 dB max.
Reference Level Range—LOG Mode: −70 to +20 dBm (−23 to +67 dBmV). LINEAR Mode: 8.8 μV/div to 280 mV/div.
Reference Level Steps—LOG Mode: 1 dB or 10 dB. LINEAR Mode: 1,2,5 sequence: 10 μV/div to 280 mV/div.
Mixer Input Level—Automatically controlled by instrument for on-screen signals. Level selectable between −20 to −50 dBm.
Display Amplitude Accuracy—10 dB/div: ±1.0 dB/10 dB to max. cum. error of ±2 dB over 80 dB range. 5 dB/div: ±1.0 dB/5 dB to max. cum. error of ±2.0 dB over 40 dB range. 1 dB/div: 1 dB max. error over 8 dB range. LINEAR Mode: ±5% of full scale.
RF Attenuation Range—0-50 dB, 2 dB steps.
Maximum Sensitivity—−117 dBm at 3 kHz RBW. −129 dBm at 3 kHz RBW w/preamp. Option 01: −127 dBm at 300 Hz RBW, −139 at 300 Hz RBW w/preamp.

SPURIOUS RESPONSE (with preamp off)

Residual Spurious Response— ≤ −100 dBm referenced to input of 1st mixer.
3rd Order IM Distortion— ≤ 70 dBc, from any two on-screen signals within any frequency span at −20 dBm input level, 10 dB atten.
2nd Harmonic Distortion— ≥ 66 dBc with +30 dBm input and 0 dB attenuation.

INPUT RELATED

LO Emission— ≤ −70 dBm with 0 dB RF attenuation.
RF Input—Type N connector, 50Ω.
VSWR with 10 dB or more RF attenuation—1.5:1 max.
Maximum Safe Input— ±20 dBm (0.1 W) continuous peak with 0 dB RF attenuation; 100 V dc (initially applied with full attenuation).
1 dB Compression Point— ≥ −15 dBm with 0 dB RF attenuation.

SWEEP RELATED

Sweep Times—1 μsec to 2 sec/div in 1,2,5 seq. (7 decade range); AUTO SWEEP mode; MANUAL SWEEP select.
Sweep Time Accuracy— ±10% over the center 8 divisions.
Trigger—Free run, internal, external, line, TV field, TV line, single sweep, manual scan.
Trigger Amplitude—Internal: One division or more of signal. External: 1.0 V peak, minimum; DC coupled (15 Hz to 1 MHz).

OTHER INPUTS/OUTPUTS

External Trigger—BNC connector, 10 kΩ impedance, DC coupled 0.1 μs minimum pulse width. 35 V max.
External Video Input—DC coupled, 0-100 kHz, 0-1.6 V (200 mV/div) signal input for vertical deflection of CRT beam.
Sweep Gate Out—TTL level signal that is HI while CRT beam sweeps.
Chassis and Signal Ground.
Sweep Output— +1.3 to −1.3 V, negative going ramp, proportional to the horizontal sweep. Source impedance ≤ 50 Ω, load impedance ≥ 10 kΩ.
Video Output—0 to +1.6 V of video signal, proportional to vertical display amplitude. 0 V is top of screen. 1 kΩ impedance.

ENVIRONMENTAL

Temperature—Operating: 0 to +50° C (MIL-T-28800C). Nonoperating: −55 to +75° C.
Humidity (Nonoperating)—Five cycles (120 hours) per MIL-T-28800C, class 5.
Vibration—Meets MIL-T-28800C Method 514 Procedure X (modified).
Shock (Operating and Nonoperating)—Three guillotine-type shocks of 30 g, one-half sine, 11 ms duration each direction along each major axis; total of 18 shocks.
Radiated and Conducted Emissions—Meets FCC Part 15, sub-part J, class A and VDE 0871, class B.
Radiated and Conducted Susceptibility—Meets Part 7 Mil-Std 461B.

GENERAL CHARACTERISTICS

Power Requirements—90 W MAX (1.2 A) at 115 V, 60 Hz. Operates 48 to 440 Hz, 90 to 250 V ac. Battery power option available (Option 06).
Weight—9.5 kg (<21 lb.) nominal for basic configuration.
Dimensions (H, W, D) with feet, handle and front panel cover—137×361×445 mm (5.4×14.2×17.5 inches).

OTHER CAPABILITIES

Markers—Single marker/delta markers; next right, next left peaks; next lower, next higher peaks; (highest) peak find; marker to CF; select start/stop frequencies; transpose Δ markers.
Nonvolatile memory—(Opt. 11, No charge): Up to 24 displays and/or 8 front panel setups may be saved. Lithium battery backup.
Digital Storage Display—Selectable acquisition modes of positive peak only, positive/negative peak. SAVE A, B, C and active D trace; up to four traces on screen; MAX HOLD A, B; MIN HOLD A, B or C; B, C minus A; WATERFALL display mode; ensemble averaging; (min, max, mean, min/max); digital storage off provides analog display.
Ensemble Averaging—Provides weighted averaging of display resulting in reduction of random noise and impulse signals without sweep speed changes.
Direct Entry of Control Parameters—Frequency, span/div, reference level, RBW, video filter, vert. scale, sweep rate.
Measurement Modes—Noise, Carrier-to-Noise, Bandwidth (User definable "dB down" points).
Internal Freq. Counter (signal counter)—Option 02.
Internal Preamplifier—Preamp may be switched in/out of circuit (degrades flatness below 10 MHz and above 500 MHz, provides approx. 12 dB sensitivity improvement) with signal input ≤10 dBm with zero RF attenuation.
Alternate Reference Level Units—dBm, dBmV, dBV, dBμV, dBμW.
User-definable Power-on Status—Instrument powers up to user-definable state or supplied default settings.
Constant Rate Tuning—Same on-screen tuning sensitivity regardless of span/div selection.
Center Measure—Signal nearest CF (from any screen location) is centered with frequency and peak amplitude automatically read out (not a marker mode). The centered signal will be counted if the Option 02 Frequency Counter is installed.
Signal Track—Drifting signal is kept at display center with correct frequency and peak amplitude displayed.
Graticule Illumination—Contrast enhancement for CRT photography.
Centronics Interface—Option 09. Will support Epson FX Series Printers and compatibles and Tek HC100 Printer/Plotter.
Rackmount Option—Option 30. Converts unit to a rack mounted installation. Five-inch rack height, 19-inch rack width.
Portable-to-Rack Adapter—Option 34. Provides rackmounting of instrument in standard enclosure with handle. Offers immediate instrument portability when needed. Seven-inch rack height, 19-inch rack width.
AM/FM Detectors—Built-in amplifier, speaker and headphone jack for aural demodulation.
Video Monitor Mode—Option 10. Allows direct viewing of television picture on analyzer screen. Functions in NTSC, PAL and SECAM systems. Includes selectable horizontal line trigger.

ORDERING INFORMATION

2710 Spectrum Analyzer. **$8,250**
Includes: Power cord (U.S. 115 V/60 Hz) (161-0104-00); operator's manual (070-6022-00); front cover (200-2520-00); and 75/50 Ω min-loss pad (131-4199-00).

OPTIONS

Option 01—300 Hz resolution bandwidth/phaselock stabilization/5×10^{-7} frequency accuracy. **+ $1,100**
Option 02—Internal frequency counter with selectable 1 kHz/1 Hz readout resolution. **+ $600**
Option 06—Battery operation. **+ $2,720**
Option 09—Centronics interface. **+ $300**
Option 10—Video monitor mode. **+ $450**
Option 11—Nonvolatile storage. **NC**
Option 15—Tek 1405 TV Sideband Analyzer Interface. **+ $200**
Option 30—Rackmount for 19-inch rack width, 5 in. height. **+ $150**
Option 33—Travel Line Package. **+ $95**
Includes: Accessory pouch; carrying strap; smoke-gray CRT filter; vinyl rain cover.
Option 34—Portable to Rackmount adaptor for 19-inch rack width, 7 inch height. **+ $425**

INTERNATIONAL POWER PLUG OPTIONS

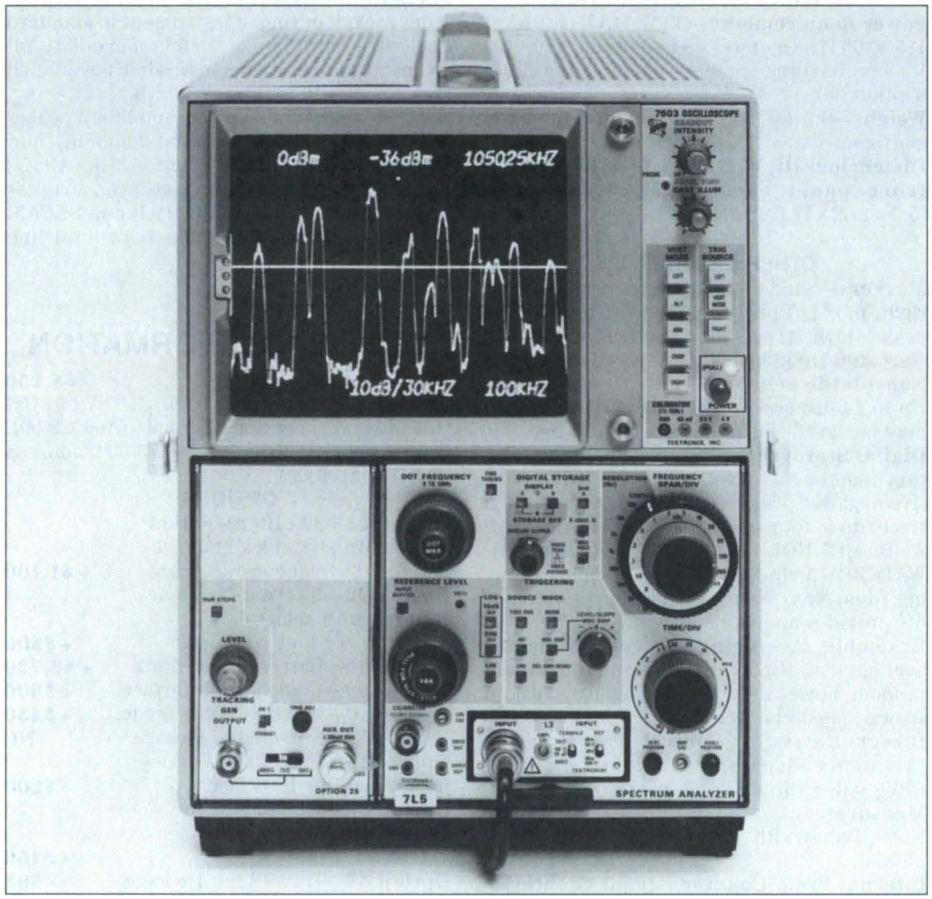
Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

WARRANTY-PLUS SERVICE PLANS

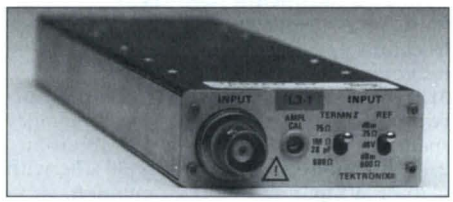
Option M1—Available. **+ $710**
Option M2—Available. **+ $1,190**
Option M3—Available. **+ $1,430**
See page 562 for description.

OPTIONAL ACCESSORIES

Front Panel Cover—Order 200-2520-00. **$5**
Accessory Pouch—Mounts on top. Order 016-0677-02. **$45**
Viewing Hoods—
(Collapsible) Order 016-0592-00. **$15**
(Binocular) Order 016-0566-00. **$21**
(Polarized) Order 016-0180-00. **$60**
Carrying Strap—Order 346-0199-00. **$17.50**
Shipping Case—Order 016-0792-01. **$225**
Smoke Gray CRT Filter—Order 337-2775-02. **$2.35**



7L5 Option 25 Spectrum Analyzer with L3 (50 Ω, 600 Ω, 1 MΩ) plug-in module in a 7603 Option 06 mainframe with internal spectrum analyzer graticule. The L3-1 module (shown at upper right) is switch selectable to 75 Ω, 600 Ω or 1 MΩ.



7L5

- **Synthesizer Tuning**
- **Digital Storage and Averaging**
- **Three-Knob Operation**
- **Preset Reference Level and Dot Frequency for Extra Input Protection**
- **Swept Measurements (Option 25 Tracking Generator)**
- **Selectable Input Impedance; Calibration in dBm, dBV, or Volts/Division**
- **Semiautomatic Measurements With the Tek 7854**

The Tektronix 7L5 is a high performance, high value spectrum analyzer providing easy-to-use low frequency measurement capability. The 7L5 can cover 20 Hz to 5 MHz in one display. Resolution bandwidth can be varied from 10 Hz to 30 kHz, with residual FM of no more than 1 Hz peak-to-peak.

Digital storage proves particularly useful in the 7L5. With digital averaging and peak detection, you can accurately measure low level signals, such as intermodulation distortion products, in the presence of noise. With Max Hold, you can capture short duration signals and random transient phenomena that would otherwise be lost.

The 7L5 combines high performance with easy-to-use three-knob operation—

1) Set frequency span
2) Set center frequency
3) Set reference level. . .and measure!

Sweep speed and resolution bandwidth are set automatically.

Digital tuning and synthesizer stability let you set center frequency with six-digit accuracy immediately upon turn-on. Reference level can be set in 1 dB and 10 dB steps, eliminating the need to interpolate amplitude levels. And for measuring wide relative amplitude differences, the 7L5 offers 80 dB spurious-free display dynamic range.

The 7L5 makes accurate baseband communications measurements such as noise, spurious response, distortion, and transient interference, all with the certainty of 10 Hz resolution. The 7L5 Option 25 provides swept frequency measurements from 20 Hz to 5 MHz. The tracking generator is built into a "three-wide" 7L5 plug-in analyzer.

This highly capable audio/baseband analyzer finds a place in many areas of use, including baseband evaluation of FM broadcast and television stereo signals, measurement of communications system basebands, power line distortion, EMC/RFI, and computer systems.

Make semiautomatic measurements by using the Tek 7854 Digitizing Mainframe. This programmable unit's calculation and marker capabilities can greatly enhance your productivity using the 7L5 Spectrum Analyzer. Specify 7L5 Option 12 for proper 7854 interface. Get full details from your Tek Sales Engineer or ask for Application Note 26W-5653.

CHARACTERISTICS

The following characteristics and features apply to the 7L5 Spectrum Analyzer after a warm-up period of ten minutes.

FREQUENCY RELATED

Center Frequency Range—Input Frequency Range: 20 Hz through 5.0 MHz. Dot Frequency Range: 0 Hz through 4999.75 kHz tuned in 10 kHz or 250 Hz steps. Accuracy at 0 to 50°C: ±(20 Hz +10^{-5} of dot frequency). 20 to 30°C: ±(5 Hz +2×10^{-6} of dot frequency).

Frequency Span/Division Range—50 Hz/div to 500 kHz/div (maximum) in a 1-2-5 sequence. Accuracy: Within 5%. Linearity: Within 5% over the center eight divisions. Zero Span: Provides fixed frequency operation for time domain display.

Resolution Bandwidth (6 dB)—10 Hz to 30 kHz in eight steps. Coupled position electronically couples resolution to span/division selection so that both are controlled by the same knob. Accuracy: Within 20% of resolution selected (30 Hz to 30 kHz). 10 Hz is 100 Hz ±20 Hz 70 dB down.

Resolution Shape Factor (60/6 dB)—10:1 or better for 10 Hz to 1 kHz and 5:1 or better for 3 kHz to 30 kHz.

Signal Level Change Between Any Two Bandwidths—30 kHz to 100 Hz: ≤ 0.5 dB. 30 kHz to 10 Hz: ≤ 2.0 dB.
Residual FM—≤ 1 Hz (p-p) for frequency span of 50 Hz/div to 2 kHz/div. ≤ 40 Hz (p-p) for frequency span of 5 kHz/div to 500 kHz/div.
Stability—≤ 5 Hz/hour.

AMPLITUDE RELATED

Display Modes—Log 10 dB/Division: Provides 80 dB display dynamic range. Accuracy is within 0.08 dB/dB to 2 dB maximum over 80 dB display dynamic range. Log 2 dB/Division: Provides 16 dB display dynamic range. Accuracy is within 0.15 dB/dB to 1 dB maximum over 16 dB display dynamic range.
LIN: 20 nV/div to 200 mV div in a 1-2-5 sequence. Accuracy is within 5%.
Reference Level—+21 to −128 dBm (50 or 75 Ω input impedance), +10 to −139 dBm (600 Ω input impedance), +8 to −141 dBV (1 MΩ input impedance). Calibrated in 1 and 10 dB steps.
Display Flatness—0.7 dB maximum from 20 Hz to 5 MHz (add 0.5% quantization error in digital storage).
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. Sensitivity is degraded an additional 8 dB when the input buffer is on.

Resolution Bandwidth	Averaged Noise Level	
	dBm 50 Ω	dBV 75 Ω
10 Hz	−135 dBm	−140.5 dBV
30 Hz	−133 dBm	−138.5 dBV
100 Hz	−130 dBm	−135.5 dBV
300 Hz	−125 dBm	−130.5 dBV
1 kHz	−120 dBm	−125.5 dBV
3 kHz	−115 dBm	−120.5 dBV
10 kHz	−110 dBm	−115.5 dBV
30 kHz	−105 dBm	−110.5 dBV

SPURIOUS RESPONSES

Residual—≤ −143 dBV (noncalibrator related, referenced to the input).
Intermodulation Products—Within any frequency span for two on-screen signals of any input level, third order down 75 dB or more and second order down 72 dB or more; of any input level up to −53 dBV or of any input level with input buffer on, second and third order down 80 dB or more.

GENERAL CHARACTERISTICS

Sweep—Triggered, manual, auto.
Sweep Time—10 s/div to 0.1 ms/div in a 1-2-5 sequence.
Accuracy—Within 5% of selected time/division.
Triggering—Sources are free run, internal and line. Modes are normal, manual sweep and single sweep.
Sensitivity—≥1.5 div of internal signal for both normal and single sweep modes over the approximate frequency range of 30 Hz to 500 kHz.
Shipping Weight—7.6 kg (17 lb).

INPUT SIGNALS

Maximum Input Power Level—1 MΩ/28 pF: 15 V (p-p) for ac or pulse signals with rise times of 2 V/μs or faster (pulses or ac beyond this specification may open an input fuse). 40 V (dc plus peak ac) for signals with rise times slower than 2 V/μs.
600 Ω (Internally Terminated): 12 V dc or RMS (+24 dBm). 50Ω (Internally Terminated): 3.5 V dc or RMS (+24 dBm).
Input Impedance—Switch selectable 1 MΩ in parallel with 28 pF, 50Ω (75Ω for L3 Option 01) termination, or 600 Ω termination.

OUTPUT SIGNAL

Calibrator—(Cal Out) 500 kHz squarewave within ±0.15 dB of −40 dBV into the plug-in impedance.
Video Out—50 mV/div ±5% (about the CRT center) with source impedance of 1 kΩ.
Horizontal Out—0 V dc to about −6 V dc sawtooth with a source impedance of 5 kΩ.

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 20 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 threewide unit for the 7000 Series mainframes.

CHARACTERISTICS

Frequency—Range 20 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 or 1 dB steps. A vernier provides continuous variation between calibrated steps.
Range—50 Ω: 0 to −63 dBm. 75 Ω: −6 to −69 dBm. 600 Ω: −17 to −80 dBm.
Accuracy (Maximum Output Calibrated at 500 kHz)—50 Ω: 0 dBm ±0.25 dB. 75 Ω: −6 dBm +0.4, −0.2 dB. 600 Ω: −17 dBm +0.5, −0.1 dB.
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 and 75Ω: Within 0.5 dB p-p. 600 Ω: Within 1.0 dB p-p. Total System Flatness (7L5 with L3 Plug-In Module and Option 25) 50 and 75Ω: Within 1.0 dB p-p. 600 Ω: Within 1.25 dB p-p.
Dynamic Range (7L5 With Option 25)—≥110 dB.
Residual FM (p-p)—(7L5 with Option 25). Spans to 2 kHz/Div: 2 Hz. Spans 5 kHz/Div or Greater: 40 Hz.
Stability—25 Hz/5 minutes after ten minute warmup decreasing to 25 Hz/hour maximum after one hour.
Spurious Suppression, 20 Hz to 5.0 MHz (Harmonic and Nonharmonic)—40 dB or more with respect to the carrier.
Auxiliary Output—≥ 200 mV RMS into 50Ω.

BALANCED INPUT TRANSFORMER

Frequency Range—50 kHz to 3 MHz, usable from 10 kHz to 20 MHz.
Flatness—0.25 dB p-p maximum (50 kHz to 3 MHz) including nominal 0.1 dB insertion loss.
Common-Mode Rejection—25 dB minimum (50 kHz to 3 MHz).
Output Termination—Switchable between 124 Ω, 135 Ω, and none for bridging or external termination.
Connectors—WECO (0.37 in with 0.090 center) on 0.625 inch spacing for balanced input. BNC for single-ended output.

ORDERING INFORMATION

7L5 Spectrum Analyzer, 20 Hz to 5 MHz (Requires L3 Plug-In Module). **$12,500**
Includes: Spectrum analyzer graticule (337-1159-00); (7000 Series), and (337-1439-01); (7603), light blue filter (378-0684-00); operator manual (070-1734-01); service manual (070-2184-01).

OPTIONS

Option 11—L3 Module with Option 01 **+$1,775**
Option 12—7854 Oscilloscope capability. **+$165**
Option 20—L3 Plug-In Module without Option 01. **+$1,775**
Option 25—Tracking Generator. **+$1,765**

L3 Plug-In Unit to 7L5—50 Ω, 600 Ω, 1 M Ω. **+$1,775**
Option 01—75 Ω, 600 Ω, 1 M Ω. **NC**
Includes: Instruction manual 070-2154-02

CONVERSION KIT

Tracking Generator—To add to existing 7L5. Order 040-0810-04 **$2,345**

RECOMMENDED MAINFRAMES

7603*1 Oscilloscope, 100 MHz. **$3,995**
R7603*1 Rackmount Oscilloscope, 100 MHz. **$4,910**
7854 Waveform Processing Oscilloscope, 400 MHz. **$15,275**

*1 *Suggested oscilloscope.*

OPTIONS (7603/R7603)

Option 06—Internal Spectrum Analyzer Graticule. **+$50**
Option 08—Protective Front Cover (7603 only). **+$115**
Option 77—GM (P7) Phosphor and Internal Spectrum Analyzer Graticule. **+$100**

OPTIONAL ACCESSORIES

75 to 50 Ω Minimum Loss Attenuator— AC coupled. Order 011-0112-00. **$60**
P6105A—10X, 2 m Probe. **$93**
Balanced Input Transformer—Order 013-0182-00. **$385**

TekSPANS®

MEASUREMENTS
Harmonic Distortion
Amplitude Modulation
Signal-to-Noise
Frequency Response
Cursors

FILTER TESTS
Band-pass Filter
Low-pass FIlter
High-pass Filter

SIGNAL SEARCH
Fast Search
Precise Search
Spur Search
Automatic Identify

WAVEFORM OPERATIONS
Acquire AVIEW Waveform
Acquire BVIEW Waveform
Send to Instrument
Store on Disk
Load from Disk
Graph Waveform
Overlay Waveform
Redraw Waveform
Normalize Waveform

UTILITIES
Talk/Listen (Command)
Sensitivity Test
Resolution Filter Test
Calibration Assistance
Select Instrument
Select Disk

The GRASP main menu lists all submenus and their routines.

GRASP® (General RF Applications Software Package)

- **Value Packed Software—Performs Automated Spectrum Analysis on Choice of Popular Controllers**
- **Applications Routines Are Selected Through Easy, Menu-Driven Operation**
- **Supports IBM PC XT/AT and Compatible Computers (Option 01/1A)**
- **Supports HP Series 200 Controllers (Option 02/2A)**
- **Supports Tek 4041 Controller and Multiple-Site/Remote-Site Monitoring of RF Equipment (Option 03)**

Tek's GRASP (General RF Applications Software Package) is the first in a family of spectrum analyzer software packages called TekSPANS. GRASP is designed to capitalize on the power of Tek's programmable spectrum analyzers and a choice of controllers such as Tek's 4041, IBM PCs or compatibles, and HP 200 Series.

This highly versatile software package offers many applications/utility routines that are selected through easy, menu-driven operation. Even a nontechnical operator has immediate access to operations such as swept-frequency measurements, waveform storage and recall, and performing signal analysis, including measurements of harmonic distortion and signal-to-noise ratio.

From GRASP's main menu, a user selects among any of the submenus for Measurements, Filter Tests, Signal Search routines, Waveform Operations, and Utilities. Selections are made by pressing the appropriate function key shown on-screen.

Prompts guide the user through each measurement task. For example, users can utilize a Cursors routine which displays the instrument CRT on their terminal screen. It calculates and displays both the absolute amplitude and frequency of one or two marked signals, plus the relative (delta) amplitude and frequency difference between the two markers.

A powerful feature of GRASP (Option 03) is the ability to monitor one or more remote sites via phone lines and modems. The user can exercise complete control over the spectrum analyzer at the remote site, and can graph the acquired waveform at the base-site terminal. The user can also specify a frequency and amplitude window, providing for an automatic telephone call back to the base site when the signal drops out of tolerance.

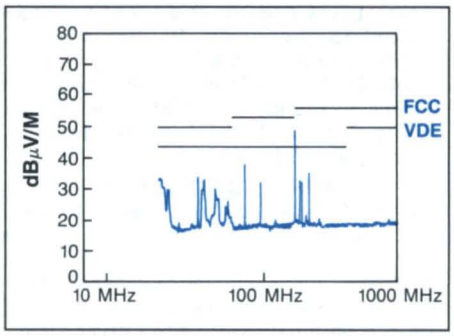
Complete source code is provided, thereby simplifying the task of integrating user-written routines into GRASP.

ORDERING INFORMATION

S26RF00 GRASP. **$875**
Includes: Software, license agreement, and users manual.

OPTIONS

Option 01—IBM PC AT high density disk. **NC**
Option 1A—IBM PC double density disk. **NC**
Option 02—HP 200 Series 5¼″ double density disk. **NC**
Option 2A—HP 200 Series 3½″ micro disk. **NC**
Option 03—Tek 4041 DC-100 Tape. **NC**
Option 10—GPIB interface for PC. **+$495**



Sample graph from radiated emissions test.

EMI Software

- **Cost-Effective Approach to Automated EMI Testing**
- **Runs on IBM or Compatible PC**
- **Easy, Menu-Driven Operation**
- **Prequalification Testing for FCC/VDE, MIL-STD-461B/462 CE03 and RE02. Test Categories include: FCC/VDE Electric Field Radiated , VDE Magnetic Field Radiated, FCC/VDE Conducted, VDE Absorbing Clamp, RE02 Radiated (MIL-STD-461B/462), CE03 Conducted (MIL-STD-461B/462)**

Tek's EMI Prequalification Software provides a low-cost, time-saving approach to EMI conducted and radiated emissions testing. It is particularly useful to design engineers who require a compact system for measuring and documenting EMI levels during the various design stages.

When used with a Tek programmable spectrum analyzer and an IBM or compatible PC (equipped with a National Instruments PC2A IEEE-488 interface card), this software enables a cost-effective approach for integrated EMI testing. This highly versatile software package includes test routines for FCC Part 15J (A & B), VDE 0871 (A & B), and MIL-STD- 461B/462 RE02 and CE03. Routines are accessed through easy, menu-driven operation. For each class of test, routines are provided for acquiring data, graphing results (semilog plot with selected limits superimposed) and creating printouts of frequencies approaching or exceeding limits. Capability is also included for updating and displaying antenna factors.

ORDERING INFORMATION

S26EM00 EMI Prequalification Software. **$1,475**
Includes: Software on DS/DD diskettes, license agreement, and user's manual.
Option 09—Source code. **+$1,000**
Option 10—GPIB interface for PC. **+$495**

MONITOR
Enter Parameters
Take a Measurement
Report Errors
Hang-Up/Monitor
Immediate Call Back
Show Parameters

WAVEFORM OPERATIONS
Acquire AView Waveform
Acquire BView Waveform
Send to Instrument
Store on Disk
Load from Disk
Graph Waveform
Acquire Mode: Norm

UTILITIES
Talk/listen (Command)
Sensitivity Test
Resolution Filters Test
Calibration Assistance
Select Instrument
Select Disk
User Program

MEASUREMENTS
Harmonic Distortion
Amplitude Modulation
Signal-to-Noise

SIGNAL SEARCH
Fast Search
Precise Search
Spur Search

RSM provides a variety of routines for signal monitoring and interactive testing.

RSM (Remote Site Monitoring) Software for the PC

- **Control Tektronix Instrumentation from Anywhere in the World**
- **Monitor RF Signals at One or More Remote Installations**
- **Immediate Call-back Warning of Failure Conditions**
- **Applications Routines Are Selected Through Pop-up Menu Structure.**

RSM (Remote Site Monitoring) software, part of the TekSPANS family of spectrum analysis software, simplifies the control and data analysis of instruments at remote sites or in hostile environments. RSM merges the power and precision of Tek's Spectrum Analyzers with the economy of PC-based controllers to provide cost effective, remote-site monitoring and control.

RSM provides the ability to connect, via telephone, a pair of PCs. The remote-site PC is connected to the remote Tek 490P or 2750P Series Spectrum Analyzer, and perhaps to other Tek programmable instruments, via the IEEE 488 interface. This remote PC includes either the Tek GURU interface or the National Instruments PC2 or PC2A card.

The host-site PC is located at a convenient location such as an office or lab. At the host site the user has complete control over the operations of the remote-site PC, and all screen displays seen are identical to those currently appearing at the remote site, including full color.

From RSM's main menu, a user selects any of the submenus for Monitor, Waveform Operations, Utilities, Measurements, and Signal Search. Each of these submenus and the included routines are accessed through a pop-up menu structure.

The Monitor menu contains several routines that control the operation of the Independent Automated Signal Monitoring mode. RSM continually checks the RF input signals to the remote spectrum analyzer and compares them to a user-defined frequency/amplitude tolerance window. The user can define all monitoring parameters, verify pass/fail conditions of the current setup, initiate monitoring, and report all current and logged errors.

The Monitor menu includes a Hang-Up/Monitor routine which terminates any existing phone connection between the host and remote sites and initiates the signal monitoring routine as specified. If the signal drops out of the previously defined amplitude/frequency window, an automatic telephone call is placed to the host site to warn the operator to the error condition. A Local Error Logging routine is also provided which logs all errors at the remote site for later analysis.

The Waveform Operations menu provides several routines such as acquiring and graphing one or more signals, storing and loading waveforms to disk, and sending waveforms back to the analyzer for display.

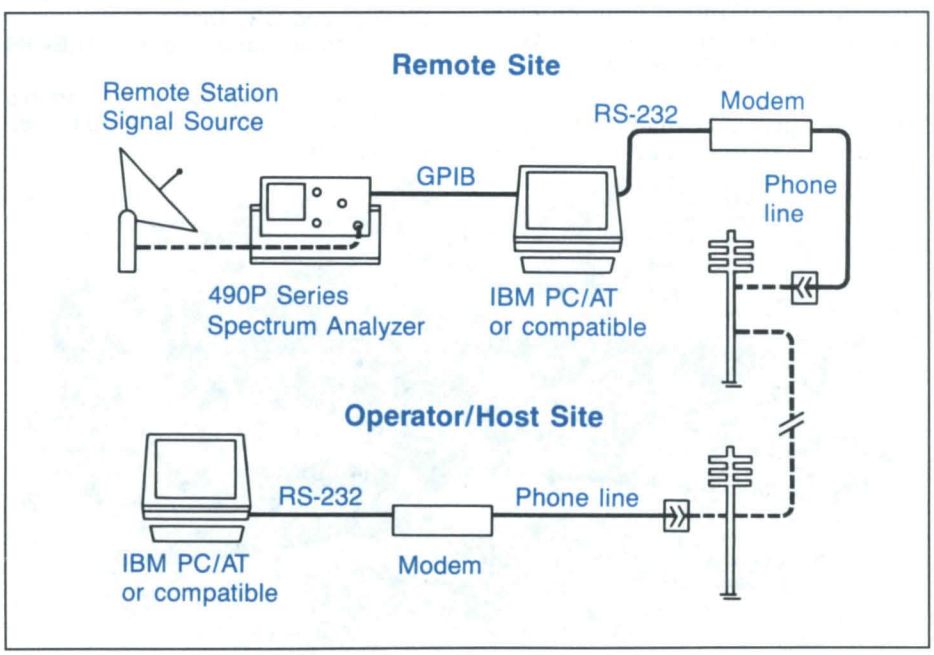
The Utilities menu includes a Talk/Listen routine that sends commands and queries to the spectrum analyzer or other Tek instruments at the remote site. This menu also allows inclusion of a user-written program to perform tasks such as automated signal surveillance of a set of communication channels.

The Measurements and Signal Search menus provide a variety of routines for performing tasks such as measuring harmonic distortion and amplitude modulation, as well as performing a precise signal search over a specified frequency range.

For maximum flexibility, the RSM system is offered in two packages: a host-site module and a remote-site module. At least one of each module is required to comprise a working remote monitoring system. Both modules are provided with source code.

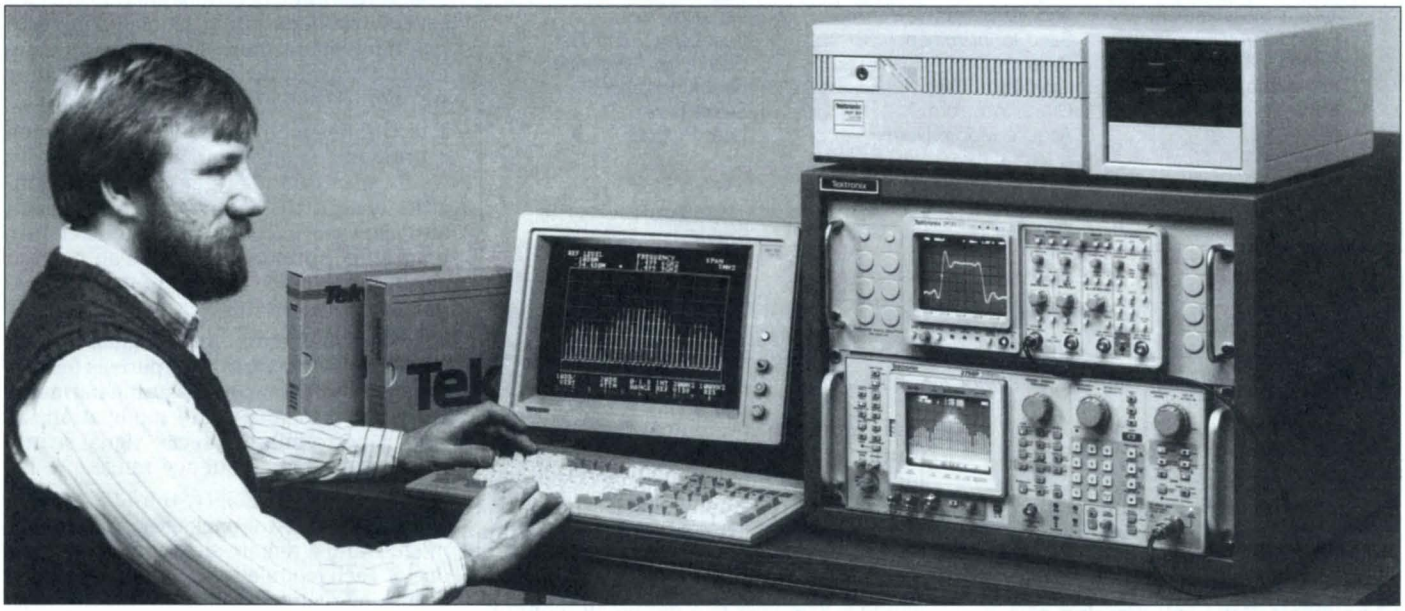
ORDERING INFORMATION

S26RM00 RSM Host-Site module. **$300**
S26RM01 RSM Remote-Site module. **$750**
Includes: Software on DS/DD diskettes, license agreement, and users manual.
Option 10—GPIB interface for PC. **+$495**



Equipment setup for remote site signal monitoring.

AUTOMATE YOUR MEASUREMENTS WITH TEK SPECTRUM ANALYZER SYSTEMS



Tektronix Spectrum Analyzer Packages are configured around the Tek PEP 301 Controllers or Compaq personal computers and Tektronix' laboratory quality programmable spectrum analyzers. Coupling the PC to the analyzer via the IEEE-488 bus enables the user to take advantage of the PC's capability, as well as the power and versatility of Tektronix Spectrum Analyzers. A highly versatile General RF Applications Software Package (GRASP®) offers many different applications and utility routines which are selected through easy, menu driven operation.

Tektronix Spectrum Analyzer Packages are turnkey systems that get your application running with a minimum of effort. Each system is fully configured and inspected prior to shipment.

High Performance Spectrum Analyzers

- 10 kHz to 21 GHz in Coax and to 325 GHz Using Tektronix Waveguide Mixers
- Built in Frequency Counter With High Accuracy and Resolution
- Fast, "Smart" Markers for Faster, More Accurate Measurements
- Nonvolatile Memory to Save Front- Panel Settings and CRT Displays
- Fully Programmable Over the IEEE-488 bus
- Available in Both Benchtop and Portable Configurations With No Performance Compromise

Value Packed Tektronix Software

- Menu Driven Operation for Easy Access to Test Routines
- Exclusive Swept Frequency Response Measurements
- A Wide Variety of Measurement and Utility Routines
- Color Annotated Displays
- Store/Recall Waveforms and Test Results to Disk

GRASP Software

Measurements

- Harmonic Distortion
- Amplitude Modulation
- Signal to Noise
- Frequency Response
- Cursors

Filter Tests

- Band-pass, Low-pass, High-pass

Signal Search

- Fast Search
- Precise Search
- Spurious Search
- Automatic Identify

Waveform Operation

- Data Storage and Retrieval
- Waveform Graphing
- Normalize Waveform

Utilities

- Talk/Listen
- Sensitivity Test
- Resolution Filter Test
- Calibration Assistance
- Select Instrument
- Select Disk

COMPAQ PC/SPECTRUM ANALYZER SYSTEMS

A choice of portable or desktop Compaq PCs is available.

- Portable II with the powerful 80286 processor and designed-in flexibility is the standard in portable personal computing.
- Deskpro Model 2 offers large storage capacity, fast, convenient access to large amounts of information, and expansion capability.
- Deskpro 286 enjoys the processing power of the 80286 microprocessor. Two models are offered with a choice of storage media.

Option 23 is intended for the user who already has a PC-compatible computer. Options 24 through 28 are turnkey systems designed for R&D, manufacturing test, and general RF automated testing. Option 29 adds a graphics-compatible printer to each of these systems.

Each of the computer options are configured and checked out prior to shipment. Thus, the customer receives a turnkey system and should encounter minimal effort in configuring and running the system.

ORDERING INFORMATION

When ordering, use the model number and desired options of the programmable spectrum analyzer plus one of the following package options.

Option 23—GRASP, PC2A*[1], GPIB cable. **+$1,750**

Option 24—GRASP, PC2A*[1], GPIB cable, Compaq Portable II, Model 2, includes: 80286 Processor, 256K RAM, two 360K Drives, Built-in Monitor, Serial/Parallel Interface. **+$4,800**

Option 25—GRASP, PC2A*[1], GPIB cable, Compaq Deskpro, Model 2, includes: 8086 Processor, 256K RAM, two 360K Drives, Enhanced Color Display, Serial/Parallel Interface. **+$4,900**

Option 26—GRASP, PC2A*[1], GPIB cable, Compaq Deskpro 286, Model 1, includes: 80286 Processor, 256K RAM, 1.2M/360K Drives, Enhanced Color Display, Serial/Parallel Interface. **+$6,400**

Option 28—GRASP, PC2A*[1], GPIB cable, Compaq Deskpro 286, Model 20, includes: 80286 Processor, 640K RAM, 1.2M/360K Drives, 20M Hard Drive, Enhanced Color Display, Serial/Parallel Interface. **+$8,400**

Option 29—Epson FX-86E printer and parallel interface cable. **+$550**

*[1] *National Instruments PC2A (GPIB) Interface Card.*

Note: Options 24–29 and 32–34 may have limited distribution due to export controls. See your local Sales Engineer for more information.

PEP 301/SPECTRUM ANALYZER SYSTEMS

Tektronix Programmable Spectrum Analyzers are now available with the Tektronix PEP 301 Systems Controller and TekSPANS software. The PEP 301 is a high performance, MS-DOS compatible computer based on the Intel 80386/80387.

The PEP 301 provided with these systems is configured the same as a standard PEP 301, except that a second floppy disk drive (360 Kb) has been added. Also, in lieu of the normal on-site installation provided by the Instrument Group, each of the computer options is configured and checked out prior to shipment. The customer thus receives a turnkey system and should encounter minimal effort in connecting and running the system.

The PEP 301 is compatible with the IBM PC/AT, but typically runs programs three to four times faster. The controller includes the following standard features:

- 16 MHz Intel 80386 32-bit microprocessor.
- Intel 80387 math coprocessor.
- 1 Mb zero-wait state RAM on-board, expandable to 16 Mb.
- 40 Mb hard disk drive (28 ms access time).
- Real-time clock/calendar.
- 5.25 in. 1.2 Mb floppy disk drive.
- 5.25 in. 360 Kb floppy disk drive.
- MS-DOS, GW-BASIC and GURU II software.
- GURU II+ hardware package (GPIB interface and cable).
- High resolution graphics card: CGA, EGA, 640×480, 800×600 modes.
- 14 in. high resolution, multi-sync color display monitor.
- 101 key, detachable keyboard with 10 ft coil cable.
- 2 asynchronous RS-232 serial ports.
- 1 Centronics-compatible parallel port.

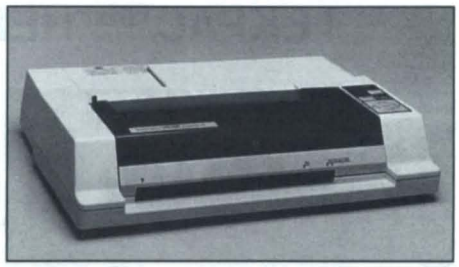
ORDERING INFORMATION

Option 32—PEP 301 Controller. **+$8,120**

Option 33—PEP 301 Controller with GRASP software (S26RF00 Opt. 1A). **+$8,995**

Option 34—PEP 301 Controller with EMI software (S26EM00). **+$9,595**

Tektronix can also provide Technical Assistance Services for users requiring custom programming or applications assistance. Contact your Tektronix Sales Engineer for details.



HC100 Plotter

HC100 Color Plotter

- **GPIB and Centronics Interfaces are Both Standard**
- **Can Be Used as a General Purpose Plotter By Using HPGL Command Set**
- **Four Color Pens in Three Styles**
- **Replaceable Pen Cartridge**
- **Compact Size**
- **Handles A4 and US Letter Size**

CHARACTERISTICS

Effective Drawing Size—267 mm (X-axis) ×192 mm (Y-axis).
Maximum Drawing Speed—230 mm/s (along pen axis).
Maximum Resolution—0.1 mm.
Pen Response Speed—15 times/s.
Number of Pens—4 (changed automatically).
Pen Types—Fiber pens: aqueous ink or oil-based ink. Ball-point pens: aqueous ink.
Pen Colors—Set of black, blue, red, and green.
Paper Sizes—ISO A4: 297×210 mm. B5: 257×182 mm. US letter size: 279×216 mm.
Paper Types—Ordinary paper; OHJ film.
Pen Movement Precision—Single Pen: 0.3 mm. Different Pens: 0.5 mm.
Pen Change Precision—Within 0.3 mm.

FUNCTIONS

Drawing Modes—Self Test, Plotter, Printer.
Character Types—ASCII (96 types); International (32 types for 11 countries).

ORDERING INFORMATION

HC-100 Color Plotter **$825**
Includes: 1 package of each pen set: Fiber tip/water based (016-0879-00); Fiber tip oil based (016-0878-00); Ball point (016-0877-00); Operator's Manual; One pen cartridge (016-0876-00).

OPTIONS

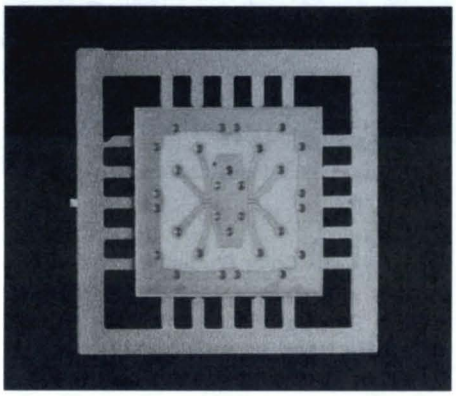
Option 01—1 m GPIB cable (012-0991-01). **+$140**

Option 02—9 ft. Centronics cable (012-1250-00). **+$45**

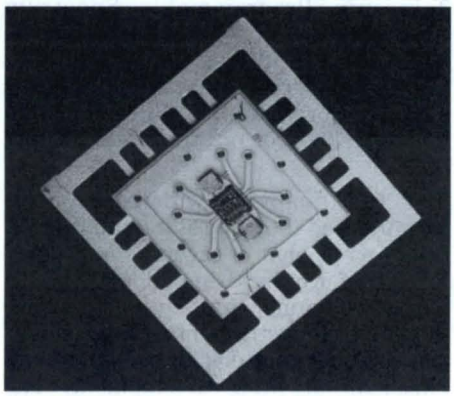
To get a 220 V/240 V, 50 Hz version order one of these options:

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A5—Switzerland 220 V, 50 Hz.
(Example: An HC100 Option A1 will be a 220 V, 50 Hz Plotter with a universal Euro plug.)

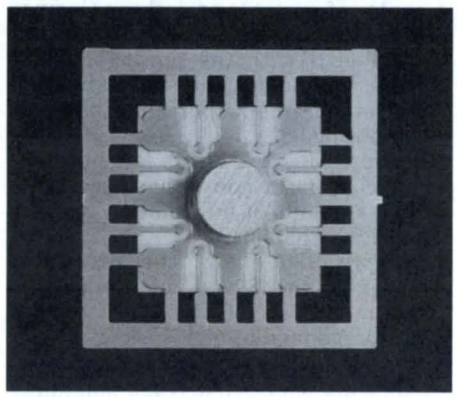
TEKPAC™: HERMETIC MMIC PACKAGE PRODUCTS



TPAK142 (top view).



Typical Application used in Micro-S product line, TriQuint Semiconductor, Inc.



TPAK142 (bottom view).

TEKPAC™ Hermetic MMIC Packages

- **Multiple RF Signal Lines From Motherboard to Chip**
- **3×10^{-8} $^{atm/cc\text{-}sec}$ Hermeticity**
- **Direct-Contact Heatsinking**

Hermetic, surface-mount MMIC packages are now available from Tektronix using a patented via design (U.S. 4,626, 805). An evaluation kit with packages, lids, an 8-port SMA text fixture, and calibration standards is also available.

TPAK142 CHARACTERISTICS

	0–12 GHz	12–18 GHz
VSWR[1]	1.2:1 max	2.0:1 max
Insertion loss[1]	0.5 dB max	1 dB max
Isolation[2]	40 dB min	30 dB min

[1] *Measured for one signal line from leadframe to die attach pad.*
[2] *Measured for two opposite signal lines with all unconnected lines grounded.*

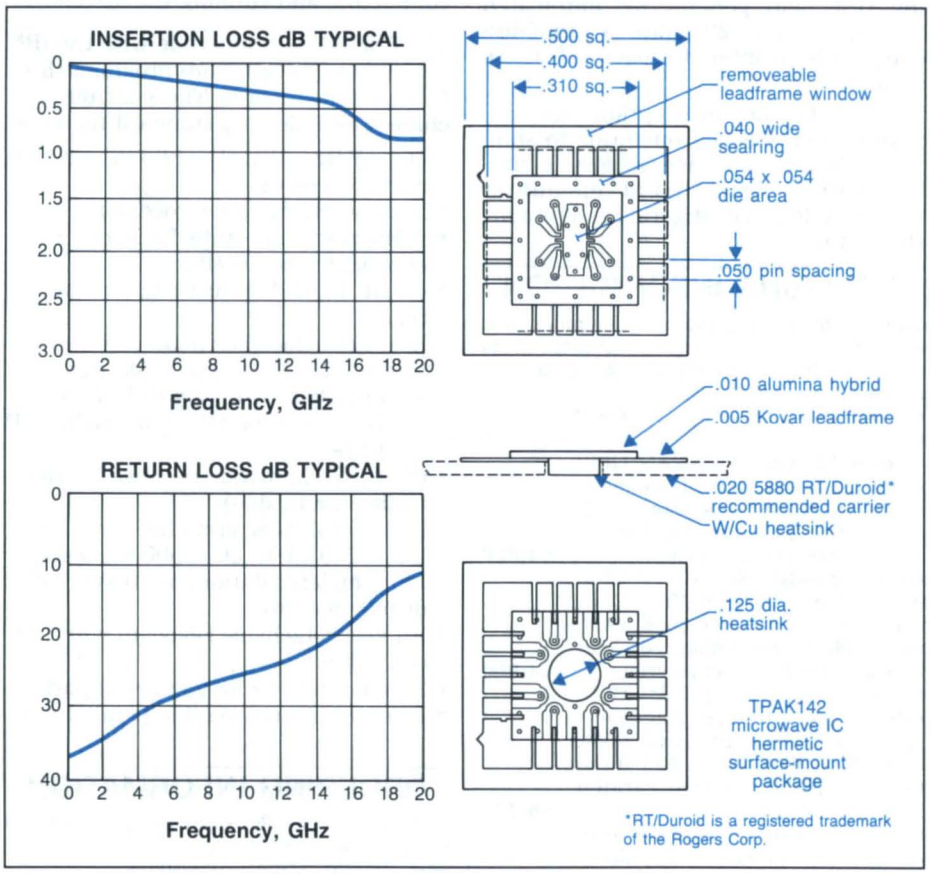
Environmentally Tested—per MIL-STD-883.

OTHER SERVICES AVAILABLE

- Product Technology/Licensing
- Custom Design/Applications

CONTACT

TEKPAC Product Line
Microwave Technology Organization
Tektronix, Inc.
P.O. Box 500, 58-MTO
Beaverton, OR 97077
(503) 627-1299

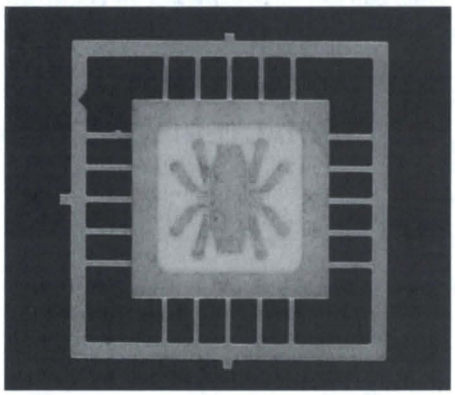


ORDERING INFORMATION

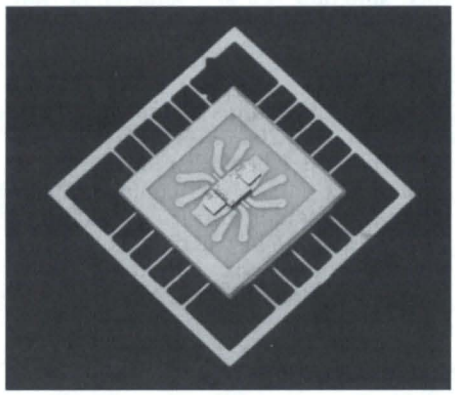
Product	Frequency Performance	Case Size (inches)	Motherboard Recommended	Diepad Area (inches)	Prices
TPAK142	DC-18 GHz	0.31 x 0.31	0.020 5880 RT/Duroid	0.054 x 0.054	$46
TPAK145	DC-18 GHz	0.31 x 0.31	0.020 5880 RT/Duroid	0.096 x 0.096	$46
TPAK155	DC-14 GHz	0.31 x 0.31	0.031 5870 RT/Duroid	0.096 x 0.096	$44
TKIT14E—Evaluation Kit for the TPAK 142					$499

Options	Prices
Option 01—Lid and preform included	+$4
Option 05—Leadframe window removed	NC
Option 40—Heatsink removed	+$5

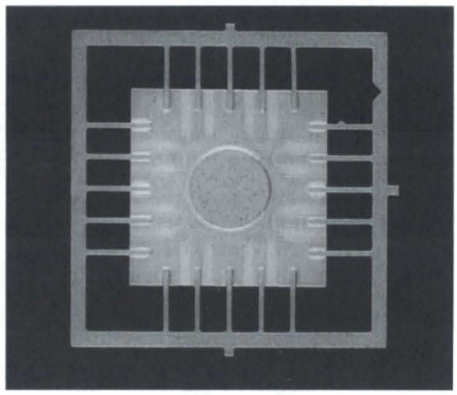
TEKPAC™: HERMETIC MMIC PACKAGE PRODUCTS



TPAX142 (top view).



Typical Application used in Micro-S product line, TriQuint Semiconductor, Inc.



TPAX142 (bottom view).

TEKPAC™ Hermetic MMIC Packages

- **Multiple RF Signal Lines From Motherboard to Chip**
- **1×10^{-8} $^{atm/cc\text{-}sec}$ Hermeticity**
- **Direct-Contact Heatsinking**

The TPAX Series MMIC package represents a new benchmark for low cost surface-mountable and hermetically sealable microelectronic packages designed for Monolithic Microwave Integrated Circuits (MMICs).

The TPAX Series is a first in a series of low cost, 12 GHz performance MMIC packages. Multi-layer ceramic technology and well established fabrication techniques provide a cost-effective solution without sacrificing performance.

TPAX142 CHARACTERISTICS

	0–6 GHz	6–12 GHz
VSWR[1]	1.2:1 max	1.5:1 max
Insertion loss[1]	0.5 dB max	1 dB max
Isolation[2]	40 dB min	30 dB min

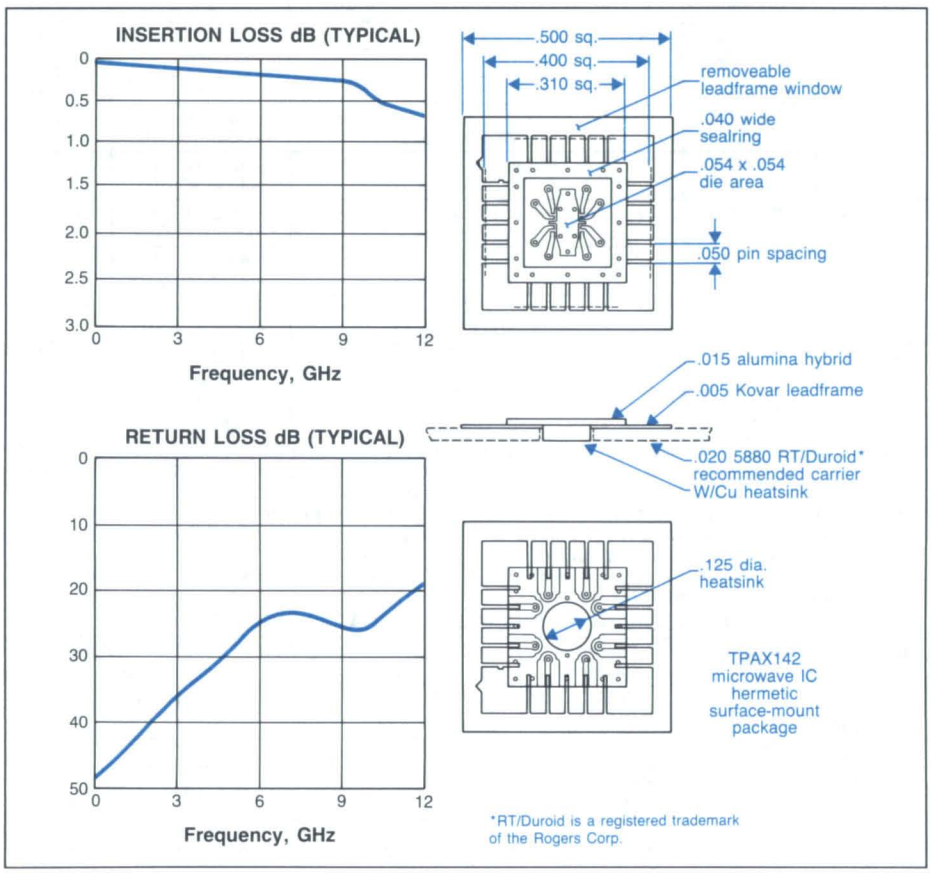
[1] *Measured for one signal line from leadframe to die attach pad.*

[2] *Measured for two opposite signal lines with all unconnected lines grounded.*

Environmentally Tested—per MIL-STD-883.

OTHER SERVICES AVAILABLE

- Product Technology/Licensing
- Custom Design/Applications



ORDERING INFORMATION

Tektronix Product	Frequency Performance	Case Size (inches)	Motherboard Recommended	Diepad Area (inches)	Prices	TEKPAC Options	Prices
TPAX142	DC-12 GHz	0.31 x 0.31	0.020 5880 RT/Duroid	0.054 x 0.054	**$23**	Option 01—Lid and perform set	**+$4**
						Option 05—Leadframe window removed	**NC**
TKIT14F—Evaluation Kit for the TPAX142					**$499**		

WM 490 Series

Waveguide Mixers

Tektronix Waveguide Mixers cover from 18 to 325 GHz with optimum flatness.

They are designed specifically for use with the Tektronix 490 and 2750 Series Spectrum Analyzers, but are compatible with most spectrum analyzers.

Two microwave mixers, with field replaceable diodes, cover ranges 18 to 26.5 GHz and 26.5 to 40 GHz. When used with the 490 and 2750 Series, the frequency response is ±2 dB.

Eight millimeter-wave mixers cover the 33 to 220 GHz range in the standard Milspec band ranges. J to G band flange transition (119-1728-00) converts the WM 490G mixer to cover the 220 to 325 GHz range.

All mixers are gold-plated brass, conforming to MIL-G-45204 Class I, Type 1 specifications and will withstand harsh environments. Mixer sets come complete with a container for spare diodes, a 28-inch cable, an instruction manual, and a wood storage box with foam cutout storage locations for five mixers.

A Diplexer Assembly is also available. It includes TNC-to-SMA adaptor and SMA semirigid coax. **A diplexer is required for waveguide mixers when used on 490 and 2750 Series spectrum analyzers.**

INDIVIDUAL MIXER ELECTRICAL CHARACTERISTICS

Freq. Range (GHz)	Tektronix Model No.	Band Desig.	Sensitivity (dBm)*1	Freq. Resp.*2 (dB)	Conv. Loss*3 Typ. (dB)	Low-Pass Cut-Off Freq.*7
18 to 26.5	WM 490K	K	−100	±2	−30	12 GHz
26.5 to 40	WM 490A	A	−95	±2	−30	16 GHz
33 to 50	WM 490Q	Q	−95	±2	−30	21 GHz
40 to 60	WM 490U	U	−95	±2.5	−30	16 GHz
50 to 75	WM 490V	V	−95 at 50 GHz −90 at 75 GHz typ.	±3 typ.*4	−30 at 50 GHz −35 at 75 GHz	28 GHz
60 to 90	WM 490E	E	−95 at 60 GHz −85 at 90 GHz typ.	±3 typ.*4	−30 at 60 GHz −40 at 90 GHz	28 GHz
75 to 110	WM 490W	W	−90 at 75 GHz −80 at 110 GHz typ.	±3 typ.*4	−35 at 75 GHz −45 at 110 GHz	30 GHz
90 to 140	WM 490F	F	−85 at 90 GHz −75 at 140 GHz typ.	±3 typ.*4	−40 at 90 GHz −50 at 140 GHz	32 GHz
110 to 170	WM 490D	D	−80 at 110 GHz −70 at 170 GHz typ.	±3 typ.*4	−45 at 110 GHz −55 at 170 GHz	40 GHz
140 to 220	WM 490G	G	−75 at 140 GHz −65 at 220 GHz typ.	±3 typ.*4	−50 at 140 GHz −60 at 220 GHz	40 GHz
220 to 325	WM 490G*6 Opt. 01	J	−65 at 220 GHz −50 at 325 GHz typ.*5	±3 typ.*4	−60 at 220 GHz −70 at 325 GHz	—

*1 *Equivalent average noise level using a 490 or 2750 Series spectrum analyzer in 1 kHz resolution bandwidth.*

*2 *Maximum amplitude variation across each waveguide mixer band (using a 490 or 2750 Series spectrum analyzer with peaking control optimized at each frequency in response to a −30 dBm CW input signal to the mixer).*

*3 *LO drive +10 dBm peaking control optimized.*

*4 *Over any 5 GHz bandwidth for millimeter wave mixers above 60 GHz.*

*5 *Value estimated at 325 GHz.*

*6 *Tapered waveguide transition allowing WM 490G to cover this range.*

*7 *These low-pass filters are in LO/IF connector.*

INDIVIDUAL MIXER MECHANICAL CHARACTERISTICS

Tektronix Model*3	Waveguide (EIA)	Flange (JAN)	Length cm	Length in.	Width*1 cm	Width*1 in.	Height*1 cm	Height*1 in.
WM 490K	WR-42	UG-595/U	8.97	3.53	2.22	0.875	3.68	1.45
WM 490A	WR-28	UG-599/U	6.93	2.73	1.90	0.750	3.35	1.32
WM 490Q	WR-22	UG-383/U	5.37	2.125	1.84	0.725	2.82	1.110
WM 490U	WR-19	UG-383/U-M	4.52	1.78	1.84	0.725	2.45	0.980
WM 490V	WR-15	UG-385/U	4.31	1.70	0.89	0.350	2.29	0.900
WM 490E	WR-12	UG-387/U	4.31	1.70	0.89	0.350	2.29	0.900
WM 490W	WR-10	UG-387/U-M	4.31	1.70	0.89	0.350	2.29	0.900
WM 490F	WR-08	UG-387/U-M*2	4.31	1.70	0.89	0.350	2.29	0.900
WM 490D	WR-06	UG-387/U-M*2	4.31	1.70	0.89	0.350	2.29	0.900
WM 490G	WR-05	UG-387/U-M*2	4.31	1.70	0.89	0.350	2.29	0.900
119-1728-00 G-J Band flange transition	WR-05 WR-03	74-003 74-005						

*1 *Physical dimensions exclude contribution due to the diameter of round waveguide flanges in U, V, E, W, F, D, and G bands.*

*2 *All mixers are equipped with standard UG-XXX/U type flanges as indicated. Flange adaptors to standard MIL-F-3022 type flanges are provided in F, D, and G bands at no additional charge.*

*3 *All mixers include a protective flange cover, an LO/IF port protective shorting cap, and two captive flange screws for round flange mixers.*

CHARACTERISTICS

For All Waveguide Mixers—Maximum CW RF Input Level: +20 dBm (100 mW).

Maximum PULSED RF Input Level—1 W peak with 0.001 maximum duty factor and 1 μs maximum pulse width.

LO Requirement—+7 dBm minimum, +15 dBm maximum, +10 dBm typical.

Bias Requirement—−2.0 V to +0.5 V with respect to the mixer body through a current limiting resistor, to provide 0 mV to 20 mA of bias current.

1 dB Compression Point—+13 dBm typical (at system level). −10 dBm typical when used with the 490 and 2750 Series spectrum analyzers.

ORDERING INFORMATION

18 to 26.5 GHz—Order WM 490K. **$1,310**

26.5 to 40 GHz—Order WM 490A. **$1,310**

33 to 50 GHz—Order WM 490Q. **$1,520**

40 to 60 GHz—Order WM 490U. **$1,805**

50 to 75 GHz—Order WM 490V. **$2,045**

60 to 90 GHz—Order WM 490E. **$2,225**

75 to 110 GHz—Order WM 490W. **$2,280**

90 to 140 GHz—Order WM 490F. **$2,445**

110 to 170 GHz—Order WM 490D. **$3,410**

140 to 220 GHz—Order WM 490G. **$3,490**

220 to 325 GHz—Order WM 490G Opt. 1. **$1,260**

18 to 40 GHz Set—Order WM 4902. **$2,675**
Includes: WM 490K, WM 490A.

18 to 60 GHz Set—Order WM 4903. **$4,515**
Includes: WM 490K, WM 490A, WM 490U.

18 to 90 GHz Set—Order WM 4904. **$6,740**
Includes: WM 490K, WM 490A, WM 490U, WM 490E.

18 to 140 GHz Set—Order WM 4905. **$9,190**
Includes: WM 490K, WM 490A, WM 490U, WM 490E, WM 490F.

Cable—Order 012-0649-00. **$33**

Case—Order 016-0465-01. **$30**

220 to 325 GHz—Tapered transition used with WM 490G. Order 119-1728-00. **$1,495**

Diplexer Assembly—Order 015-0385-00. **$235**

Diplexer Assembly Cable—Required for use with Diplexer Assembly. Order 012-0649-00. **$33**

GENERAL PURPOSE WAVEGUIDE MIXERS AND SET

12.5 to 18 GHz—Order 119-0097-01. **$335**

18 to 26.5 GHz—Order 119-0098-01. **$455**

26.5 to 40 GHz—Order 119-0099-01. **$500**

Cable—Order 012-0748-00. **$60**

Case—Order 016-0465-01. **$30**

12.5 to 40 GHz Set—Order 016-0640-00. **$1,405**
Includes: 119-0097-01, 119-0098-01, 119-0099-01.

NEW WM780 SERIES WAVEGUIDE MIXERS

WM780 Series

Waveguide Mixers

- **Individually Characterized**
- **Improved Reliability, Especially in The High Frequency Bands**
- **Increased Sensitivity**
- **Uniform Size**
- **Band Coverage and Breaks Compatible With WM 490 Series Waveguide Mixers (see facing page)**

Tek WM780 Series Waveguide Mixers
Although designed for operation with Tektronix spectrum analyzers, these broadband mixers also serve a wide variety of general-purpose uses for the frequency bands from 18 to 325 GHz. Such uses include down-conversion for noise figure and network analysis measurements.

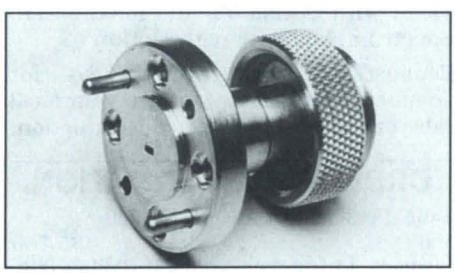
Rugged diode mount and stepped-tapered termination offer improved performance and reliability. Individual characterization curves up to 110 GHz provided on housing. Custom characterization for system use is available on request. Modular construction yields a uniform size.

Frequency Range (GHz)	Tektronix Model No.	Band Designation
18 to 26.5	WM780K	K
26.5 to 40	WM780A	A
33 to 50	WM780Q	Q
40 to 60	WM780U	U
50 to 75	WM780V	V
60 to 90	WM780E	E
75 to 110	WM780W	W
90 to 140	WM780F	F
110 to 170	WM780D	D
140 to 220	WM780G	G
220 to 325	WM780G Opt. 01	J

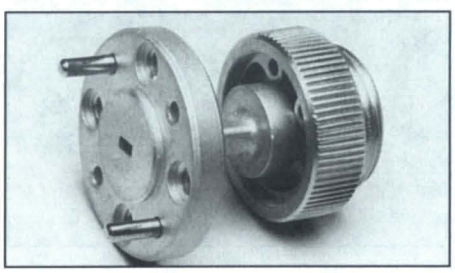
ORDERING INFORMATION

For complete specifications and ordering information, contact your Tektronix Sales Representative.

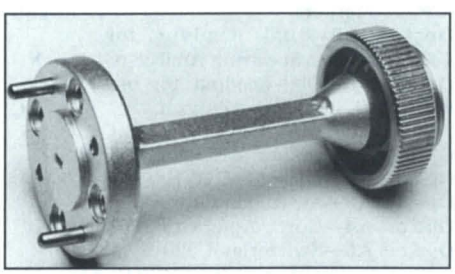
WAVEGUIDE ADAPTERS AND ACCESSORIES



220 to 325 GHz tapered transition



90 to 140 GHz flange adapter



140 to 220 GHz flange adapter

Diplexer assembly

Waveguide accessories such as flange adapters, tapered transitions, and diplexer assemblies are necessary and useful accessories for assembling waveguide measurement systems.

ORDERING INFORMATION

Diplexer Assembly—Order 015-0385-00 **$235**

Precision Flex Cable—50Ω coax SMA-to-SMA, required for use with Diplexer Assembly. Order 012-0649-00 **$33**

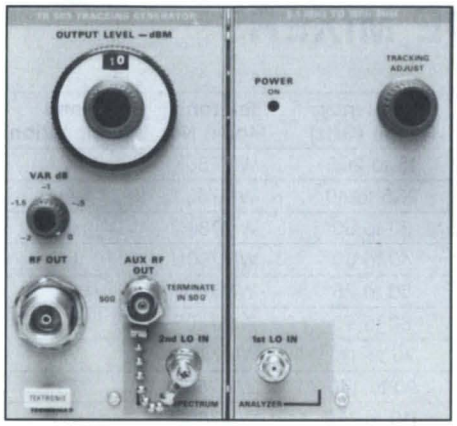
220 to 325 GHz Tapered Transition—Order 119-1728-00 **$1,495**

90 to 140 GHz Flange Adaptor—Order 119-1324-00 **$400**

110 to 170 GHz Flange Adaptor—Order 119-1743-00*[1]

140 to 220 GHz Flange Adaptor—Order 119-1744-00*[1]

[1] Contact your local sales office.



TR 503

Tracking Generator

- **Swept Measurements to 1.8 GHz**
- **Enhances Dynamic Range to Better Than 110 dB**
- **Very Stable—Resolve Signals Using 30 Hz Resolution Bandwidth**
- **Auxiliary, Constant-Level Output Provides for Frequency Counter Measurement Even of Signals at the Noise Floor**

The TR 503 works with all 2750 and 490 Series spectrum analyzers to provide constant level, calibrated RF sources for swept frequency tests to 1.8 GHz. The tracking generator is a two-wide unit compatible with the TM 500 and TM 5000 Modular Instrument Series.

The low residual FM of these systems enhances narrow bandwidth frequency response measurements. When used as a CW signal source with the analyzer in a manual mode, these systems have excellent frequency stability.

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 TR 503 Aux RF Output may be used to drive a frequency counter package, such as the recommended DP 501, DC 509 Option 01. Frequencies up to 1.8 GHz may be measured accurately in the presence of high level adjacent signals to the sensitivity limits of the analyzer.

CHARACTERISTICS

TR 503/All 490 and 2750 Series

Frequency Range—100 kHz –1.8 GHz
Output Level—(Max) 0 dBm ±0.5 dB
Range—0 to –59 dB in 10 dB and 1 dB steps
Flatness—Within ±2.25 dB Max from 100 kHz to 1.8 GHz (Typically ±1.5 dB)
Dynamic Range— ≥110 dB
Residual FM—50 Hz p-p
Output Impedance—50 Ω Nominal, VSWR 2:1 or less to 1.8 GHz
Auxiliary Output—0.1 V RMS into 50 Ω load –7 dBm minimum
Spurious Signoff—Harmonic: –20 dBc Nonharmonic: –40 dBc

ORDERING INFORMATION

TR 503 Tracking Generator. **$7,080**
Includes: Two 50 Ω coax cables (012-0649-00); N male to BNC female adapter (103-0045-00); retainer plug-in (343-0604-00); 3 mm male to BNC female adapter (015-1018-00); instruction manual (070-3526-00).

OPTIONAL ACCESSORIES

TM 503A—Power Module. **$325**
TM 504—Power Module. **$590**
Blank Panel—Order 016-0195-03. **$35**

2710 Spectrum Analyzer and the 1405 TV Sideband Adapter.

1405 TV Sideband Adapter

- **Facilitates In-Service Testing of Transmitter**
- **Measure Transmitter Frequency Response to ±0.2 dB**
- **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**

To analyze the sideband response of a television transmitter, the 1405 Sideband Adapter is recommended for use in tandem with the Tektronix 2710, 2750 Series and 490 Series spectrum analyzers. It generates a composite video signal, which is applied as modulation to a television transmitter. The output is displayed on the spectrum analyzer and appears as a response curve, to within ±0.2 dB, of the transmitter being tested.

The 1405/Spectrum Analyzer combination will display frequency response characteristics of RF and IF circuits for transmitters with frequencies to 1 GHz. Video circuits can also be analyzed.

Correct frequencies at the TV Channel marks on the dial readout for 2750 and 490 Series spectrum analyzers are provided with Option 02, and for the 2710 Spectrum Analyzer with Option 03.

Request Tek Brochure 26W-4787-1 for complete specifications or call your local sales engineer for additional information.

ORDERING INFORMATION

1405 TV Sideband Adapter 525/60 Markers. **$5,780**
Includes: Instruction manual (070-2078-00).

OPTIONS

Option 01—TV Sideband Adapter (625/50 Markers). **+$200**
Option 02—Dial Readout for 490/2750 Series Spectrum Analyzers. **NC**
Option 03—Dial Readout for use with 2710 Spectrum Analyzer. **NC**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

RACKMOUNT CONVERSION KIT

Standard 19-inch Rack—Order 016-0489-00. **$475**

POWER SPLITTER

75 Ω/50 Ω BNC Output, 50 Ω BNC Input—Order 067-1232-00. **$250**

CABLES, PADS AND ADAPTORS

50 Ω Coaxial Cable—BNC to BNC 5.5 in. Order 012-0214-00. **$55**

50 Ω Coaxial Cable—BNC to BNC Conn, 18 in. Order 012-0076-00. **$18.25**

50 Ω Coaxial Cable—BNC to BNC Conn, 42 in. Order 012-0057-01. **$19.25**

75 Ω Coaxial Cable—BNC to BNC Conn, 42 in. Order 012-0074-00. **$19.75**

75 Ω to 50 Ω Minimum Loss Adapter—With dc block, 5.7 dB loss. Order 011-0112-00. **$60**

75 Ω to 50 Ω Matching Attenuator—With 11.25 dB conversion factor from dBm to dBV with dc block. Order 011-0118-00. **$75**

"F" Female to BNC Male Adapter—Order 013-0126-00. **$19**

BNC Female to "F" Male Adapter—Order 103-0158-00. **$5**

"N" Female to BNC Male Adapter—Order 103-0058-00. **$9.25**

BNC Female 75 Ω to N Male 50 Ω Adapter—Order 103-0273-00*[1].

DC BLOCKS

N(F) to N(M)—10 kHz to 21 GHz, 50 V dc maximum. Order 015-0509-00. **$310**

DC Block 015-0509-00 is rated over the coaxial frequency range of 10 kHz to 21 GHz. Its electrical characteristics, rugged construction, and type "N" connectors make it the preferred solution for EMI/RFI and other applications requiring the blocking of 275X and 49X front ends.

Characteristics—Operating Frequency: 10 kHz to 21 GHz. Insertion Loss: 1.0 dB maximum. VSWR: 1.4:1 maximum, 10 kHz to 18 GHz; 1.6:1 maximum 18 to 21 GHz. Voltage Rating: 50 V dc maximum. Impedance: 50Ω. Construction: Passivated Stainless Steel. Connectors: Type "N" male and female per MIL-C-39012. Dimensions: 2.15×0.84 (dia.) inches maximum.

BNC to BNC—Maximum dc potential 50 V. Order 015-0221-00. **$115**

PROTECTIVE VINYL COVERS

2750/490 Series Rear Panel Connector Cover—Order 337-3274-00. **$5**

Rain Cover—for 2710. Order 016-0848-00. **$16.25**

GRATICULES, FILTERS

CRT Light Filter—for 2710.
(Clear) Order 337-2775-01. **$1.95**
(Gray) Order 337-2775-02. **$2.35**

CRT Filters—For 2750/490 Series
Light (Amber) Order 378-0115-01. **$3.30**
Light (Gray) Order 378-0115-02. **$6**
Mesh—Order 378-0227-01. **$85**

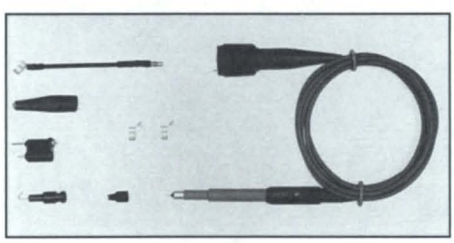
CARTS

K217—Lab Cart (2750 Series). **$570**

K212—Portable Instrument Cart (490 Series). **$350**

2755P and K217

494AP and K212



PROBES

A variety of probes are available in varying frequency and impedance ranges that can be used with the 7L5, 2710, and all 2750/490 Series spectrum analyzers.

FET Probe P6201—DC to 900 MHz. **$1,280**
FET Probe P6202A—DC to 500 MHz. **$735**
1101A Probe—Power Supply for 2710. **$440**
Conventional Probe P6056—DC to 3.5 GHz, 6 ft. **$200**
Conventional Probe P6057—DC to 1.4 GHz, 6 ft. **$195**
Current Probe P6022—DC to 150 MHz. **$495**

CAMERAS

A camera can greatly enhance the versatility of a spectrum analyzer. Many different units are available. However, the most popular units for the 2710 and 2750/490 Series spectrum analyzers are:

C-4 Low-Cost Camera—Standard: 2710. Option 02: 490/2750 Series. **$410**

C-5C Camera—
Option 01: 490/2750 Series. **$465**
Option 02: 2710 Series. **$465**

CARRYING CASES

Hard Case—Transit for the 2750 Series. Order 016-0962-00. **$450**

Hard Case—Transit for the 490 Series. Order 016-0658-00. **$795**

Soft Case—For the 490 Series. Order 016-0659-00. **$140**

Transit Case—for 2710. Order 016-0792-01. **$225**

INTERNATIONAL POWER PLUG OPTIONS

A1—Universal Euro 220 V/6A, 50 Hz.
A2—UK 240 V/5A, 50 Hz.
A3—Australian 240 V/6A, 50 Hz.
A4—North American 240 V/12A, 60 Hz.
A5—Switzerland 220 V/6A, 50 Hz.

OPTIONAL *WARRANTY-PLUS* OFFERINGS

Tektronix *Warranty-Plus* Offerings for the 2750 Series, 490 Series, and 2710 Spectrum Analyzers provide for both routine and remedial service, depending on the plan selected.

Plan M1—Provides two routine calibrations, one each in years two (2) and three (3) of product ownership, and two years of remedial maintenance in years two (2) and three (3) of ownership.

Plan M2—Provides four years coverage of remedial service in years two (2), three (3), four (4), and five (5) of product ownership.

Plan M3—Provides for four years of routine calibrations, one each in years two (2), three (3), four (4) and five (5) of product ownership, and four years of remedial maintenance in years two (2), three (3), four (4), and five (5) of ownership.

MISCELLANEOUS

Manual—Service for 2710. Order 070-6024-00. **$50**

Accessory Pouch—For 2710. Order 016-0677-00.*[1]

Viewing Hood—For 2710. Order 016-0566-00. **$21**

Carrying Strap—For 2710. Order 346-0199-00. **$17.50**

Diplexer Assembly—For use with 2750/490 Series Spectrum Analyzers and WM490 Series Waveguide Mixers. Includes TNC to SMA adapter and SMA semi-rigid coax. Order 015-0385-00. **$235**

Diplexer Assembly Cable—Required for use with Diplexer Assembly. Order 012-0649-00. **$33**

LITERATURE

Numerous Application Notes and magazine article reprints on spectrum analyzer measurements are available. Notes on baseband, EMI, two-way radio and television measurements, 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 Sales Office or representative.

*[1] *Contact your local sales office.*

TEST & MEASUREMENT

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As design and test become more specialized and complicated, instruments are adapting to keep up and meet the challenge.

We've added new capabilities to the world's broadest selection of portable and laboratory oscilloscopes, programmable and manual general-purpose instruments, waveform digitizers, systems, and accessories.

Tek supplies test and measurement instruments to customers engaged in education, research, design, manufacturing, operation, and electronic equipment service. We provide individual instruments, instrument system solutions, plus a host of accessory products that enhance your signal acquisition process, provides various methods to document your results to maximize the utilization of your products.

Plus we offer solutions for the education, mechanical/automotive, automated manufacturing, and the testing of application-specific integrated circuits (ASICs) markets.

Handshake

HANDSHAKE is a quarterly newsletter published by the Instrument Group of Tektronix, Inc. It provides new product and application information on test and measurement instruments and techniques. This covers all aspects of analog and digital measurements including the acquisition, processing, and storage of digital signals. Specific types of instruments covered include manual and programmable oscilloscopes, digital storage oscilloscopes, transient digitizers, stimulus and measurement instruments, instrument controllers, and the software that makes them work.

TEK LEARNING SYSTEMS

TEKTRONIX IN THE CLASSROOM

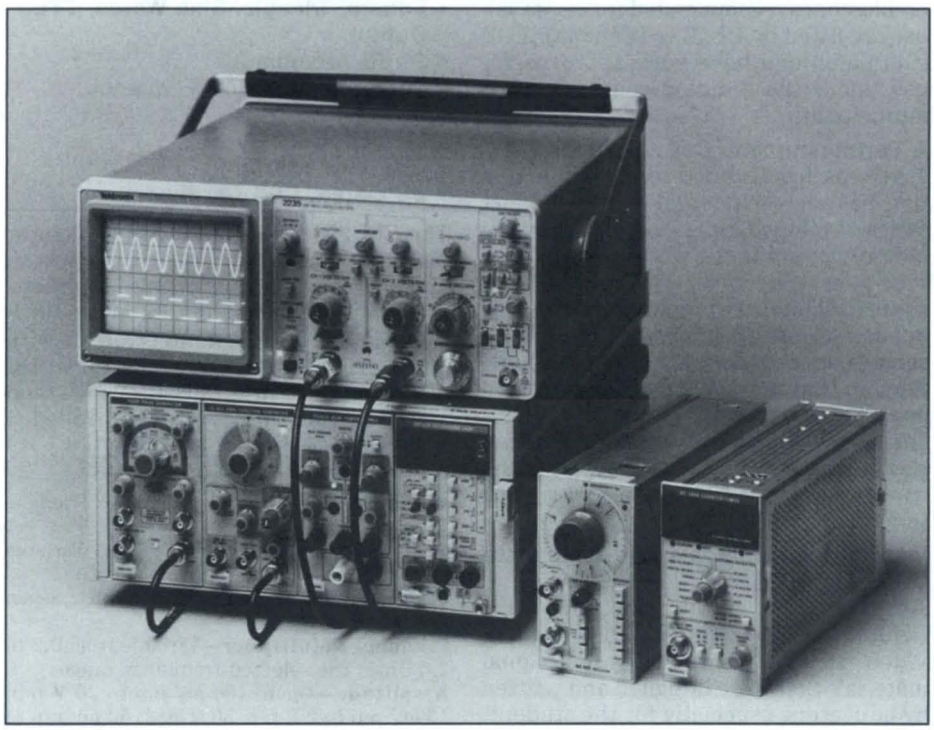
Educators have told Tektronix that they would like to use simple, easy to learn, industrial quality, safety certified equipment in their classrooms and labs. They say it should be equipment that their students will use when they graduate to jobs in industry. Since most school budgets are limited, industrial quality equipment has not always been affordable, particularly for beginning electronics student labs.

To take the guess work out of classroom equipment selection, Tektronix offers classroom materials that many schools and training facilities, worldwide, are using. Listed on the adjacent chart is a sampling of instruments from the Portable Oscilloscope group and TM 500 Series. Various combinations to meet specific lab requirements are available. For more information on a configuration to meet your specific lab needs, contact your local Tektronix Sales Representative or call the National Marketing Center at 1-800-426-2220. These units have been designed to be "student proof" and reliable. You can count on them to withstand the intensive use test equipment receives in the lab, day after day.

EQUIPMENT AND MATERIALS

Warranty/Service

The recommended oscilloscopes all come with a warranty. After the warranty period—you can still get replacement parts, when they're needed, because service documentation is complete and accurate. There are also a variety of service options available which can give you years of minimum-cost maintenance. Service is available through your local Tektronix Sales Office. The overall cost of ownership over the life of these instruments is excellent. See Customer Service Section for further information, contact your Tektronix Sales Representative, or call the National Marketing Center at 1-800-426-2200, ext. 99.



EBS502 Intermediate Lab Station with optional plug-ins.

Products	Beginning Labs	Intermediate Labs	Advanced Labs	Digital Labs
2205	✓			
2235		✓		
2236			✓	
2210				✓
2230				✓
CFC250	✓	✓	✓	✓
CFG250	✓	✓	✓	✓
CDM250	✓	✓	✓	✓
CPS250	✓	✓	✓	✓
EBS501*1	✓			
EBS502*1			✓	✓
EBS503*1				

*1 *EBS500 Series products represent packages of TM500/TM5000 Series Modular test and measurement instruments configured for the engineering test bench. For more informaiton* *see page 371 Modular Instruments.*

Safety

Having safe equipment in the classroom is especially important when there are inexperienced equipment operators. The oscilloscopes recommended for classroom use are listed by UL, CSA (Canada), VDE (Germany) and have been approved for use under the building codes of major municipalities.

A Partnership You Can Count On

Tektronix has listened to educators and now has a new industrial-quality product series developed especially for beginning electronics students, whether they're in four-year electrical engineering/electronics technology programs or two-year applied science programs, trade/technical schools or secondary schools. It's a partnership that pays off in more ways than one. Students who get started with Tektronix equipment get a real head start. And their successful careers in the coming years will speak well for your school.

Instructional Materials Add Even More Value

To support the school's electronics curriculum we also made available manuals, video tapes and other instructional materials that were designed and written by educators, especially for the student. These materials are detailed in the "Instructional Material Catalog" available from your local Tektronix representative.

The following Test and Measurement equipment combined with one of the 2200 Series oscilloscopes, (see page 231) comprise lab packages of standalone bench equipment that are UL listed and approved by CSA and VDE.

Contact your Tektronix Sales Engineer or other Tektronix representative for support materials availability.

Special Discount Advantages

Our complete measurement packages offer even greater economy. These packages are built around Tek's analog or digital osciloscopes or other instruments and are offered together at a package price.

The National Marketing Center at 1-800-426-2200 will also know about new educational materials and instrumentation as they are introduced throughout the year.

Industrial Quality Bench Equipment

CFG250 2 MHz Function Generator

- **Square, Triangle, Sine Waves, TTL Ouptut**
- **20 dB Attenuator**
- **Internal or External Fequency Sweep**
- **Variable Duty Cycle**
- **One Year Warrtanty**
- **UL Listed, CSA Certified**

The CFG250 2 MHz Function Generator produces sine, square and triangle waves, and TTL signals for testing amplifiers, filters and digital circuits. Its sweep function can be controlled internally or with an external signal level. Duty cycle, DC offset, sweep rate, sweep width and amplitude are all operator controlled.

CHARACTERISTICS

Waveform Outputs—Sine, Square, Triangle, TTL pulse.
Symmetry—Fixed 1% to 100 kHz: Variable 20% and 80%.
Frequency Range—0.2 Hz to 2.0 MHz, seven ranges.
Frequency Multiplier—Variable from 0.2 to 2.0 times the selected frequency range.
Amplitude—Open: 100 mV p-p to 20 V p-p; 10 mV p-p to 2 V p-p. 50 Ω load: 50 mV p-p to 10 V p-p; 5 mV p-p to 1 V p-p.
Accuracy—±5% of full scale.
DC Offset—+10 to −10 V dc continuously variable.
Output Impedance – 50 Ω: ±10 %.
Sine Wave Distortion—10 Hz to 100 kHz: <1% (max output, 50 Ω load).
Square Wave Response—≤100 ns rise/fall time, with maximum output into 50 Ω.
Triangle Linearity—20 Hz to 200 kHz: ≥99%. 200 kHz to 2 MHz: ≥97%.
Pulse Output Amplitude—<3 V p-p (open); Rise Time: ≤25 nsec.
Sweep Rate—0.5 Hz to 50 Hz continuously variable.
Sweep Width—Variable from 100:1 to 1:1.

POWER REQUIREMENTS

Line Voltage Ranges—90 to 110 V ac, 108 to 132 V ac, 180 to 220 V ac, and 216 to 250 V ac at 50 to 60 Hz.
Max Power Consumption—20 V A, 17 W.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	240	9.5
Height	64	2.5
Depth	190	7.5
Weight ≈	**kg**	**lb**
Net	1.6	3.6

OTHER CHARACTERISTICS

Temperature—Operating: 0° to +50°C, 75% R.H. Nonoperating: −20° to +60°C, 80%R.H.

ORDERING INFORMATION

CFG250 Function Generator **$330**

CFC250

100 MHz Frequency Counter

- **5 Hz to 100 MHz (1 Hz Resolution)**
- **8 Digit Display**
- **Switchable Input Sensitivity**
- **Overrange Indicator**
- **100 kHz Lowpass Filter**
- **One Year Warranty**
- **UL Listed, CSA Certified**

The CFC250 Frequency Counter counts the signal frequency of sine, square and triangle waves from 5 Hz to 100 MHz at input levels from 30 mV to 42 V peak. Applications include the adjustment, testing and repair of items including audio instruments, AM/FM radios, televisions, CB radios, computer clocks, amateur radios and musical instruments.

CHARACTERISTICS

Frequency Range—AC coupled.
Sensitivity—5 Hz to 30 MHz: 30 mV rms; 30 MHz to 70 MHz: 50 mV rms; 70 MHz to 100 MHz: 80 mV rms.
Attenuation—Selectable Range: 3 V to 42 V range or 80 mV to 5 V range.
Impedance—1.0 MΩ paralleled by 40 pF.
Dynamic Range—V p-p ≤1 V times attenuation.
Maximum Input Voltage—5 Hz to 100 kHz: 42 V peak; 100 kHz to 10 MHz: 13.8 V peak; 10 MHz to 100 MHz: 5.4 V peak.
Resolution—1 Hz.
Accuracy—±1 count ± time base accuracy.
Gate Time—1 second.

TIME BASE ACCURACY

Crystal Frequency—3.579545 MHz at calibration ±3 ppm.
Temperature Stability—±10 ppm, 0 to 50°C.
Aging Rate: ±10 ppm per year.

POWER REQUIREMENTS

Line Voltage Ranges—90 to 100 V ac, 108 to 132 V ac, 180 to 220 V ac, and 216 to 250 V ac at 50 to 60 Hz.
Max Power Consumption—16 V A, 13 W.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	240	9.5
Height	64	2.5
Depth	190	7.5
Weight ≈	**kg**	**lb**
Net	1.9	4.2

OTHER CHARACTERISTICS

Temperture—Operating: 0 to +50°C, 75% R.H. Nonoperating: −20 to +60°C, 80% R.H.
Sampling Rate—2.5 Samples/second.
Display—8 digit LED.
Overflow Indicator—Flashing LED.

ORDERING INFORMATION

CFC250 Frequency Counter **$295**

CPS250 Triple Output Supply

- **Two Variable 0 to 20 V, 0.5 A Supplies**
- **Fixed 5 V, 2 A Supply**
- **Variable Current Limiting**
- **Overload Indicators**
- **Independent/Tracking Modes**
- **One Year Warranty**
- **UL Listed, CSA Certified**

The CPS250 Triple Output Power Supply is a versatile instrument with two variable and one fixed output to meet the needs of semiconductor and digital lab experiments, which can be performed easily and with minimal training. Three sets of test leads are included.

CHARACTERISTICS

Outputs—Two 0 V to 20 V, 0.5 A max; One 5 V fixed, 2.0 A max.
Load/Line Regulation—0 to 20 V: 0.01% +3 mV. 5 V fixed: 0.1% +5 mV.
Ripple/Noise—2 mV RMS (5 Hz to 1 MHz).
Tracking Error—±0.2% ±20 mV.
Indicator—Analog type meters
Voltage Range: 0–25 V dc ±2.5% of full scale.
Current Range: 0–600 mA ±2.5% of full scale.

POWER REQUIREMENTS

Line Voltage Ranges—90 to 110 V ac, 108 to 132 V ac, 180 to 220 V ac, and 216 to 250 V ac; at 50 to 60 Hz.
Max Power Consumption—165 V A, 131 W.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	240	9.5
Height	100	3.9
Depth	190	7.5
Weight ≈	**kg**	**lb**
Net	4.8	10.5

OTHER CHARACTERISTICS

Temperature—Nonoperating: 0 to +40°C, 75% R.H. Nonoperating: −10 to +60°C, 80% R.H.

ORDERING INFORMATION

CPS250 Triple Output Power Supply **$395**

CDM250 Digital Multimeter

- **AC/DC Volts (500 V Range)**
- **Ohms (20 MΩ Range)**
- **Current (10 A Range)**
- **Overload Protection**
- **One Year Warranty**
- **UL Listed, CSA Certified**

The CDM250 Digital Multimeter displays measurements in digital form on a 3½-digit LED display. Sine wave alternating voltages and currents are displayed in RMS values. Test leads are included.

CHARACTERISTICS

DC VOLTS

Voltage Range	Resolution
200 mV	100 μV
2 V	1 mV
20 V	10 mV
200 V	100 mV
500 V	1 V

Accuracy—±5% of reading ±1 count (18 to 28°C).
Response Time—3 seconds.
Input Impedance—10 MΩ.
Max Input Voltage—500 V dc.
CMRR—>100 dB (50/60 Hz).
NMRR—>50 dB (50/60 Hz).

AC VOLTS (45–500 Hz)

200 mV	100 μV
2 V	1 mV
20 V	10 mV
200 V	100 mV
500 V	1 V

Accuracy—±1.0% of reading ±4 counts (18 to 28°C).
Response Time—8 seconds.
Imput Impedance—10 MΩ <100 pF.
Max Input Voltage—350 V ac RMS.
CMRR—>60 dB (50/60 Hz).

DC CURRENT

Current Range	Resolution
200 μA	0.1 μA*1
2 mA	1.0 μA*1
20 mA	10.0 μA*1
200 mA	100.0 μA*1
2 A	1 mA*2
10 A	10 mA*2

*1 *Accuracy: ±1.0• of reading ±1 count (18 to 28°C).*
*2 *Accuracy: ±1.0• of reading ±3 counts (18 to 28°C).*
Response Time—3 seconds.
Input Impedance—Varies with range from 1 KΩ to 0.01 Ω.
Maximum Input Current—2 A fused; 10 A unfused.

AC CURRENT (45–500 Hz)

Current Range	Resolution
200 μA	0.1 μA
2 mA	1.0 μA
20 mA	10.0 μA
200 mA	100.0 μA
2 A	1 mA
10 A	10 mA

Accuracy—±1.5% of reading ±4 counts (18 to 28°C.
Response Time—8 seconds.
Maximum Input Current—2 A fused with 4 A high-energy fuse; 10 A unfused.

RESISTANCE

Ohm Range	Resolution	Maximum Test Current
200 Ω	0.1 Ω	2.5 mA*1
2 kΩ	1 Ω	250 μA*2
20 kΩ	10 Ω	50 μA*2
200 kΩ	100 Ω	5 μA*2
2 MΩ	1 kΩ	500 nA*2
20 MΩ	10 kΩ	50nA*3

*1 *Accuracy: ±0.75• of reading ±4 counts (18 to 28°C).*
*2 *Accuracy: ±0.75• of reading ±1 count (18 to 28°C).*
*3 *Accuracy: ±1.5• or reading ±5 counts (18 to 28°C).*
Response Time—200 Ω to 2 MΩ: 5 seconds. 20 MΩ: 15 seconds.
Open Circuit Voltage—200 Ω: 3.2 V max; 2 kΩ to 20 MΩ: 0.6 max.

POWER REQUIREMENTS

Line Voltage Ranges—90 to 110 V ac, 108 to 132 V ac, 180 to 220 V ac, and 216 to 250 V ac; at 50 to 60 Hz.
Max Power Consumption—8 V A, 7 W.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	240	9.46
Height	64	2.5
Depth	190	7.49
Weight	1.6 kg	3.5 lb

OTHER CHARACTERISTICS

Operating Temperature—0 to +50°C, 75% R.H.
Storage Temperature—−20 to +60°C, 80% R.H.
Sampling Rage—2.5 samples/second.
Overrange Indicator—Leftmost digit is "1" and all other digits are blank.

ORDERING INFORMATION

CDM250 Digital Multimeter. **$310**
Includes: DMM test leads, one pair, black/red (196-3200-00); operators manual (070-6736-00); U.S. standard power cord

WARRANTY-PLUS SERVICE PLANS

Option M1—2 years extended service plus 2 calibrations. **+ $101**
Option M9—2 years extended service. **+ $56**

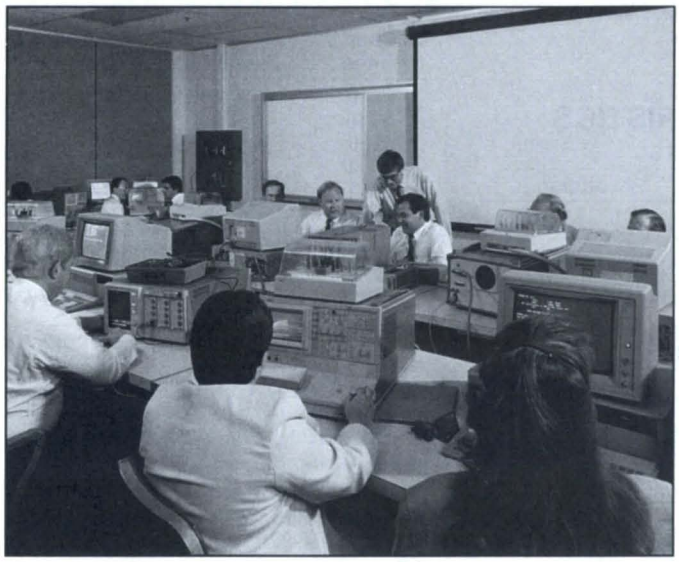
INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland, 220 V, 50 Hz.

OPTIONAL ACCESSORY

Service Manual—Order 070-6735-00. **$25**

TRAINING GETS USERS UP TO SPEED, FAST



An Investment—Tektronix workshops develop your skills and are one of the best methods to realize more effective use of your equipment.

New Perspective on Applications—Professional instructors are available to help you examine and evaluate your application problems during laboratory sessions.

New Methods of Making Measurements—Our workshops are designed to aid in developing new ideas through comprehensive discussion and laboratory exercises.

Tektronix offers formal classes and self-study aids. See the following paragraphs for general information on our workshops, then ask your Tektronix Sales Engineer for details about Customer Training.

Test and Measurement—Tektronix instruments and programmable instrument systems represent the upper limits of productivity potential. Tektronix has designed workshops to help enhance your understanding of the capabilities of your equipment.

Measurement workshops are a natural complement to the Tektronix commitment to help you achieve optimum utilization of your equipment. Our commitment begins with engineering excellence and continues through high-quality training that will help you develop new and more productive applications.

These fast-paced workshops, conducted at key locations throughout the U.S., combine classroom lectures with supervised, hands-on laboratory sessions. You will spend at least 60% of your time in labs, so you can *learn by doing*. You will receive workbooks containing detailed course notes and lab exercises in all Tektronix workshops.

For your convenience, Tektronix also offers private workshops conducted at your company.

WORKSHOPS

WAVEFORM MEASUREMENTS

(Based on the 11200/11400 Series)
Length: 1 day **$250**

After completing this one-day workshop, you will be able to easily make standard and custom measurements using Tek 11400 Series digital oscilloscopes. The training workshop consists of six training modules and six intensive workshop labs.

ADVANCED WAVEFORM MEASUREMENTS

(Based on the 11200/11400 Series)
Length: 2 days **$500**

This two-day workshop includes the six modules of the standard Tek 11200/11400 workshop, plus five more modules and labs: time A-B measurements using triggers, waveform functions, waveform arithmetic, GPIB, RS232-C, and Utility Software for the PC (Personal Computer).

WAVEFORM MEASUREMENTS AND ANALYSIS (Based on the 11300 Series)

Length: 1 day **$250**

This comprehensive one-day workshop takes you from using the built-in automatic measurements, to counter/timer measurements and enhanced measurements accuracy on the Tek 11300 Series instruments. The workshop includes six training modules and six comprehensive labs.

OSCILLOSCOPE CONCEPTS & OPERATION

(Based on the 2200 Series)
Length: 1 day **$250**

This workshop provides an introduction to the oscilloscope for the new user. Basic operation is explained and measurement techniques are described and performed in lab exercises. This is an intensive one-day workshop that will bring first-time users of oscilloscopes up to a high level of competency.

PARAMETRIC MEASUREMENTS

(Based on the 2465B/2467B)
Length: 1 day **$250**

This fast-paced workshop covers parametric measurements typically made with an oscilloscope. The workshop gives the average oscilloscope user a high degree of expertise in making accurate parametric measurements that fully utilize the capabilities of an oscilloscope.

ADVANCED PARAMETRIC MEASUREMENTS

(Based on the 2465B/2467B)
Length: 1 day **$250**

This fast-paced workshop teaches advanced applications using the enhanced measurement options available on the Tek 2465B. Advanced parametric measurements are made in "hands-on" labs utilizing special features of the Digital Multimeter, TV/Video Trigger, Counter/Timer/Trigger, and Word Recognizer.

WORKSHOPS

DIGITAL STORAGE MEASUREMENTS

(Based on the 2230 Series)
Length: 1 day **$250**

Digital storage oscilloscopes offer new and exciting measurement capabilities. Digital storage techniques save time, increase productivity, and signals can be acquired for direct viewing or stored for later analysis. This workshop covers various techniques of measuring signal parameters. Also covered are the basic concepts of digital acquisition and storage. These are taught using the Tek 2230 Digital Storage Oscilloscope.

ADVANCED DIGITAL STORAGE MEASUREMENTS (Based on the 2430 Series)

Length: 2 days **$500**

Many measurements that are difficult or impossible with an analog oscilloscope are made faster, simpler, and more accurately with a digital oscilloscope. This workshop covers several types of measurements and the techniques behind them. You will see how they can immediately increase your through-put. Comprehensive labs cover the operating modes of the 2432.

WAVEFORM PROCESSING (Based on the 7854)

Length: 2 days **$500**

This fast-paced two-day workshop is designed to increase your proficiency with the Tektronix 7854 Waveform Processing Oscilloscope and to satisfy your application/measurement needs. The workshop is oriented toward technically competent oscilloscope users with wide variances in background and experience. All 94 commands/operators on the front panel and remote keyboard are covered.

DSO CONCEPTS

Length: 1 day **$250**

Concepts and typical applications using digital storage oscilloscopes. Lecture and labs.

INSTRUMENTATION CONTROL

(Using a PC Compatible)
Length: 1 day **$250**

GPIB concepts and instrumentation control using a PEP 300 Series PC compatible.

USING AN INSTRUMENT CONTROLLER

(Based on the Tek 4041)
Length: 1 day **$250**

Many measurements that were done manually in the past can now be made with automated systems. A very important element of the system is the controller. This intensive workshop shows you how to quickly generate extensive instrument Controller programs using the Tek 4041. The workshop gives you "hands-on" experience with an automated programmable instrument system.

SAMPLING AND TDR MEASUREMENTS

Length: 1 day **$250**

This workshop introduces the concepts of Analog Sampling and Time Domain Reflectometry. The workshop discusses measurement challenges and provides valuable "hands-on" experience.

DEVICE INTERFACE TECHNIQUES

(Based on Voltage/Current/Active Probes)
Length: 1 day **$500**

This workshop is designed to teach the basics of signal acquisition. Types of probes available, how probes affect measurements, and how to select the appropriate probe for your application are discussed in this workshop. Participants make various measurements using the three families of probes in comprehensive lab situations.

INFORMATION/REGISTRATION

If you are interested in registering for one of these workshops or would just like more information, call:
Instrument Group Customer Training at

1-800-835-9433 Ext 430.

In Oregon, call collect: 1-629-1017.

Tektronix reserves the right to cancel or reschedule a workshop.

SELF-STUDY COURSES

FUNDAMENTALS COURSES

Fundamentals of Analog Scopes
Fundamentals of Digital Scopes
Fundamentals of Probes
Fundamentals of GPIB Instrument Control
Fundamentals of RS232 Instrument Control

OPERATION COURSES

Operating the 2213A/15A
Operating the 2225
Operating the 2235
Operating the 2236
Operating the 2245A/46A
Operating the 2210
Operating the 2220
Operating the 2221
Operating the 2230
Operating the 2430A
Operating the 2432
Operating the 2440
Operating the 2445A/65A
Operating the 2445B/65B
Operating the 11301A/302A
Operating the 11401/402
Using the PC as a Controller

Training new instrument operators is an important, yet time consuming, task. Now, Tektronix offers several forms of operation training to help the instrument user gain more competence in less time than learning by trial and error. Operation training is available in a variety of formats to match your needs—video-based self-study packages, on-site workshops at your company, or group workshops in major U.S. cities.

A self-study package has the advantage of being completely time flexible. You can go through it in sections as it fits into your schedule. Want to see a demonstration again? Just reverse the tape and play it again. Want to try that control? Do it in one of the labs that come with the self-study packages.

Workshops add the advantage of a knowledgeable instructor to direct the learning process, answer your questions, or help with a lab. A complete list of regularly scheduled workshops is provided in each issue of *Handshake*. On-site workshops can be scheduled at a site and time most convenient for you.

For further information, call IG Customer Training:

1-800-835-9433, ext. 430.

OSCILLOSCOPES

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Broadest Selection

We've added new capabilities to the world's broadest selection of portable and laboratory oscilloscopes. These additions illustrate our continuing commitment to make your time and resources more productive.

Analog and Digital Laboratory Oscilloscopes

The programmable 11000-Series mainframes and plug-ins set the standard for a world of analog and digitizing oscilloscopes. These oscilloscopes provide unparalleled versatility and operator convenience. The new 11801 and 11802 Digital Sampling Oscilloscopes feature up to 20 GHz bandwidth, differential TDR, internal delay lines, and the capability of being expanded to 136 channels.

The new 11302A Counter/Timer Oscilloscope incorporates a 750 MHz precision counter/timer and a microchannel-plate CRT to provide 500 MHz analog bandwidth and visual display of hard-to-see low-repetition-rate transients in the fastest signals.

The new 11201 Digitizing Oscilloscope has waveform processing power like the 11400 Digital Storage Oscilloscopes. Its monolithic design includes state-of-the-art features that make it extremely easy to use in your lab or system.

Analog and Digital Portable Oscilloscopes

The 400-MHz 2467B Oscilloscope features 4 cm/ns visual writing rate, the fastest among portable scopes. Tek's exclusive microchannel-plate CRT makes it possible to see single-shot, 1 ns pulse transitions in normal room light at 500 ps/div sweep speeds.

The 2440B family has higher bandwidth (2465B, 2467B), auto set up, instant recall, and set up sequencing. Optional GPIB compatibility, digital timer/counter, digital multimeter, and video-measurement capabilities enable this family of scopes to meet many service and bench test-and-measurement needs.

The General Purpose Scope (GPS) family includes the new 2245A, 2246A, and 2247A. These scopes feature four vertical channels, flexible triggering, extensive CRT readouts, and pushbutton ease of use. Channels 3 and 4 are optimized for logic signals.

The new 300 MHz 2440 extends the 2400 Series Digital Oscilloscope performance to 500 MS/s. It includes all the standard features of the other series members: auto setup, auto measurements, auto pass/fail testing, and auto sequencing.

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The following pages show the depth and breadth of our product line: from dc to 20 GHz, digital and analog, hand-held or complete integrated system.

We give you a choice—the broadest range of choices available. We give you advanced technologies, and a broad range of standard and optional features—each designed to provide you the very best value for your special needs.

Overview—Guide to Technology and Features

A brief discussion is included here to assist you in using the product matrix. More detailed specification matrices are included with the reference materials at the beginning of each major application area, i.e., Digital Storage, CRT Storage, and Analog Oscilloscopes. Complete specifications are located on the individual product pages. Other literature is available for many products to further assist you in the selection process, or with a particular application. See the individual product reference section for further information.

At a Glance—The Product Matrix

The bandwidth spectrum at the top of the page is the best place to start. It is a good idea to select a product bandwidth (or rise time) faster than the signal you wish to evaluate. (Refer to the following graph to see why.) Then scan down the column to see which products have the technology, configuration, features, and application areas which best meet your needs. The specific product is identified at the bottom of each column, along with its catalog page number.

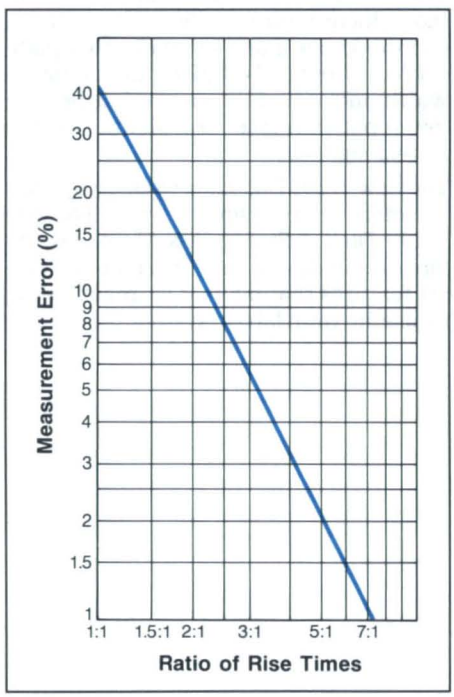
KEY OSCILLOSCOPE CHARACTERISTICS

Consider both performance specifications and convenience features when making your selection. By having more than the bare necessities, you will find that measurements are easier, take less time, and provide extra flexibility for your future needs. Those key considerations are discussed here to assist in your evaluation.

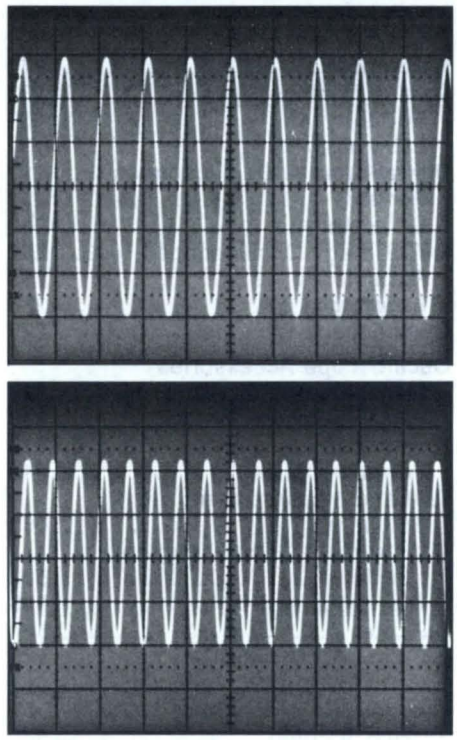
The Vertical System

Bandwidth and rise time are key performance characteristics to consider in choosing an oscilloscope. In both storage and nonstorage scopes, appropriate bandwidth and sensitivity ratings will ensure that your scope faithfully reproduces the range and types of signals you want to measure. The relationship of bandwidth and rise time for most scopes can be determined from this approximation:

$$Tr = \frac{0.35}{BW}$$



Measured rise-time errors depend on the ratio of the scope's rise time to the actual rise time of the signal being measured. For timing measurements, select an instrument with a rise time at least five times faster than the measurement you expect to make. A 5:1 ratio gives you a rise-time measurement with <2% error, as shown above. You should consider the amplitude of your signal, and select a sensitivity great enough to provide several divisions of vertical display. The same holds true for horizontal amplification, if you want to view X-Y displays.



If you intend to view non-sinusoidal signals, the fidelity of the display is greatly influenced by the bandwidth of the oscilloscope. For example, the same 15 MHz signal is shown as displayed by a 35 MHz scope (top), and by a 50 MHz system (below). Square waves have a great deal of high-frequency information in their rising and falling edges that is lost as the signal bandwidth approaches the bandwidth of the oscilloscope.

Multiple inputs provide a convenient method of comparing events, whether on the dual channel 1.9 lb T201 and 202, four channel portable and lab scopes, the 11801 with expansion option to 136 channels, to the Digitizing Camera MUX16 option at 256 channels.

Triggering System

The flexibility of your scope's trigger system is an important consideration, as it enhances your ability to quickly view the signal of interest. Modes include:

- Rejection of high or low frequencies (and noise).
- Peak-to-peak auto for quick triggering with automatic level limits.
- TV trigger for automatic synchronization with video signals.
- Single-sweep operation for capturing a transient pulse, and for CRT photography.

STORAGE AND ANALOG CONSIDERATIONS—TEK GIVES YOU A RANGE OF CHOICES

Will your application benefit from digital storage? It may if you need to do any of the following:

1. View signals having low repetition rate, or annoying flicker.
2. Achieve the greatest accuracy and repeatability in making time and voltage measurements.
3. Save waveforms indefinitely without using film.
4. See what occurred prior to the trigger point (pre-trigger).
5. Send data to a printer, plotter, or PC using a built-in GPIB or RS-232C interface.
6. Process or manipulate quantized waveform data to an almost unlimited degree.

When the signals behave as expected, and are repetitive, a digital-storage scope is an excellent choice.

When is an analog scope best? When you need to do any of the following:

1. Observe the individual variations of each occurrence of a time-jittering signal.
2. Observe fast single-shot events.
3. Observe unknown or unpredictable signals.
4. Observe the real-time affect of circuit adjustments.

When is CRT storage best? When you:

1. Need to view data for longer than an instant, but do not require long-term storage.
2. Want storage at the least cost.
3. Desire to eliminate occasional variations in a repetitive signal, and integrate the results.

It doesn't have to be an "either/or" choice. Several Tek scopes provide more than one technology (refer to Product Matrix). Also, modern analog scopes are almost entirely digital instruments. The input channels, sweeps, and triggers are all microprocessor controlled in today's advanced analog scopes. This internal digital processing capability, along with precision ramps and triggering control, provides the basis for the new automatic measurement capability.

Digital Features Increase Oscilloscope Performance

The Tektronix 11301A, 11302A, 2465B, 2445B, and 2467B programmable analog scopes provide many of the measurement capabilities normally associated only with digitizing oscilloscopes. Both the 11301A and 11302A scopes make up to eight selected pulse-parameter measurements on the displayed signal automatically at a single request, without further operator intervention. The results of all eight measurements are displayed numerically on the screen, and are immediately available over the GPIB bus or RS-232C port.

The results of all measurements made with the 11301A/11302A's built-in 750 MHz universal counter/timer—frequency, period, width, ratio, time A→B, and totalize—are also immediately available over the GPIB or RS-232C. Display of template waveforms allows immediate visual comparison of live signals with previously defined waveform limits. A touch-screen numeric keypad permits the immediate scaling of scale factors to match transfer characteristics of devices such as accelerometers and pressure transducers.

The 2445B/2465B Family offers a Counter/Timer/Trigger (CTT), which is included on the Special Editions, 2465B CT, DM, and DV, and optional for the standard scopes. This CTT option provides crystal-controlled time-base accuracy for several time-related measurements and is fully integrated with the operation of the scope and on-screen menus.

The 7B10, 7B15, 7B80, and 7B85 plug-ins for the 7000 Series oscilloscopes also provide Δtime measurements. With these plug-ins, the time-interval measurement can be shown on the screen using the 7000 Series CRT-readout capability.

What the Specifications Mean

Bandwidth is specified for two conditions: repetitive acquisitions (equivalent-time bandwidth) and single-event acquisitions (single-shot bandwidth). Bandwidth is usually lower for the latter, but this is not always the case, as shown in the Product Comparison Matrix.

Digitizing (sampling) rate is the rate at which a digital scope samples an incoming signal. In the case of real-time sampling, to adequately reconstruct the signal takes approximately 10 points per waveform period to yield a 2 MHz real-time sampling bandwidth for a 20 MS/s digitizer. In the case of the 11402 for example, its 20 MS/s digitizing rate yields a single-shot storage bandwidth of 2 MHz, and equivalent time sampling bandwidth of 1 GHz. With equivalent-time sampling, repetitive signals can be captured up to the scope's analog bandwidth.

Resolution is the measure of a scope's ability to see detail in a waveform. Specifying 8-bit vertical resolution means the ability to show 256 (2^8) distinct vertical levels. It is important to look a bit closer at this particular specification. Some manufacturers do not maintain their product's stated resolution throughout the entire sensitivity or bandwidth range, for example.

As always, there are trade-offs; vertical resolution is no exception.

BITS	PERCENTAGE	PPM
1	50.0%	500,000
2	25.0%	250,000
3	12.5%	125,000
4	6.25%	62,500
5	3.125%	31,250)
6	1.563%	15,625
7	0.781%	7,812
8	0.391%	3,906
9	0.195%	1,953
10	0.098%	977
11	0.049%	488)
12	0.024%	244
13	0.012%	122
14	0.006%	61

Record length is determined by the number of samples you can acquire and store. Sometimes this is different from the number of points you can display on screen (display resolution). When the record length exceeds the display resolution, the waveform data can be scrolled through for on-screen viewing.

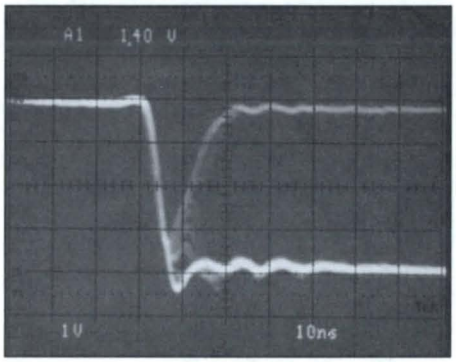
VISUAL WRITING SPEED—THE DETERMINING FACTOR FOR MANY OF TODAY'S APPLICATIONS

We've organized our product matrix by bandwidth, because that is where the emphasis has traditionally been. But for many applications, this is quickly changing. In fast low-repetition laser pulsing, electrostatic discharge testing, and high-speed circuitry, the emphasis is writing speed. And it's writing speed—not bandwidth—that determines waveform visibility on the CRT.

To display infrequent events, such as digital faults that are mixed with frequent normal events, the scope must have a wide range of adaptive intensity. Buying more bandwidth does not always solve this type of problem. The real solution is in higher writing speeds, specifically visual writing speeds on the order of 4 cm/ns, which is 100 to 1000 times faster than usual. No conventional CRT scope can achieve this level, and can only approach it using a fast camera/film system.

Tek's unique microchannel plate (MCP) tube delivers a visual writing speed of 4 cm/ns to 6 div/ns. It literally intensifies transient waveforms, and instantly displays events which are invisible on any other instrument, analog or digital. The MCP design is included in the 400 MHz 2467B Portable, the 500 MHz 11302A Counter/Timer Plug-in Lab Scope, and the 1 GHz 7104 and R7103 Plug-in Lab Scopes.

Adaptive intensity, as shown here, limits the bright (stable) portion of the display to a comfortable viewing level, while increasing the intensity of the dim (infrequent metastable) pulse. Tektronix is the only company commercially producing large-scale, uniform-gain MCP CRTs for oscilloscope applications.



The metastability in this high-repetition rate flip-flop output occurs only once in a million normal cycles, yet is clearly visible, thanks to the MCP's high visual writing speed.

The faster visual writing speed offered by MCP CRTs opened the way for the development of the DCS01 Digitizing Camera System. The DCS01 uses a special charge-coupled device (CCD) video camera with a spectrally-coupled lens. The associated frame-store board and software are installed within the Tek PEP 301 System Controller, or other PC. This combination allows extensive waveform analysis, including array math, and complete pulse parameter analysis.

The DCS can be used to digitize waveforms displayed on a wide range of conventional analog scopes, but is particularly recommended for all MCP scopes, where digitization of single-shot events occurs up to the full scope bandwidth. Used with the 7104 this provides an equivalent sampling rate of 250 GS/s.

PHOTOGRAPHIC WRITING SPEED

Photographic writing speed is a measure of the scope camera and film's capability to record high-speed signals.

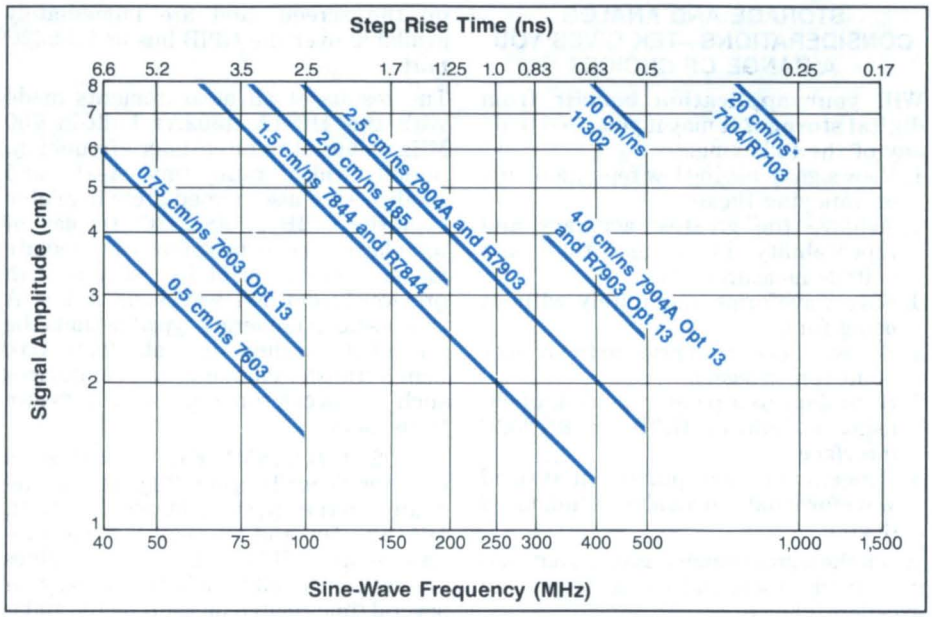
Recording high-speed signals on film depends on at least three factors:

- The oscilloscope used
- Film characteristics
- The camera

For maximum writing-speed capability the objective is to get as much light to the film surface as possible. Since each component affects photographic writing speed, the selection for top performance is important.

Writing Speed Comparison Graph

On the graph, signal amplitude on the vertical scale is shown against maximum sine-wave frequency (lower scale) and fastest rise time (upper scale). These speeds assume a small horizontal spot velocity compared to the maximum vertical velocity. The ramp is assumed to be linear between the 10 and 90% points.



Amplitude vs speed and photographic writing rate comparison of high-performance mainframes using BE (P11) phosphors (Option 78), 20,000 ASA film, and the C-51 (f/1.2, 1:0.5) Camera.

BE (P11) phosphor has a different spectral output than GH (P31) phosphor and more closely matches the sensitivity spectrum of silver halide film types. While photographic writing rate is approximately two times the GH (P31) rate, the visual output luminance is approximately 15% of GH (P31) phosphor.

** The specified photographic writing speeds indicated for the 7104/R7103, 11302A, and 2467B are not directly comparable with that of the other mainframes shown. The microchannel-plate CRT of these scopes allows for the following relaxed photographic requirements: P31 phosphor, C-53 camera with f/1.9, 1:0.85 lens, and Polaroid Type 107 3,000 ASA film without film fogging.*

COMPARATIVE CRT PHOSPHOR DATA

Phosphor*1 WTDS	JEDEC	Fluorescence and Phosphorescence	Relative Luminance*2	Relative Photographic Writing Speed*3	Decay	Relative Burn Resistance	Ordering Information Option*6
GJ	P1	Yellowish-green	50%	20%	Medium	Medium	Special order
WW	P4	White	50%	40%	Med-Short	Med-High	74
GM	P7	Blue*5	35%	75%	Long	Medium	76
BE	P11	Blue	15%	100%	Med-Short	Medium	78
GH	P31	Green	100%	50%	Med-Short	High	80
GR	P39	Yellowish-green	27%	NA*4	Long	Medium	40
GY	P43	Yellowish-green	40%	NA*4	Medium	Very High	Special order
GX	P44	Yellowish-green	68%	NA*4	Medium	High	
WB	P45	White	32%	NA*4	Medium	Very High	

*1 *Tektronix has adopted the Worldwide Phosphor Type Designation System (WTDS) as a replacement for the older JEDEC "P" number system referenced in this catalog. The chart lists the comparable WTDS designations for the most common "P" numbers.*

*2 *Measured with Tektronix J16 Photometer and J6523 Luminance Probe which incorporates a CIE standard eye filter. Representative of 10-kV aluminized screens. GH (P31) as reference.*

*3 *BE (P11) as reference with Polaroid 612 or 106 film. Representative of 10-kV aluminized screens.*

*4 *Not available.*

*5 *Yellowish-green phosphorescence.*

*6 *Some phosphor options may not be available on some products.*

An application note describing photographic writing speed, including measurement procedures and applications is available.

NOTE: A writing speed enhancer used to fog the film may increase the photographic writing speed. See the Accessories section.

Selecting a Phosphor

The catalog description of each oscilloscope indicates the phosphors normally supplied or available as options. While a special phosphor may be desirable for a specific measurement application, remember that each phosphor has its own color, persistence, and burn resistance. Improvements in one characteristic are usually at the expense of others. The CRT Phosphor-Data chart provides comparisons.

DIGITAL STORAGE

Analog to Digital Converters

There are several methods of digitizing or quantifying the different voltage levels of a waveform: successive approximation converters, flash converters, and scan converters.

Successive Approximation Converters

These converters compare the input voltage to the output of a digital to analog converter (D to A). If the input is higher than the D to A output, the MSB (most significant bit) is set high; if it is lower, the MSB is set low. The converter then progresses to the next significant bit. Successive approximation converters have a fixed conversion time per bit. So, there is a trade-off between conversion speed and-resolution (8-bit versus 10-bit). For a high resolution converter, you must accept a relatively long conversion time.

Flash Conversion

Flash Conversion is a technique for converting analog signals to digital output in the shortest period of time. It consists basically of a binary resistive divider and a number of comparators equal to the binary resolution.

Although having a short conversion time, the weighted values of the resistive divider may degrade as the frequency increases.

Scan Conversion

This method is used in Tek's signal processing systems instrumentation. It involves storing the information on a target in the CRT and reading off this data using a separate scanning beam on the other side of the target. The scan conversion process provides effective sampling rates as high as 1000 GS/s in the case of the 7250. It is, however, quite expensive and dependent on the writing beam's intensity, similar to conventional CRT storage.

Real-Time or Equivalent Time?

Real-time digitizing for everything would be ideal, but there are limits. Real-time digitizing of a high-frequency waveform requires very fast sampling and conversion rates along with very fast memory for storing the data. For example, to capture just two samples per cycle on a 100 MHz sine wave requires a sample rate of 5 nanoseconds/point. That means leading-

PORTABLE DIGITAL STORAGE OSCILLOSCOPES

Features	336A Scope	2201 Digital Scope	2230/2221/2220 Digital Scope	2430A/2432A/2440 Digital Scopes
Digitizing Technique	Successive approx.	Dual stage flash conversion	Dual stage flash conversion	CCD
Maximum Sample Rate	1 MS/s (1 μs/point)	10 MS/s	20 MS/s	500 MS/s (2440) 250 MS/s (2432A) 100 MS/s (2430A)
Vertical Amplifier Analog Bandwidth	50 MHz	20 MHz	100 MHz (2230) 60 MHz (2220, 2221)	300 MHz (2440, 2432A) 150 MHz (2430A)
Vertical Resolution	8-bits	8-bits	8-bits	8-bits
Record Length (Points)	1024 per channel	2048 per channel	2048 dual 4096 single	1024 per channel
Input Channels	2 chopped	2 simultaneous	2 chopped	2 simultaneous
Independent Time Bases	1 plus delaying	1	1 plus delaying (2230); 1 (2220,2221)	1 plus delaying
Maximum Sweep Speed	100 ns/div (10 ns in X10)	100 ns/div (10 ns in X10)	50 ns/div (5 ns in X10)	2 ns/div (2440, 2432A) 5 ns/div (2430A)
Pretrigger	pre, mid, post	Yes	Yes	Yes
Posttrigger	Yes	Yes	Yes	Yes
Waveform Storage Registers	2 plus 16 opt	1	3 plus 26 opt (2230); 1 (2220, 2221)	6
Waveform Processing	averaging enveloping CH1±CH2 CH1×CH2 RMS, mean, p-p	None	averaging (2230,2221) smoothing enveloping (2230,2221)	averaging envelope auto pass/fail, multiply, add, auto waveform measurements
Waveform Date Output Format	Binary	HPGL	ASCII, binary, hex	ASCII or binary
Prices begin at	*1	$1,495	$4,995/$3,995/$2,995	$7,950/*1/$11,500

*1 *Contact your local sales office.*

edge, state-of-the-art digitizing and memory technology. This need for speed usually results in a speed/resolution trade-off, the major disadvantage of continuous real-time digitizing.

The exception in real-time digitizing is the scan-conversion technique. Scan conversion, however, is not really continuous. A scan converter takes a snapshot of the waveform and then spends a block of time doing the conversion of all samples as a batch, rather than continuously digitizing on a sample-by-sample basis like other real-time digitizers.

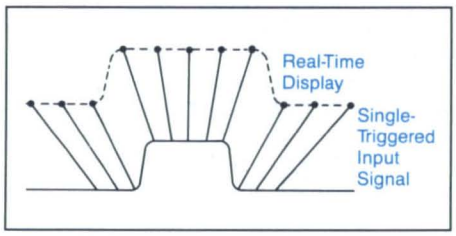


Figure 1. In real-time sampling, samples are taken one after the other, in order, from the beginning of signal acquisition to its end.

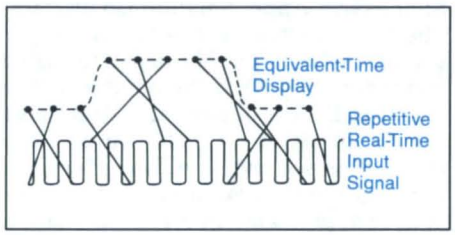


Figure 2. Equivalent-time digitizing can use either random or sequential sampling (random is shown in the illustration). In both cases, a few samples are taken from each of numerous acquisitions of a waveform and then assembled into a representation of one waveform (the dotted line).

If the waveform is repetitive, you don't have to capture it in real time. A typically lower-cost approach for repetitive waveforms is using equivalent-time methods to achieve higher effective sampling rates, as high as 100 GS/s or more in some cases.

The equivalent-time sampling technique limitation is that it can be used to its full range only on repetitive waveforms. For single-shot acquisitions, the bandwidth is much lower since the digitizer must take data in real time. That means the sample rate is the actual—not the effective—real-time sample rate of the equivalent-time digitizer. Newer digitizers provide a different solution to this dilemma—combining real-time and equivalent-time digitizing in one instrument. This extends the effective bandwidth of the digitizers.

SAMPLING OSCILLOSCOPES

Sampling is a powerful technique for examining very fast repetitive signals. Sampling is similar to the use of stroboscopic light to study fast mechanical motion. Progressive samples of different 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 CRT. The display produced is a replica of the sampled waveforms.

If your measurements require full programmability and up to 20 GHz bandwidth, the 11801 or 11802 will fill your needs. If you prefer the flexibility of the 7000 Series, but still need equivalent bandwidths to 14 GHz, consider the sampling plug-ins described in the Plug-In section.

CRT STORAGE

Stored Writing Speed

For CRT-storage scopes, the storage-capability specification is stored writing speed. This figure of merit is expressed in distance per unit of time. Often div/μs is more meaningful for your measurements. However, because some scopes have nonstandard-sized graticules (that is, other than 1-cm-square major divisions) cm/μs is useful for comparisons.

Stored writing speed is dependent on the speed and amplitude of the input signal. If you know the step (pulse) rise time or sine-wave frequency of the input signal and the amplitude of the waveform you want to display, you can use the graph to determine which storage scope is recommended.

Bistable CRT Storage

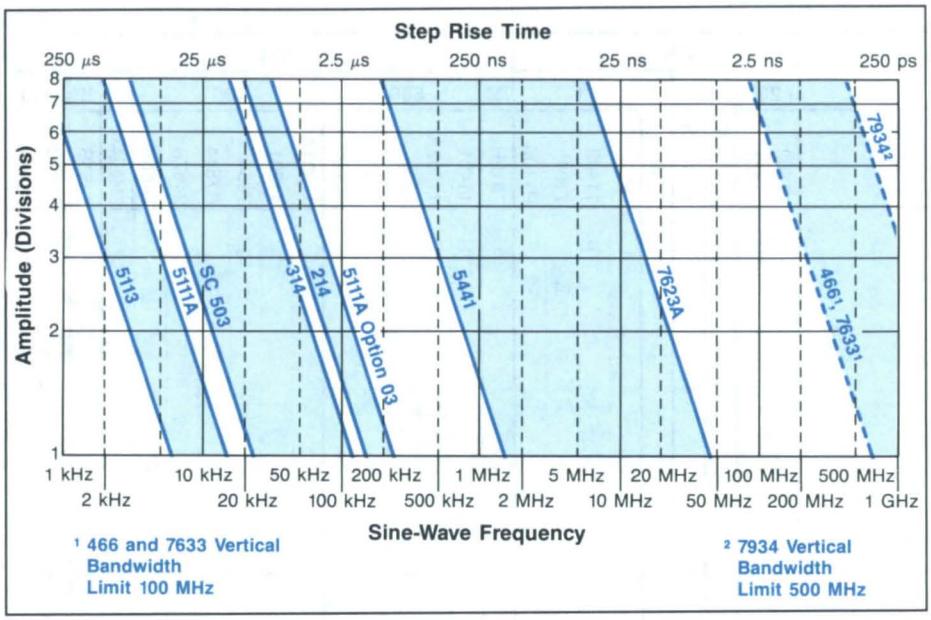
The phosphor in a bistable CRT-storage scope has two stable states: written and unwritten. Once stored, this phosphor typically allows waveforms to be displayed for several hours, or until erased by the operator. Bistable storage is the easiest CRT-storage type to use. It is also the least expensive CRT-storage technology. It features bright, long-lasting displays, but in comparison with other storage technologies, bistable storage displays have less contrast.

LABORATORY DIGITAL STORAGE OSCILLOSCOPES

Features	11801/11802 Digital Sampling Scopes	11401/11402/11201 Digitizing Scopes	7854 Waveform Processing Scope
Digitizing Technique	Sequential sampling	Dual stage flash conversion	Successive approx.
Maximum Sample Rate	200 kS/s	20 MS/s	500 kS/s (2 μs/point)
Vertical Amplifier Analog Bandwidth	20 GHz	500 MHz (11401) 1 GHz (11402) 400 MHz (11201)	400 MHz/real (14 GHz/samp.)
Vertical Resolution	8 bits	10 bits; 14 bits with averaging (9 bits 11201)	10 bits
Record Length (Points)	512 to 5120	512 to 10,240	128 to 1024
Input Channels	Up to 136*1 (up to 68 simultaneous)	Up to 12 (Up to 8 displayed) (11201: 4 channels, up to 8 displayed)	Up to 4 chopped
Independent Time Bases	1 plus 7 windows	1 main and 1 window	1 delaying
Maximum Sweep Speed	1 ps/div	500 ps/div	500 ps/div (20 ps/div) Sampling
Pre-trigger	Yes (11802)	Yes	No
Post-trigger	Yes	Yes	Yes, w/delaying
Waveform Storage Registers	512K points variable	64K points 102K points (opt)	2 to 16 (5 to 40 opt)
Waveform Processing	Waveform functions,, pulse parameters, TDR, propagation delay	Waveform functions, pulse parameters	Averaging parameters keystroke programming
Waveform Data Output Format	ASCII or binary	ASCII or binary	ASCII
Prices begin at	$23,500/$22,000	$13,000/$15,500/*2	$15,275

*1 *11801—up to 8 channels; with four SM11s—up to 136 channels.*
11802—up to 4 channels.
Both display up to 8 waveforms.
*2 *Contact your local sales office.*

CRT STORAGE PERFORMANCE



The advantages of bistable storage make it particularly useful for mechanical measurements, signal comparisons, and data recording.

Variable-Persistence CRT Storage

If you don't need to store waveforms for hours at a time, variable-persistence CRT storage provides easy viewing with high contrast between the dark background and bright waveforms. This type of storage provides the best displays when viewing traces with varying intensities, such as delaying and delayed sweeps, or traces with external z-axis (intensity) modulation.

Varying the persistence permits you to adjust the scope so that the entire waveform can be viewed, yet the stored trace will fade from view just as a new waveform is being stored. Also, you can view several traces before the first one fades from view. Then you can see signal-response variations as you make changes in a circuit.

Variable persistence can also be used to provide display integration so that only the coincident portions of a repetitive signal are displayed. Aberrations or jitter not common to all 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 with this storage technology by allowing each repetition to build up the trace brightness.

Fast-Transfer CRT Storage

Fast-transfer storage scopes use a CRT with a special intermediate mesh target optimized for speed. This target captures the waveform and then transfers it to another mesh, one optimized for longer-term storage. As the name implies, the fast-transfer storage mode provides increased writing speed (see below) for the 7623A, 7633, and 7934 Laboratory Oscilloscopes.

The second target can also be designed to offer bistable, variable persistence, or both modes in combination with the transfer mesh, or by itself. In the 7623A, 7633, and 7934, this combination of capabilities provides unique multimode-storage instruments. Using front-panel controls, you can select the operating mode suited to your specific measurement situation.

TECHNICAL ASSISTANCE SERVICES

When you need technical assistance to supplement your own resources, Tektronix can arrange the services of an application engineer skilled in meeting your needs. For more information, see the New Products/Solutions Section.

GPIB AND RS-232C OSCILLOSCOPES

All 11000 Series Oscilloscopes provide both GPIB and RS-232C interfaces as standard features. These instruments and the 7854, 7250, 2465B/2445B, 2467B, 2455B, 2220, 2221, 2230, 2440, 2432A, 2430A, 222, 336A, and 5223, with their respective GPIB features and options, give you an opportunity to improve the consistency of measurements and to control costs.

The new 2440 extends the 2400 Series Digital Oscilloscope line by offering 500 MS/s sampling as well as 300 MHz bandwidth. These compact, portable scopes provide time-saving, drudgery-eliminating automation features such as auto setup, auto measurements, auto pass/fail testing, and auto sequencing. They are fully GPIB compatible.

The 2465B/2445B/2467B Family offers a Counter/Timer/Trigger option for automatically measuring frequency, period, rise time, fall time, pulse width, and time between events. Also, by combining the GPIB and Digital Multimeter options, this system can efficiently perform both waveform and steady-state measurements. For a truly comprehensive measurement system, combine GPIB, Counter/Timer/Trigger, and DMM options.

Software development won't overwhelm your program if you use the built-in *Learn* mode of the 2465B/2445B/2467B-Family GPIB option to generate detailed set-up instructions. With Tektronix EZ-TEST software, your controller will do more for you with less programming effort.

The following factory installed or retrofit options are available for the 2230/2221/2220 Oscilloscopes:

- GPIB (IEEE-488) Talker/Listener (instrument not fully programmable).
- RS-232 Talker/Listener (instrument not fully programmable).

Only one of these options can be installed at the time of order. The scopes are not programmable; however, single-sweep reset and some limited storage functions are programmable to enable "babysitting" applications. The 2230 also includes 26K of battery-backed memory with either the RS-232 or GPIB option for additional waveform storage (up to 52 waveform sets).

The 2220/2221 is available with GPIB or RS-232 options, but does not have battery-backed reference memory.

The compact 336A Oscilloscope simultaneously displays real-time and digitally stored waveforms. An Auto mode allows "hands-off" operation in many applications.

TRAINING

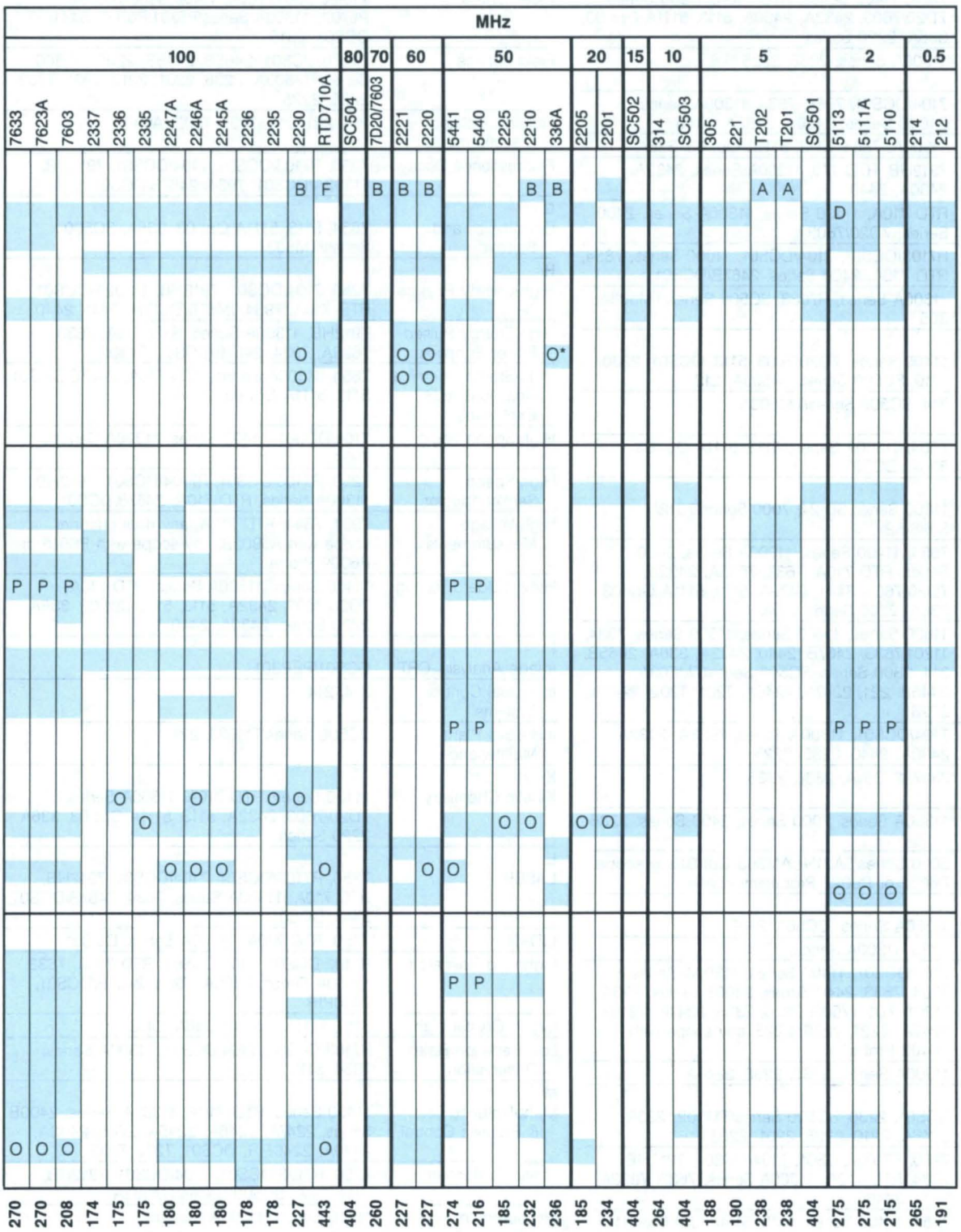
Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. Information is in the Customer Training Section. For further information, or to enroll, call us at 1-800-835-9433 ext. 430. In Oregon call collect 1-629-1017.

Tektronix Oscilloscopes/Signal Measurement Systems

Bandwidth	GHz									MHz																	
	20		14	11.5	6	1				750	500					400						300	250	150			
	11802	11801	7603 SMP	7603 TDR	7250	DCS	11402	7104	R7103	7912HB	11401	11302A	7934	7904A	R7903	11301A	11201	7854	R7844	2467B	2465B	2440/2432	2455B	2445B	2430A		
FEATURES																											
Digital Storage					S		F			S	F						F	B				B			B		
Analog								M	M			M							D	M							
CRT Storage																											
Portable																											
Battery Powered																											
Plug-in, Modular																											
Programmable																		P									
IEEE-488 (Talker, Listener)					P															O	O		O	O			
RS-232C																											
Keyboard																											
Touch Screen																											
APPLICATIONS																											
Classroom, lab																											
Counter/Timer							P				P	G				G	P			O	O		O	O			
DMM																					O		O	O			
Delta Time Analysis																								O			
Differential							P	P	P	P	P	P	P	P	P	P		P	P								
Digitizing Camera DCS/MUX						X																					
Automatic Measurement																											
Dual Channel										P																	
Three Channel								P	P																		
Four Channel							P	P	P			P	P	P	P			P	P								
Eight Channel							P				P	P				P											
>Eight Channel		O					P				P																
Software/Hardware Package																											
Military, Special Service																						O			O		
Rackmounting																								O			
Waveform Processing						P																					
Word Recognizer								P	P				P	P	P					O	O		O	O			
Plotter/Hard Copy Out																											
SIGNALS																											
Complex Timing																				O	O						
Low-level																											
Fast Transient																											
Frequency Spectrum			O	O																							
Optical			O	O				P	P	P			P	P	P												
Sampling, TDR																											
Semiconductor Curves			O	O																							
Low Rep Rate (Slowly Changing)																											
Television								P	P	P			P	P	P			P	P	O	O	O	O	O	O		
Temperature																											
Catalog Page	251	251	299	299	450	453	246	203	203	448	246	195	268	206	206	195	244	258	210	159	161	220	161	161	220		

A=Successive approximation B=Bandwidth reduction for single-shot events D=Dual Beam
F=Flash conversion G=Gated 750 MHz, 10-digit universal counter/timer
□ Shading indicates features, applications and signals handled by each product.

cover the measurement spectrum in depth



M=Microchannel plate CRT O=Optional feature

P=Performance limitation may exist in certain modes or for certain applications S=Scan conversion

* Talker only

Applications	Recommended Products
A	
Acoustic Emission	7854, 11400 Series, RTD 710A, 11300 Series, 7D20/7603, 2432A, 2430A, 5113, 5111A Opt 03, 336A, 2220 Series
Amplifier Design and Testing	11300A Series, 2236, 2225
Analog Design	7104/DCS01, 7854, 7934, 11300A Series, 2400B Series, 2430A, 2432A, 2440
Audio	11300A, 7854, 5113, 5111A Opt 03, 336A
Applied Research	7912HB, RTD 710, 11300A Series, 2432A, 2430A, 2440
Automated Production Testing	RTD 710A, 11400 Series, 11300A Series, 2400 Series, 7D20/7603
Automatic Waveform Measurements	R7103/DCS01, 7104/DCS01, 11000 Series, 7854, RTD 710A, 2400 Series, 2467B/DCS01
Automotive/Motor Vehicle	11300A Series, R7633, SC500 Series/TM503A, 305
B	
Biomedical Research	11400 Series, 7D20/7603, 5113, DCS01, 2230, 5110, SC500 Series/TM503A, 212
Biophysical Instrumentation	314, SC500 Series/TM503A
Biophysical R&D	7854, 11300A Series, 5113, 5111A Opt 03, 336A, DCS01
C	
Cable Testing, Fault Locating	11800 Series/SD-24, 7000 Series/7S12/ S-6/S-52
CCD Development & Testing	7854, 11400 Series, 11300A Series, 2400 Series, RTD 710A, 7633, 7623A, 2432A, 7D20/7603, 5441, 2430A, 5113, 5111A Opt 03, 336A, 2200 Series, 2240
Communications	11800 Series, 11400 Series, 11300 Series, 7934, 11201,7633, 2467B, 2440, 2432A, 336A, 2465B, 314, 2300 Series, SC500 Series/TM503A, 2445B, 221, 2247A, 2246A, T201, T202, 2245A, 2225
Component Testing	7104/DCS01, 11300A Series, 7623A, 2432A, 2430A, 2440, 2235, 2225
Computer Peripheral Service	2337, 2236YA, 2336, 2335
Counter Timer Measurements	11300A Series, 7000 Series, 2400 Series, 2236
Current Measurements	5000 Series/5A21N, AM503 Opt 01/any scope, P6032 or P6022 Probe/any scope
D	
Data Logging	11300A Series, DCS01, 2402
Destructive Testing	7633, 11300A Series, 7934
Digital Design and Troubleshooting	7104/DCS01, 11400 Series, 11300A Series, 7904, 7633, 2440 Series, 2400B Series, 7934, 11201, 7D20/7603, 2230, 2336, 2247A, 2246A, 2245A, 2221, 2220, 2225, any scope with P6408 Probe
Disk Drive Repair	11300A Series, 2230, 2236, 2246A
E	
Education	DCS01, 2230, SC500 Series/TM502, 2235, 2246A, 2210, 2225, 2201, 2205
Electro-Magnetic Pulse	7250, R7103/DCS01, 7104/DCS01, 7912HB, 7934, RTD 710A, 11300A Series, 7633, 7623A, 5441, 2440
Electromechanical Design and Test	7854, 11400 Series, 5113, 5111A Opt 03, 5111A, 336A, 2230, 5110, SC500 Series/ TM503A, 305, 214, 221, 2210, 212, 2201
Electrostatic Discharge (ESD)	R7103/DCS01, 7104/DCS01, 7912HB, 7934, RTD 710A, 11300A Series, 7633, 7623A, 2467B/DCS01, 5441, 2440

Applications	Recommended Products
F	
Fiber Optics	7104/DCS01, 7854, 11400 Series/P6701/ P6702, 11300A Series/P6701/P6702, 5441, DCS01, 2815
Field Service	2467B/DCS01, 2465B, 2445B, 2205, SC500 Series/TM503A, 2236, 2201, 2210, T201, T202, 2235, 2225
Floating Isolated Measurements	214, 221, 212, T201, T202, A6901
Fluorescence Decay	7250, R7103/DCS01, 7104/DCS01, 7912HB, 11302A/DCS01, 7934, 2467B/DCS01
G	
Geophysics and Seismic	7854, 5113, 5111A Opt 03, 336A, SC500 Series/TM503A
H	
High-Energy Physics	7250, 7104/DCS01, 7912HB, 11302A/DCS01, RTD 710A, 7934, 2467B/DCS01, 5441, 2440
High-Energy Pulsed Power Supplies	7912HB, 11300A Series, RTD 710A, 7633, 7623A, 7934, 2467B/DCS01, 2440F1
High-Speed Chemical Reactions, E.G., Explosives	7854, 11300A Series, RTD 710A, 2467B/DCS01, 5113, 5111A Opt 03, 336A
High-Speed Logic	7104/DCS01, 11400 Series, 11300A Series, 7934
High-Speed Semiconductor	7250, R7103/DCS01, R7104/DCS01, 7912HB, 11300A Series, RTD 710A, 2467B/DCS01
High-Voltage Measurements	7934, 7844, RTD 710A, any dual channel scope with A6902B, any scope with P6015 or P6009 Probe
Hybrid Board Testing	11400 Series, 11300A Series, RTD 710A, 7D20/7603, 2432A, 5113, 5113 Opt 03, 336A, 2220 Series, 2430A, 2440
I	
Image Analysis, CRT	DCS01/PEP301
Industrial Control Systems	314, 214
Industrial Plant Maintenance	SC500 Series/TM503, 221
K	
Kinetic Chemistry	11400 Series, RTD 710A, 11300A Series, 7D20/7603, 2432A, 5113, 5111A Opt 03, 336A, 2220 Series
L	
LASER	7250, R7103/DCS01, 7104/DCS01, 7912HB, RTD 710A, 11300A Series, 7934, 2467B/DCS01, 5441, DCS01
LIDAR	7250, RTD 710A, 11300A Series, DCS01
Lightning Research	R7103/DCS01, 7104/DCS01, RTD 710A, 7633, 11300A Series, 7623A, 7934, 2467B/DCS01, 2440PIR
Liquid Crystal Light	5113, 5111A Opt 03, 336A, DCS01
Low-Repetion Rate Observation	R7103/DCS01, 7104/DCS01, 11300A Series, 7934, 5113
M	
Manufacturing Test & Process Control	11400 Series, RTD 710A, 11300A Series, 2400B Series, 2247A, 2246A, 2245A, 2205, 2432A, 2430A, 2240FIR, DCS01, T201, T202
Materials Research	7250, R7103/DCS01, 7104/DCS01, 7912HB, RTD 710A, SC500 Series/TM503A
Measurement Against a Standard	11400 Series, 11300A Series
Mechanical Measurements	11400 Series, 7854, 5113, 5111A Opt 03, 5111A, 336A, DCS01, SC500 Series/TM503A
Medical Equipment Servicing	2230, SC500 Series/TM503A, 2221, 2220, 305

Please refer to Alphanumeric Index on pages 2 to 5 for location of each product.

Applications	Recommended Products
Medical Signals, E.G., QRS Complexes	7854, 11400 Series, 11300A Series, 5113, 5111A Opt 03, 336A, SC500 Series/TM503A
Memory Core IO Measurements	7000 Series
Microprocessor System Design and Debug	7000 Series/7A42, 11400 Series, 11300A Series, 7D20/7603, 2432A, 5113, 5111A Opt 03, 336A, 2220 Series
Military	2336YA, 2440, 2246 Opt 1Y, 2235 Opt 01
Module ATE	2402
Multi-Channel Differential TDR	11800 Series
Multi-Channel Time Domain Reflectometry (TDR)	11800 Series
Multi-Channel Time Domain Transmission (TDT)	11800 Series
N	
Non-Destructive Testing & Ultrasound	7912HB, R7103/DCS01, 7104/DCS01, 7854, 11400 Series, 11302A/DCS01, RTD 710A, 2467B/DCS01, 7633, 7D20/7603, 2440, 2432A, 5441, 5113, 5111A Opt 03, 336A, SC500 Series/TM503A, 2430A, 2200 Series, DCS01.
O	
Optical Communications	R7103/DCS01, 7104/DCS01, 11400 Series, 11300A Series, 2467B/DCS01, 2815
Optical Component Development	R7103/DCS01, 7104/DCS01, 11300A Series, 2467B/DCS01, 2815
Optical to Electrical Converters	7000 Series/7F10, 7000 Series/S-42, 11300A Series/P6702/P6701, OT503/OR/503/TM503A/ any scope, 1103/P6702/P6701/any scope
P	
Partial Physics Research	7250, R7103/DCS01, 7104/DCS01, 7912HB, 11300A Series, RTD 710A, RTD720, DCS01
Plant Maintenance	T201, T202
Power Supply Design and Testing	7104/DCS01, 7854, 11400 Series, RTD 710A, 7633, 11300A Series, 7623A, 7934, 11201, 7D20/7603, 5441, 2432A, 2430A, 5113, 2465B, 5111A Opt 03, 336A, 2230, 2221, 2445B, 2220, 2245A, 2201, AM503 Opt 01/any scope, 1 MΩ scope/P6046 FET Probe, any dual channel scope/A6902B
Power Transmission Fault Detection Design	RTD 710A, 2430A
Power-Line Monitoring	11400 Series, 7D20/7603, 2432A, 5113, 5111A Opt 03, 336A, 2220 Series
Pressure Switches/ Activators	11400 Series, 11300A Series, 7D20/7603, 2432A, 5113, 5111A Opt 03, 336A, 2220 Series
Process Control	DCS01, 214, 221, 212, 2201
Production Line Automatic Testing	11400 Series, 11300A Series, 2467B, 2465B, 2445B,2430A
Pulse Echo Measurements	7000 Series/7D15, RTD 710A, 11300A Series, 2440
R	
Radar	7250, R7103/DCS01, 7104/DCS01, 7912HB, RTD 710A, 11300A Series
RADAR Signature Analysis	R7103/DCS01, 7104/DCS01, 11300A Series, 2467B/DCS01
Relay Testing	11400 Series, 7D20/7603, 2432A, 5113, 5111A Opt 03, 336A, 2220 Series

Applications	Recommended Products
Remote Monitoring/ Services	DCS01, 2430A, 2402
RF Modulation	7D20/7603, 2430A, DCS01
Robotics	7854, 5113, 2430A, 5111A Opt 03, 336A, DCS01
Rugged Field Service	2465B, 2445B, 2400 Series, SC500 Series/TM515, 2337, 2336YA, 2336, 2335
S	
Semiconductor Test	7000 Series/7S12/7S11, 7000 Series/7CT1N, 7854, RTD 710A, 11400 Series, 2467B/DCS01, 2465B, 2440
Shock Testing	11400 Series, 7D20/7603, 2432A, 5113, 5111A Opt 03, 336A, 2220 Series
Signal Averaging	7854, 2440, 2432A, 2430A, 2230
Smart-Scope Applications	11800 Series, 11400 Series, 11300A Series, 2402
Spectrum Analysis	7000 Series/7L5, 7L12, 7L14
T	
Telecommunications	11800 Series, 11400 Series, 11300 Series, 2430A, 2230, 2221, 2440, 2200
Television Measurements	7000 Series, RTD 710A, 11300A Series, 2400 Opt 05 Series, 2200 Series
Television and VCR Service	2445A Opt 05, 2246A, 2205, 2201
Temperature Measurement	2400 Opt 01 Series, 2236, DM502A/TM503 with any scope, DM501A/TM503 with any scope
Tempest/Intelligence Testing	RTD 710A, 7633, 7623A, 5441, 2440
Time Domain Reflectometry (TDR)	11800 Series, 7000 Series/7S12
Time Domain Reflectometry (Differential)	11800 Series
Time Domain Transmission (TDT)	11800 Series, 7000 Series/7S12
T-Carrier Verification	11300A Series, 2432A
U	
UHF Measurement	11800 Series, 7000 Series/7S11, 11300A Series
V	
Vibration Analysis	7854, 5113, 5111A Opt 03, 5111A, 336A, SC500 Series/TM503A
Video Research, Design	RTD 710A,7623, 11300A Series, 7623A, 2467B Opt 05, 7934, 5441, DCS01, 2440
Video Signals	11300A Series, 2467B Opt 05, 2432A, 5113, 5111A Opt 03, 336A, 2445B Opt 05, 2220 Series
VITS Analysis	2400 Series Opt 05, 2245A, 2246A
W	
Waveform Analysis, Characterization	7250, 7104/DCS01, 7912HB, 11800 Series, 11400 Series, RTD 710, 11300A Series, 7854, 2440, 2432A, 2430A, 336A, DCS01, 2230, 2221, 2220, 2240, 2402
Word Recognition	11300A Series, 2400 Series, 2200 Series/P6408
X	
X-Ray Equipment Maintenance	336A, 2230
X-Y Power Dissipation Measurements	7000/7D15, 11400 Series, RTD 710, 11300A Series, 11201

Please refer to pages 521 and 522 for recommended or standard oscilloscope/probe combinations.

ANALOG OSCILLOSCOPES

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PORTABLE NONSTORAGE OSCILLOSCOPE SELECTION GUIDE

Product	Bandwidth	Minimum Deflection Factor	Dual Channel	Maximum Sweep Rate	Delayed Sweep	Price
2467B*1	400 MHz	2 mV/div at BW	4 Channels	500 ps/div	X	$11,900
2465B*1	400 MHz	2 mV/div at BW	4 Channels	500 ps/div	X	$5,850
2465B CT*1						$7,700
2465B DM*1						$9,000
2465B DV*1						$9,900
2455B*1	250 MHz	2 mV/div at BW	4 Channels	1 ns/div	X	$5,350
2445B*1	150 MHz	2 mV/div at BW	4 Channels	1 ns/div	X	$3,695
2337	100 MHz	5 mV/div at BW	X	5 ns/div	X	$4,700
2336	100 MHz	5 mV/div at BW	X	5 ns/div	X	$4,270
2336YA	100 MHz	5 mV/div at BW	X	5 ns/div	X	$4,490
2335	100 MHz	5 mV/div at BW	X	5 ns/div	X	$3,940
2235	100 MHz	5 mV/div at BW; 2 mV/div	X	5 ns/div	X	$1,595
2235 Opt 01	100 MHz	5 mV/div at BW; 2 mV/div	X	5 ns/div	X	$2,395
2236	100 MHz	5 mV/div at BW 2 mV/div	X	5 ns/div	X	$2,995
2205	20 MHz	5 mV/div at BW	X	10 ns/div		$695
2225	50 MHz	500 μV/div at 5 MHz; 5 mV/div at BW	X	5 ns/div	X	$1,095
2245A	100 MHz	2 mV/div	4 Channels	2 ns/div	X	$1,895
2246A	100 MHz	2 mV/div	4 Channels	2 ns/div	X	$2,395
2247A	100 MHz	2 mV/div	4 channels	2 ns/div	X	$2,795
305	5 MHz	5 mV/div	X	100 ns/div		$3,150
221	5 MHz	5 mV/div	X	100 ns/div		$2,715
213	1 MHz	20 mV/div at BW 5 mV/div		400 ns/div		$3,400
212	500 kHz	10 mV/div at BW; 1 mV/div	X	1 μs/div		$2,095

MODULAR OSCILLOSCOPES

SC 504*2	80 MHz	5 mV/div at BW	X	5 ns/div	$3,960
SC 502*2	15 MHz	5 mV/div at BW; 1 mV/div	X	20 ns/div	$2,840

*1 *Programmable via included or optional GPIB; useful in automated test applications.*
*2 *The SC 502 and SC 504 are oscilloscopes that plug into a TM 500 or TM 5000 Mainframe for operation. See Modular Instruments section.*

LABORATORY NONSTORAGE OSCILLOSCOPE SELECTION GUIDE

Product	Bandwidth*2	Minimum Deflection Factor	Number of Channels	Maximum Sweep Rate	Price*3
7104/R7103	1 GHz	10 mV/div at BW	Up to 4	200 ps/div	$26,695/$27,275
7904A/R7903	500 MHz	10 mV/div at BW; 10 μV/div;1 mA/div	Up to 4	500 ps/div	$11,530/$10,980
11302A*1	500 MHz 750 MHz (Counter/Timer)	10 mV/div at BW 1 mV/div at 250 MHz	Up to 8	500 ps/div	$12,950
11301A*1	400 MHz 750 MHz (Counter/Timer)	10 mV/div at BW 1 mV/div at 250 MHz	Up to 8	500 ps/div	$8,550
R7844	400 MHz	20 mV/div at BW 10 μV/div; 1 mA/div	Up to 4 Dual-Beam	1 ns/div	$18,335
7603/R7603	100 MHz	5 mV/div at BW 10 μV/div; 1 mA/div	Up to 4	5 ns/div	$3,995/$4,910
5440/R5440	50 MHz	5 mV/div at BW 10 μV/div;0.5 mA/div	Up to 8	5 ns/div	$4,220/$4,300
5110/R5110	2 MHz	1 mV/div at BW 10 μV/div; 0.5 mA/div	Up to 8	100 ns/div	$2,305/$2,405

*1 *Programmable via GPIB or RS-232C; useful in automated test applications.*
*2 *Bandwidths are real time. Sampling plug-ins that extend bandwidths to 14 GHz are available for most 7000 Series mainframes.*
*3 *Price does not include plug-ins.*

PORTABLE ANALOG OSCILLOSCOPES

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A6901 Ground Isolation Monitor . 542
A6902B Voltage Isolator 543

Tektronix offers the widest selection of portable scopes so you'll be able to choose the scope that best suits your needs.

Twenty-eight portable scopes with many optional features are available with bandwidths from 500 kHz to 400 MHz.

All Portable Oscilloscopes listed in this section are available through the National Marketing Center by calling toll free 1-800-426-2200 ext. 99. Besides giving you direct order entry, NMC Sales Engineers offer immediate technical assistance with product specifications, capabilities, and applications. They can send you literature, discuss available accessories, tell you about payment terms and options, or help you contact your local sales and service office.

PORTABLE ANALOG OSCILLOSCOPE SELECTION GUIDE

Product	Bandwidth (MHz)	Sensitivity (mV/div)	Number of Channels	Delayed Sweep	Fastest Sweep (ns/div)	Features	Size mm (in.) H×W×D	Weight kg (lb)	Power Requirements	Prices Begin at
2467B	400	2	4	✓	500 ps	4 div/ns visual writing speed, CRT readout, ΔVolts, ΔTime cursors, Auto Measurements	190×330×467 (7.5×13×18.4)	10.9 (24)	Line (90-132/180-250 V ac, 48-440 Hz)	$11,900
2465B[*1] **2465B CT**[*2] **2465B DM**[*2] **2465B DV**[*2]	400	2	4	✓	500 ps	CRT Readout, ΔVolts, ΔTime Cursors, Auto Measurements	190×338×434 (7.5×13.3×17.1)	10.2 (22.4)	Line (90-132/180-250 V ac, 48-440 Hz)	$5,850 $7,700 $9,000 $9,900
2455B[*1]	250	2	4	✓	1	CRT Readout, ΔVolts, ΔTime Cursors, Auto Measurements	190×338×434 (7.5×13.3×17.1)	10.2 (22.4)	Line (90-132/180-250 V ac, 48-440 Hz)	$5,350
2445B[*1]	150	2	4	✓	1	CRT Readout, ΔVolts, ΔTime Cursors, Auto Measurements	190×338×434 (7.5×13.3×17.1)	10.2 (22.4)	Line (90-132/180-250 V ac, 48-440 Hz)	$3,695
2335	100	5	2	✓	5	Rugged, compact, lightweight	140×270×430 (5×11×17)	7.7 (17)	Line (100-132/200-250 V ac, 48-440 Hz)	$3,940
2336	100	5	2	✓	5	B Trigger, ΔTime	(140×270×430) (5×11×17)	7.7 (17)	Line (100-132/200-250 V ac, 48-440 Hz)	$4,270
2336YA	100	5	2	✓	5	B Trigger, ΔTime, elapsed time indicator, extra probes and manual	(140×270×430) (5×11×17)	7.7 (16.5)	Line (100-132/200-250 V ac, 48-440 Hz)	$4,490
2337	100	5	2	✓	5	B Trigger, ΔTime, DMM	140×270×430 (5×11×17)	7.7 (17)	Line (100-132/100-250 V ac, 48-440 Hz)	$4,700
2245A	100	2	4	✓	2	Front panel auto setup. CRT Readout of scale factors and delay time.	176×360×445 (7×14.2×17.5)	7.5 (16.5)	Line (90-250 V ac, 48-440 Hz)	$1,895
2246A	100	2	4	✓	2	20 store/recall front panel setups. Front panel Auto setup. Time/Volts cursors and Δtime function. Voltmeter functions with smart cursors.	176×360×445 (7×14.2×17.5)	7.5 (16.5)	Line (90-250 V ac, 48-440 Hz)	$2,395
2247A	100	2	4	✓	2	Time/Volts cursors and Δtime function. Voltmeter functions with smart cursors. Frequency counter; time measurements with smart cursors. 20 store/recall front panel setups. Front panel Auto setup.	176×360×445 (7×14.2×17.5)	7.5 (16.5)	Line (90-250 V ac, 48-440 Hz)	$2,795
2246 Opt 01Y Mod A	100	2	4	✓	2	2246 meets MIL SPEC 28800C Type III, Class 3.	176×360×445 (7×14.2×17.5)	7.5 (16.5)	Line (90-250 V ac, 48-440 Hz)	*5
2235	100*3	2	2	✓	5	Dual Time Base, Single Sweep Trigger View, BW Limit	137×360×440 (5.4×14.2×17.3)	6.1 (13.5)	Line (90-250 V ac, 48-440 Hz)	$1,595
2235 Opt 01	100*3	2	2	✓	5	Dual Time Base, Single Sweep Trigger View, BW Limit, Scale Illumination, HF/LF Rej Meets MIL SPEC 28800C Type III, Class 3	137×360×440 (5.4×14.2×17.3)	6.1 (13.5)	Line (90-250 V ac, 48-440 Hz)	$2,395
2236	100*3	2	2	✓	5	Dual time base with 100 MHz counter, timer, and full-function voltmeter. P-P auto	137×360×440 (5.4×14.2×17.3)	7.4 (16.3)	Line (90-250 V ac, 48-440 Hz)	$2,995
2225	50	0.5 5 @ 50 MHz	2		5	Alternate magnification, p-p auto X10 vert mag, HF/LF rej single sweep, TV trigger	138×380×438 (5.4×15.0×17.2)	6.6 (14.6)	Line (95-128/185-250 V ac 48-440 Hz)	$1,095
2205	20	5	2		10	P-P Auto, X10 vert mag, horiz-mag, TV trigger	138×380×438 (5.4×15.0×17.2)	6.6 (14.6)	Line (95-128/185-250 V ac 48-440 Hz)	$695
305	5	5	2		100	Autoranging DMM battery power	110×240×370 (4.4×9×15)	4.8 (10.6)	Built-in battery, line (90-132/180-264 V ac, 48-440 Hz), or external dc	$3,150
221	5	5			100	5 MHz hand-held	80×130×230 (3×5×9)	1.6 (3.5)	Built-in battery, line (90-250 V ac, 48-62 Hz)	$2,715
213	1	20			400	DMM/scope at <4 lb (1.7 kg)	70×130×230 (3×5×9)	1.7 (3.7)	Built-in battery, line (90-136/180-250 V ac, 48-62 Hz), or external dc	$3,400
212	0.5 (500 kHz)	10	2		1000 (1 μs/div)	Integral 1 MΩ probe	80×130×240 (3×5×10)	1.6 (3.5)	Built-in battery, line (104-126 V ac, 58-62 Hz)	$2,095

*[*1] The 2467B, 2445B, 2455B and 2465B offer as options: 4½ digit DMM, 150 MHz Counter/Timer/Trigger, 17-Bit Word Recognizer, TV Trigger and GPIB Interface.*
*[*2] Special Edition 2465B.*
*[*3] The 2235 and 2236 are specified 100 MHz for sensitivities from 5 mV to 5 V/div and 90 MHz in 2 mV.*
*[*4] See specifications in Digitizer section.*
*[*5] Contact your local sales office for information.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

PORTABLE ANALOG SCOPE PRODUCT LITERATURE AND APPLICATION NOTES

Tektronix product literature is readily available from your local Tektronix Sales Office.
For data sheets and product brochures, just ask for literature on the specific instrument. Additional related publications also available are listed below.

Title	Description	Order
2000 Series Warranty Brochure	Describes Tek's 3-year warranty on 2000 Series scopes and 5-year *Warranty-Plus* Service	81W-5258
Using the 2336	Pocket Reference Guide	46W-5732
2245/65, 2445/65 TDR	Application Note	38W-5221-1
Quick and Easy Phase Measurement	Application Note	38W-5223-1
Chip CRT and Assembly	Article Reprint	38W-5312
400 Series Portable CRT Storage Scopes	Describes the 466, 464, and 434 portable storage scopes	40W-3793-2
336 Brochure	Describes 336	53W-5426-1
XYZs of Using a Scope	A primer that features the 2225 Series	46W-6428
XYZs Instructor's Aid	Supplement to Primer	46W-6466
XYZs Workbook	Supplement to Primer	46W-6465
Using Delayed Sweep In Measuring Digital Word Trains	Application Note (2246)	41AX-3349
VITS Analysis for TV Servicing	Application Note	41AX-4047-1 46W-5207
Basic Video System Measurements	Describes TV measurements using 2445B/65B Option 05 scopes	38W-5511
Pulse Parameters	Application Note (2236)	46W5205-1
Frequency Measurements	Application Note (2236)	46W-5206-1
Pulse Ringing and Overshoot	Application Note (2236)	46W-5209
Swept Frequency Filter and Amplifier	Application Note (2236)	46W-5210

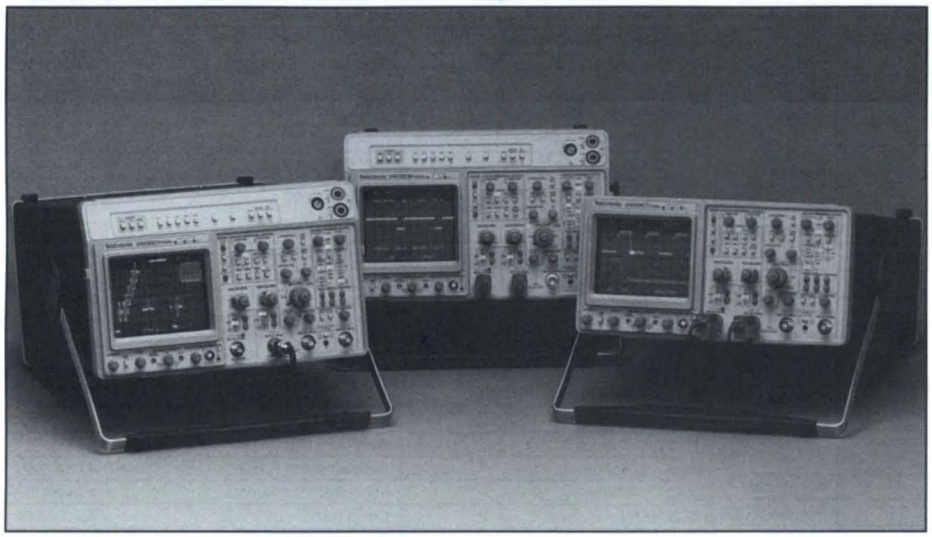
Title	Description	Order
Power Supply Testing	Application Note (2236)	46W-5211
General Troubleshooting	Application Note (2236)	46W-5212
TDR Measurements with a scope	Application Note (2236)	46W-5215 46-W-5216
Pulse Rise Time	Application Note (2236)	46W-5217-1
Integrating a Scope	Article Reprint	46W-5337
Portable Storage	Selection Guide	41W-5546
Your Direct Line to the World's Best Instruments and Technical Expertise	Find out about the Tektronix National Marketing Center and Tek's Service Offices	60A-4873-1
2245/2246 VITS Analysis for TV Servicing	Application Note	46W-6311
2225: Setup and Analysis Rise Time Dual Trace & X-Y Phase Amplitude Period and Frequency	Technique Brief Technique Brief Technique Brief Technique Brief Technique Brief	46W-6425 46W-6427 46W-6424 46W-6426 46W-6423
2225 Primer	Concepts	46W-6428
2225 Instructor's Aid	Supplement to Primer	46W-6466
2225 Workbook	Supplement to Primer	46W-6465
2225 Poster	Supplement to Primer	46W-6430
2215A Primer	Concepts	46AX-4758-2
2215A Poster	Supplement to Primer	46TT-528
ABCs of Probes	Primer on signal acquisition probes, applications, specs and selections	60W-6053

PORTABLE SCOPE/ACCESSORIES COMPATIBILITY GUIDE

	PROBES*5			CAMERAS			CARTS	MISCELLANEOUS ACCESSORIES
	Passive	**Active**	**Current**	**Single Shot or Low Rep Rate**	**Stored/Stable or Repetitive**	**Low Cost**		
2445B **2455B** **2465B** **2465B DV** **2465B CT** **2465B DM** **2467B**	P6015, **P6133***6 (2445B, 2430A) P6136*6 (24558) P6137	P6202A P6230	A6302/AM 503 A6303/AM 503	016-0269-03 adapter*1	016-0269-03 adapter*1	adapter*1 C-4 122-0894-01		Folding Polarized Viewing Hood 016-0180-00; Collapsible Viewing Hood (Binocular) 016-0566-00; 1105 Power Supply; 1106 Battery Pack; 1107 Dc Inverter Power Supply; Protective Cover 016-0720-00.
2335 **2336** **2336YA** **2337**	P6130 P6009 P6063B P6015 **P6108A** P6101A (2236YA)	P6202A P6201 P6230	P6022 A6302/AM 503 A6303/AM 503 P6021	NA	NA	C-5C Opt 04 016-0359-01 adapter*1 (with flash) C7 Opt 2 016-0359-01 adapter*1	K212	2335 Rack Adapter Kit 016-0468-00.
2245A **2246A** **2247A** **2235** **2236** **2225** **2205**	P6101A P6009 P6130 P6015 P6121 (2236) P6109 (2236, 2245A, 2246A, 2247A) P6103 (2225/2210)	P6201 P6202A	P6021 P6022 A6302/AM 503	C-31B Opt 01 016-0269-03 adapter*4	C-31B Opt 01 016-0269-03 adapter*4	C-5C Opt 04 016-0359-01 adapter*1*3 (with flash) C-4 Option 02*4 C-7 Opt 02*4, Opt 03*4 C-5C Opt 02*4	K212	Clear CRT Light Filter 337-2775-01; CRT TV Graticule Custom Mod; Accessories Pouch 016-0677-02; Front Cover 200-2520-00; RM Kit: 016-0466-00 for 2235; 016-0819-00 for 2225; 016-0833-00 for 2235 Opt 01; 016-0015-00 for 2236; RM Kit: F2240R for 2245/2246; P6602 Temperature Probe.
314, 305 **336**	P6101A **P6149A** **P6148A (336)**		P6021, P6022 A6302/AM 503 A6303/AM 503	C-31B Opt 01 016-0327-01 adapter*2	C-30B Opt 01 016-0327-01 adapter*2		NA	Viewing Hood 016-0297-00; Mesh Filter 378-0063-00; 1105 Battery Power Supply; Rain Cover (314, 335) 016-0612-00.

*1 *Mounting adapter comes with camera/option listed, others are optional.*
*2 *Mounting adapter must be ordered in addition to the camera/option listed.*
*3 *2235 Opt 01 Order C-5C Opt 02 or C7 Opt 03.*
*4 *Camera listings recommended for 2235 Opt. 01, 2245, and 2246.*
*5 *Highlighted probes are preferred for typical general purpose use and/or are shipped as included accessory to the instrument.*
*6 *P6133 and P6136 meet bandwidth requirements of specified scopes, but lack Auto Setup from probe.*

2400B Series Portable Analog Oscilloscopes



2400B Series 150 to 400 MHz Four-Channel Oscilloscopes

Now your top choice in portable analog scopes is more automatic than ever.
The Tek 2400B Series combines new convenience and leading-edge performance, *now up to 400 MHz.* Six scopes bring unprecedented efficiency to your design lab, production line or field service site.

Measure signals on screen in less time—automatically.
You can measure rise time, fall time, frequency, width, voltage and time interval A to B on A sweep at the push of a button. In addition, setup and measurement functions can be initiated by pressing an ID button on the head of Tek's new P6137 passive voltage probe.

The 2400B Series features Auto Setup—a tremendous time-saver. Just attach up to four probes to signal points, press AUTO SETUP, and within seconds you have a stable, automatically triggered display of your probed waveforms. It couldn't be simpler.

Auto Setup includes Tek's proprietary Pulse Mode for viewing narrow pulses in detail. Your scope calculates the duty factor and properly displays either the low-duty-cycle pulse or several cycles of symmetrical waveforms. The scope will display, position and scale up to four waveforms.

NEW NEW NEW

2467B/2465B/2445B

TYPICAL APPLICATIONS

- Design Test and Measurements
- Production Line Testing
- Communications Equipment Design and Service
- Field Servicing

BENEFITS

- Better Repeatability From Built-in Automation
- Faster Results From Automated Measurements
- Less Drudgery From Push-button Selections
- Better Accuracy From Reduced Operator Error

FEATURES

- 400 MHz Bandwidth (2467B, 2465B)
- 875 ps Rise Time (2467B, 2465B)
- Push-button Measurements
- Four Independent Channels 500 ps/div Time Base (2467B, 2465B)
- Auto Setup
- Save and Recall Setups
- Set-Up Sequencing
- Volts and Time Cursors
- Cursors After Delay
- 500 MHz Trigger Bandwidth (2467B, 2465B)
- Selectable Input Impedance (1 MΩ, 50 Ω)
- 20 ps Time-Interval Resolution
- 400 MHz at 5 mV/div
- 350 MHz at 2 mV/div
- Lightweight and Rugged

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

Instant access to complex setups means even faster measurements.
For closer examination of your signals and for specialized setups—such as delayed sweep displays or displays using the extended measurement options—front-panel control manipulations are still necessary. But now you need to create complex setups only *once*.

Non-volatile memory for 30 setups stores all front-panel information, including trace and readout intensity, cursor locations and control settings for the measurement options. Each setup can be labeled with a descriptive name for natural association and ease of recall.

This is a fast, easy alternative to the process of re-creating a front-panel setup every time you want to change measurements. Your attention can be focused on problem-solving, not control adjustments.

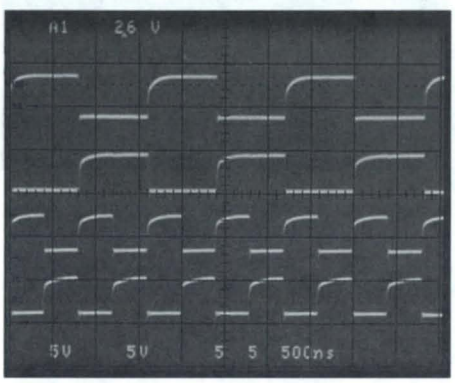
For example, by simply recalling previously saved setups, design engineers can display and make measurements on widely varying waveforms for purposes such as verifying products, demonstrating prototype behavior, generating documentation and characterizing devices, all without having to repeat time-consuming, manual front-panel setups.

Field service personnel can preset frequently used test setups and operate more effectively in much less time.

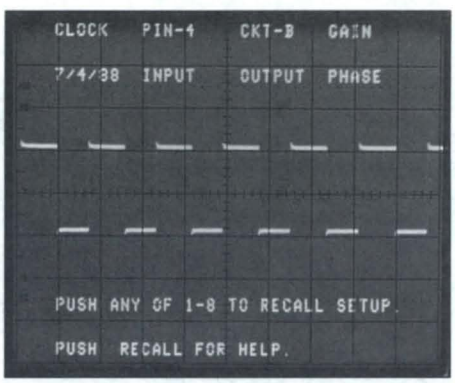
Automate measurement sequences without an external controller.
You can also set up, store and sequence your systematic verification procedures for engineering prototypes, final production test or field service without a computer—and without writing a single line of code. Step through up to 30 stored setups. Just press the STEP button once for each sequence step. Or plug a foot switch into the rear-panel jack for "hands-free" operation.

As a further aid, seven-character alphanumeric labels can be stored with each setup. These can be test titles or even operator prompts for test point connections. Guard your saved setups and sequences with write protection.

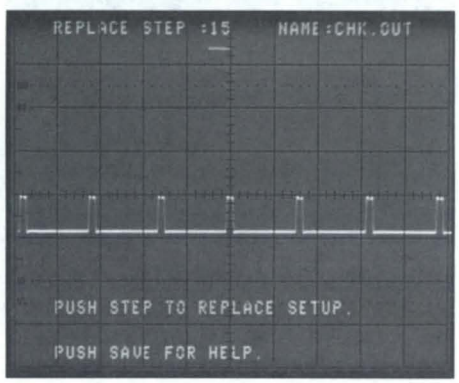
Built-in sequencing is standard throughout the 2400B Series. You can implement semi-automated procedures with a single, standalone portable oscilloscope. This also offers an excellent, price-competitive entry into automated testing. You can move from the 2445B through the 2467B and its options with complete upward mobility.



Four waveforms were triggered, scaled and positioned by simply pressing AUTO. No other adjustments were necessary.



Pressing RECALL and a test number resets the 2445B/2465B controls to a previously stored setup. The first eight names appear on the CRT when you press RECALL.



Sequences are arranged and modified with the front-panel controls. Information about the sequence steps and directions for the operator are written on the scope display for easy reference.

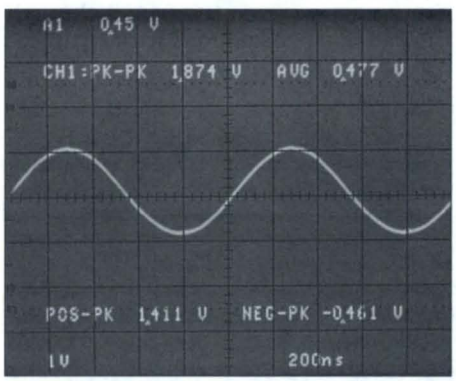
PRODUCT CONFIGURATION GUIDE

Features	Standard Models				Special Edition Models		
	2467B	2465B	2455B	2445B	2465B CT	2465B DM	2465B DV
Bandwidth	400 MHz	400 MHz	250 MHz	150 MHz	400 MHz	400 MHz	400 MHz
GPIB	Option 10	Option 10	Option 10	Option 10	Included	Included	Included
Counter/Timer/Trigger, Word Recognizer	Option 09	Option 09	Option 09	Option 09	Included	Included	Included
DMM	NA	Option 01	Option 01	Option 01	NA	Included	Included
Video Measurement System	Option 05	Option 05	Option 05	Option 05	NA	NA	Included
Counter/Timer/Trigger, No Word Recognizer	Option 06	Option 06	Option 06	Option 06	—	—	—
Two Additional Probes	Included	Option 22	Option 22	Option 22	Included	Included	Included
Rackmount	Option 1R	Option 1R	Option 1R	Option 1R	Option 1R		
Probe Power	Option 11	Option 11	Option 11	—	—	—	—

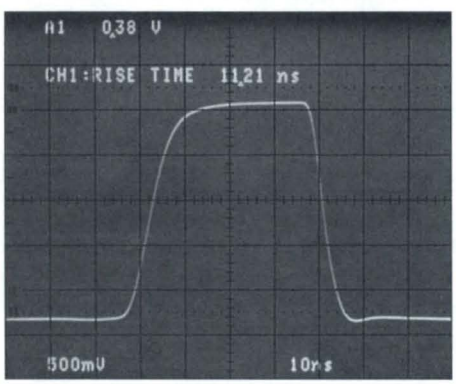
Tek state-of-the-art technology makes possible the 2465B's 400 MHz bandwidth along with new pushbutton measurements, the first in an analog instrument. In addition, new pushbutton probes take the full bandwidth to the probe tip—where you really need it.

Get rise, fall, frequency, width, voltage and time measurements at the push of a button.

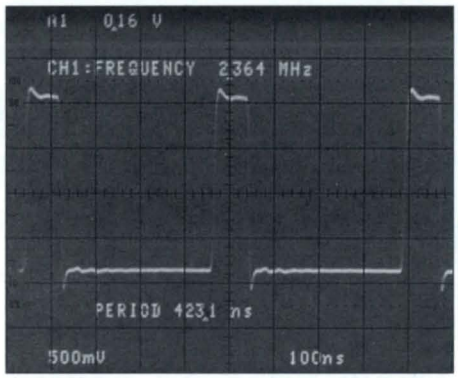
New 2400B Series pushbutton smarts offer capability previously available only with a digital storage oscilloscope or high-performance counter. No need even to press AUTO. Your scope sets itself automatically and scales a signal for display—at the push of a button.



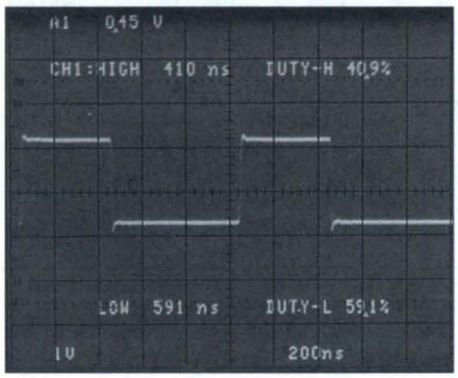
1. Volts Simply select VOLTS to access amplitude information such as Positive and Negative Peak, Average and Peak to Peak. With Tektronix-coded probes, scaling is automatic.



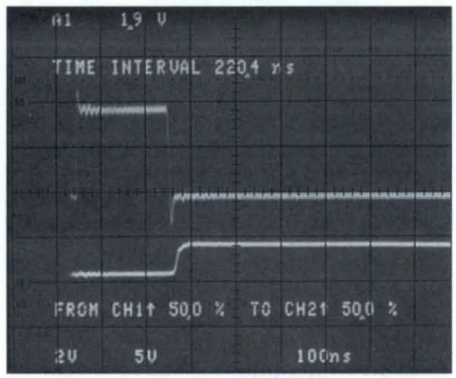
2. Risetime/Falltime Select RISETIME or FALLTIME and your scope presents an automatically triggered and scaled display of your probed waveform along with measurements results—either rise or fall using 10% and 90% points.

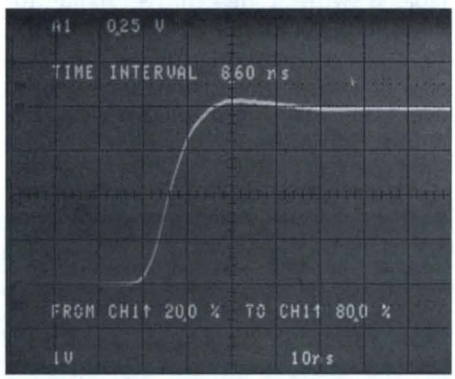


3. Frequency When you need a measurement "snapshot," both frequency and period are available at the touch of a button. For high accuracy measurements, include the Counter/Timer/Trigger option for expanded functions and accuracies to 0.001%.



4. Width Both width and duty cycle are measured with a single selection.

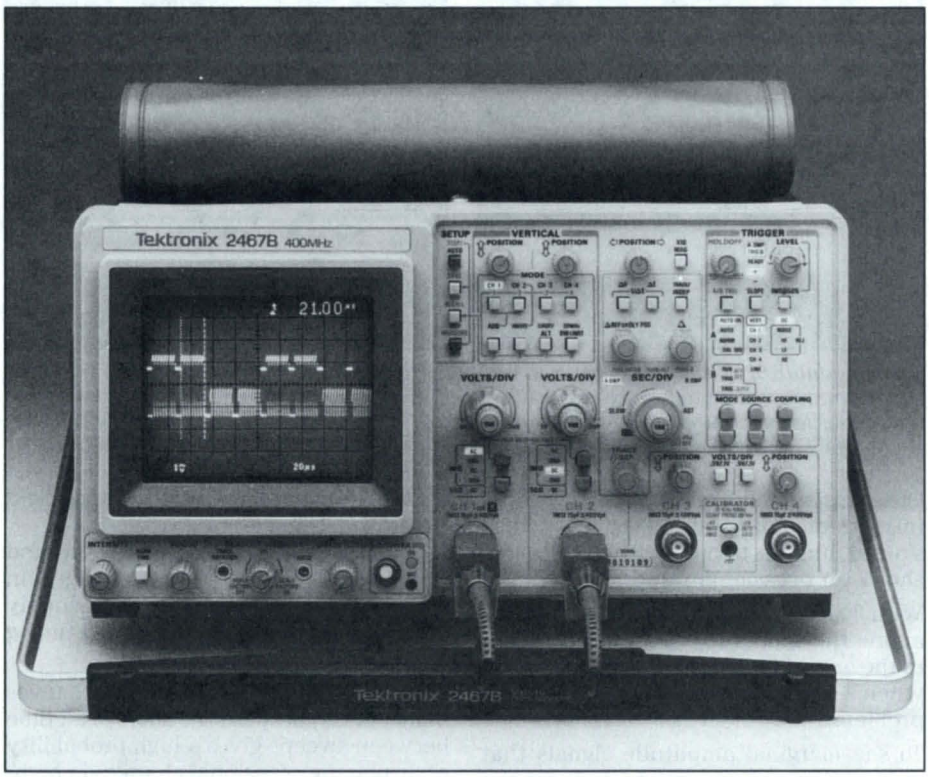




5. Time A to B Channel-to-channel TIME is the most versatile of all the new pushbutton measurements. You have complete control of the triggering on channel-to-channel timing measurements. Start and stop events can be set in percent of peak-to-peak or in volts—on either rising or falling edges of CH1 and CH2. Applications include measureing risetime from other than the standard 10% and 90% points, such as 20% and 80%.

True four-channel capability includes two channels optimized for logic signals. You can also make three-channel X-Y comparisons such as multiple transducer measurements.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.



NEW 2467B

GPIB IEEE-488

The 2467B Option 10 complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

• 4 ns/div Visual Writing Speed

4 ns/div visual writing speed—the advantage is visible!

Writing speed has traditionally been a measure of CRT performance. However, the performance of conventional CRTs is usually specified as *photographic writing speed* and represents the point at which phosphor luminance is adequate to record a waveform using a camera and high-speed film—but still *invisible* to the eye.

On the other hand, specifying *visual writing speed* identifies a scope as being able to emit enough light to be visible to the eye in normal room light without a viewing hood.

The Tek 2467B specifies CRT visual writing speed at 4 cm/ns. Most important, its single-shot and system bandwidths are the same, 400 MHz. For the first time with a portable instrument you can use *all* of its bandwidth in single-shot applications.

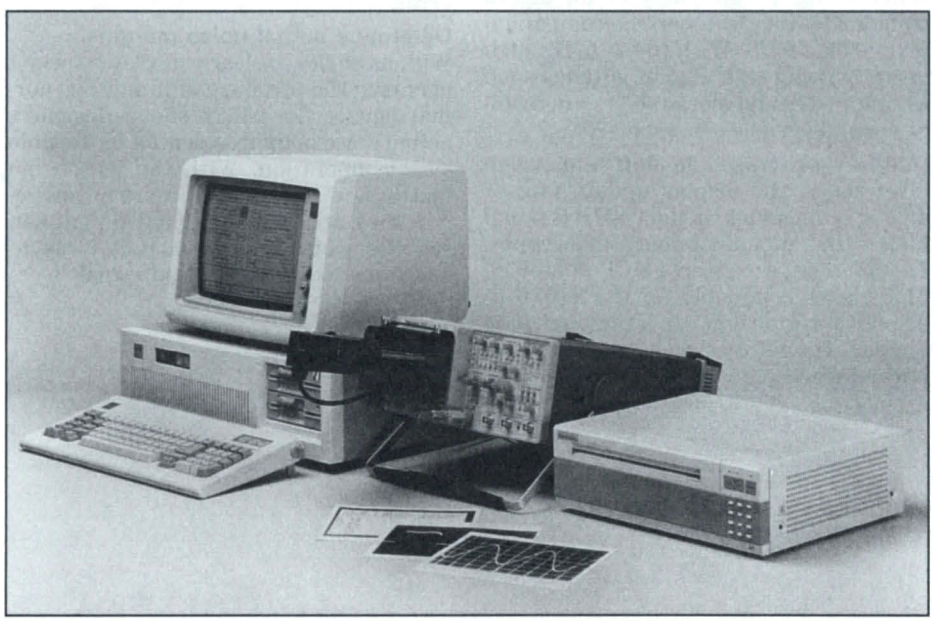
The visual writing speed of conventional analog scopes is inadequate to permit full-bandwidth, single-shot use.

Visual writing speed combined with the high display update rate of the 2467B provides the quick response and high visibility necessary to see faults in today's complex, high speed systems.

Observe faults you couldn't see before. The 2467B with microchannel-plate (MCP) CRT instantly reveals events other scopes fail to show. At 4 cm/ns, its *visual writing speed* is approximately 100 times faster than that of *any other portable instrument.* This makes it possible to see and identify circuit faults caused by erratic or infrequent events that may occur only once in a million normal cycles. Plus, these faults can be seen in normal room light, without a viewing hood.

Tek's exclusive microchannel-plate CRT. Tek's unique MCP display amplifies the intensity of infrequent signals, yet limits the intensity of signals with high-repetition rates. This results in visual writing speed sufficient to display everything that happens in your circuit, whether it occurs once or repetitively.

The 2467B displays glitches that remain hidden on scopes with conventional CRTs, and that digital storage scopes fail to capture because of low trigger probability. Being able to see unexpected transients, even within highly repetitive events, makes the critical difference in many troubleshooting situations.



The 2467B and Tek DCS01 Digitizing Camera System combine to give you 400 MHz single-shot capability along with up to 10 ps/point digitizing.

Digital design and test engineers, for example, now have an effective and affordable tool for identifying system faults caused by troublesome design bugs such as asynchronous noise, crosstalk, bus contention, marginal timing, metastability or a one-in-a-million anomaly. This helps shorten product design cycles—and deliver more reliable products.

Digitize, store and analyze waveforms on your IBM PC.

The Tektronix DCS01 (Digitizing Camera System) bridges the gap between your analog scope and PC. It easily and cost-effectively adds digitizing and signal processing capability to the 2467B. The scope's microchannel-plate CRT allows the capture of transient and repetitive signals at the full 400 MHz bandwidth with 8-bit resolution (12 bits on repetitive signals).

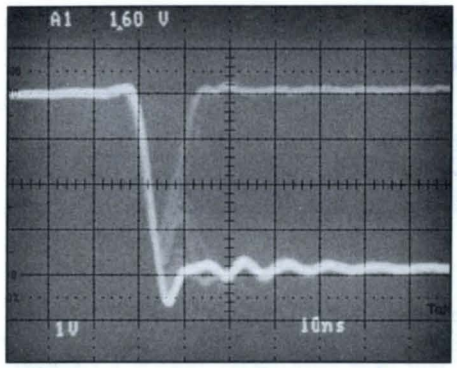
Add Tek Signal Processing and Display (SPD) software for 186 waveform analysis functions. Both DCS and SPD software are modular for solutions satisfying your unique requirements.

For additional information on DCS software see the Digitizer section. For SPD refer to the Test and Measurement Software section.

Find circuit problems in digital systems.

When troubleshooting a digital system, you want to see a fault immediately. When using a logic analyzer for digital troubleshooting, the perfect companion is the Tek 2467B. With the 2467B's high visual writing rate, digital glitches such as runt pulses and metastability are readily viewed—as they happen.

Due to short trigger holdoff and sweep reset times, the display update rate of analog scopes such as the 2467B is much higher than digital storage oscilloscopes. This plus Tek's exclusive MCP-enhanced CRT makes it possible for the 2467B to display intermittent variations *as they happen*, even if masked by thousands of normal traces.



The metastability in this high-repetition rate flip-flop output occurs only once in a million normal cycles, yet it is clearly visible thanks to the 2467B's high visual writing speed.

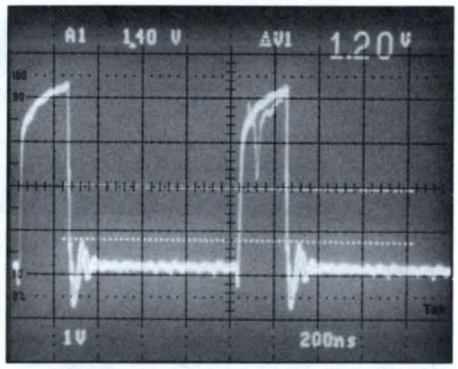
Other instruments may not display these infrequent faults at all or may take several minutes to build up a display that shows an occasional fault.

With 30 ns pretrigger display, you can examine the inputs to a logic device prior to the output transition. Seeing the inputs when a fault occurs can point to the real problem.

To see marginal amplitude signals that might otherwise go undetected, set the trigger level just above the low logic level or just below the high logic level. Trigger-level readout lets you set the trigger point where you want it, without trial and error.

Determine actual noise margins.

With its ability to clearly display transient events in the presence of numerous normal signals, the 2467B shows designers actual noise margins essential for reliable system operation. With the 2467B, no matter how infrequently noise pulses occur, they are clearly displayed. You can see the worst case even if it is asynchronous to the monitored signal.

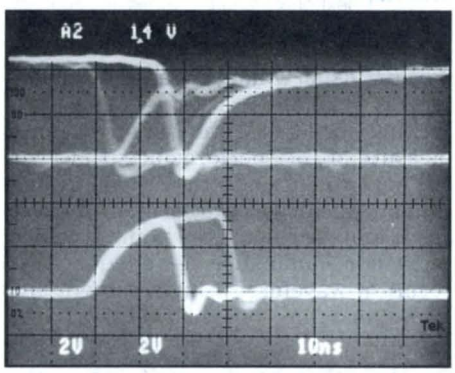


Cursors are set to indicate input threshold limits. The high visual writing speed of the 2467B easily shows this infrequent glitch narrowly missing the upper threshold limit.

Measure worst-case setup and hold times.

Digital systems rely on valid setup and hold times. Noise, timing changes in various system states, and power-supply coupling—all can cause infrequent timing violations.

The 2467B lets you see timing changes immediately, because the short dead time between sweeps gives a high probability of displaying occasional changes in high-repetition rate signals. Other instruments may require long periods to construct a display, if they can show the variations at all.



In this display, the data (upper trace) occasionally moves into coincidence with the rising edge of the clock (lower trace), violating the timing margin. Also note the occasional change in clock pulse width.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

2465B Special Packages—Preconfigured Packages That Fit Specific Needs

Your choice of 2400B Series portables also includes three 400 MHz 2465B Special Editions: the 2465BCT, 2465BDM, and 2465BDV.

Substantial Savings

As preconfigured packages, Special Editions offer significant savings over the cost of individual enhancements. You get multi-instrument capabilities while reducing rack space, equipment cost and programming complexity.

Common to the 2465BCT, 2465BDM and 2465BDV is the GPIB interface which makes each a perfect systems choice. All front-panel controls are programmable.

The 2465BCT with CTT-Word Recognizer is ideal for making the precise timing measurements needed with communications, office and computer-related equipment.

The 2465BDM has the CTT-Word Recognizer *and* a digital multimeter that extends its applications as a self-contained, multipurpose instrument in government/military electronics, avionics, and ATE stations.

The 2465BDV has the CTT-Word Recognizer, the digital multimeter, *plus* video waveform display capability for even more extensive applications—including the design, manufacture and service of raster scan devices and high-resolution video equipment.

Options for the 2467B, 2465B, 2455B, and 2445B

Option 01 Digital Multimeter
Option 05 Video Waveform Measurement System
Option 06 Counter/Timer/Trigger (CTT)
Option 09 CTT with Word Recognizer
Option 10 GPIB Interface
Option 1E External Clock
Option 1R Rackmounting
Option 2R Rackmount for Opt. 01

Descriptions for each of the options begin on the following page.

Features	2467B	2465BDV	2465BDM	2465BCT	2465B	2445B
Bandwidth	400 MHz	400 MHz	400 MHz	400 MHz	400 MHz	150 MHz
High Visual Writing Speed	STD	—	—	—	—	—
GPIB	OPT	STD	STD	STD	OPT	OPT
Counter/Timer/Trigger-Word Recognizer	OPT	STD	STD	STD	OPT	OPT
Digital Multimeter	N/A	STD	STD	N/A	OPT	OPT
Video Trigger	OPT	STD	N/A	N/A	OPT	OPT
Counter/Timer/Trigger (w/o Word Recognizer)	OPT	STD	STD	STD	OPT	OPT
Probes	4	4	4	4	2	2
Rackmount	OPT	OPT	OPT	OPT	OPT	OPT
Warranty	Three years on parts and labor, including the CRT					

Digital Multimeter

Option 01

FEATURES

- **4½ Digit Autoranging Digital Multimeter**
- **True RMS AC Volts From 20 Hz to 100 kHz**
- **True RMS AC Current From 20 Hz to 10 kHz**
- **10 μV Resolution on DC Volts**
- **Continuity Beeper**
- **UL Listed, CSA Certified**
- **Temperature Probe −62 to +230°C**
- **Calibration via Front Panel Without Removing Instrument Covers**
- **Convenience Features Include: Set Reference, Hold, Smooth, Minimum/Maximum, dBV, and dBm**

The 2465B/2445B's Digital Multimeter (Option 01) makes it possible to measure dc and ac (RMS) volts and current, dBm, dBV, resistance, and temperature at your workbench with no added space requirements. Carry everything you need into the field for maintenance and repair, all in one rugged, portable package. Plug a DMM-equipped 2465B/2445B into your system (rack-mounting is optional as a modified product) to take advantage of its fully programmable measurements and screen prompts.

Blocks of accumulated measurements can be averaged and smoothed. Minimum and maximum values can also be displayed. Set a reference function if, for example you need to compare deviations from a norm. Audible continuity checking is useful for applications in service, production, and design/development. Troubleshoot circuit board hot spots with the temperature probe, which registers temperature variations with 0.1 °C or °F resolution.

Combining the DMM and CTT options allows direct measurement of system frequency, period, or time interval while monitoring ac or dc volts, current, or temperature. Use just one instrument to characterize voltage-to-frequency converters and temperature drift of crystal oscillators.

Video Waveform Measurement System

Option 05

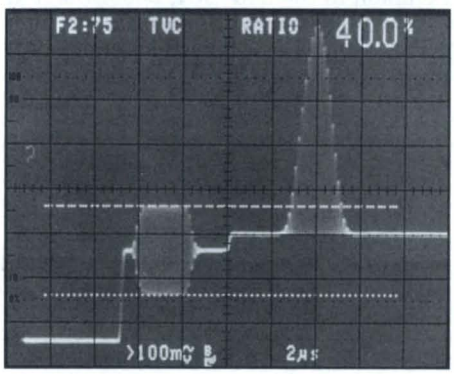
FEATURES

- **Television Waveform Analysis Capabilities**
- **Selectable System-M and Nonsystem-M Protocols**
- **Selectable Triggering on Any Line Within a Field, With Line-Number Readout**
- **Compatible With Composite Video Having 13.1 to 77 kHz Line Rates**
- **TV Blanking-Level Clamp (Back-Porch)**
- **Optimized Vertical Response Comparable to High Performance TV Waveform Monitors**

Video measurement capabilities extend the 2467B/2465B/2445B's power and versatility to meet the challenges in broadcast and cable television, graphics displays, and raster-scan systems. The Video Waveform Measurement System makes quality measurements convenient during every stage of a product's life cycle: design, production, system calibration, quality assurance, maintenance and service.

With CRT readout of the line number and field selected for triggering, an operator knows precisely what the display represents. Any line can be selected from Field 1, Field 2, or Field 1 alternating with Field 2. The fourth video trigger selection is Lines, which superimposes all the lines in both fields. Systems with up to 1280 lines can be accommodated.

The back-porch clamp locks the video black level to a fixed point, so the display is stable and clean, even when the composite video contains low-frequency hum or when the average picture level changes with ac coupling. Controls are provided for compatibility with a wide variety of system protocols.

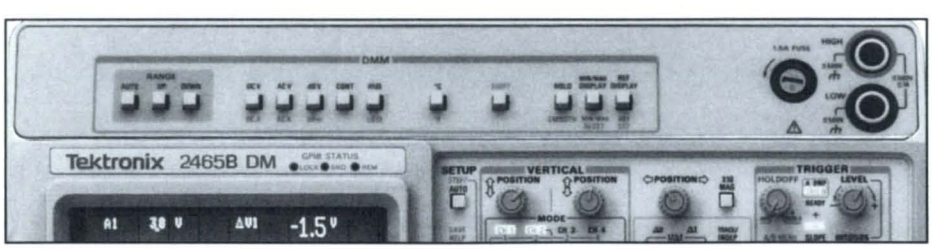


This sample waveform and CRT readout show a 2445B's high-fidelity display and measurement of the color subcarrier amplitude on Line 75, Field 2 of an NTSC signal with the television blanking-level clamp (TVC) engaged. The cursor readout of 40% is interpreted as 40 IRE units with appropriate adjustment of the vertical gain.

Counter/Timer/ Trigger (CTT)

Option 06

Option 06 provides the Counter/Timer/ Trigger without the word recognizer probe. Specifications and included accessories are the same as those for Option 09. The Word Recognizer cannot be added to Option 06 after delivery of the oscilloscope (field retrofit kits are not available.)



Digital Multimeter

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

Counter/Timer/Trigger (CTT) with Word Recognizer (WR)

Option 09

FEATURES

- **Crystal-Controlled Time Base**
- **0.001% Accuracy**
- **Totalize Up to 9,999,999 Events**
- **Delay-by-Events Triggering up to 4,194,303 Events**
- **Boolean Logic Triggering on both Digital and Analog Signals**
- **17-Bit Word-Recognizer Probe**

Option 09 delivers the crystal-controlled timing accuracy and the extra triggering power you need for digital systems. Frequency and period are measured directly from any vertical channel. Time intervals can also be measured by the counter, with ease. The delayed sweep (B sweep) trigger has been expanded to select independent signal sources, slopes, and levels for the beginning and ending of a time interval. This expansion allows precise time measurements between two events, each with different characteristics (using the same or separate channels). This new capability provides for measurement of propagation delay (through a level shifter or an amplifier), as well as rise time, fall time, or processor power-up delay.

When saved in the scope's setup memory, recalled measurements are completely automatic and require no operator intervention.

With the Word Recognizer, any pattern of up to 17 bits can act as an input to the counter or as a trigger for the A or B sweep.

Pinpointing a "needle-in-a-haystack" signal in a digital system becomes feasible with the Word Recognizer and Delay-by-Events functions as these advanced triggering capabilities eliminate extraneous signals.

To characterize system problems, the CTT can measure the frequency or period of recognized words. The CTT can also delay the scope trigger by a selected number of words.

With the Totalize function, you can record the passing of unusual events or verify a burst of events on any vertical input or recognized word.

The Boolean-logic trigger allows triggering on either the logical AND or OR of any two input channels. Logical-OR triggering lets you trigger on either the positive or negative slope of any input signal. This function, known as "bislope triggering," allows you to catch events reliably— even if you don't know whether the transition will be high-to-low or low-to-high.

The Counter/Timer/Trigger is also available without the Word Recognizer probe as Option 06.

Rackmounting

Option 1R

The 2467B/2465B/2445B instruments are available in standard 19-inch rackmount configuration, complete with slide-out chassis tracks.

GPIB Interface

Option 10

GPIB IEEE-488 Bus Interface complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

FEATURES

- **Remote Control of Front Panel**
- **Functions Selectable at Front Panel: Device Address, Talk/Listen Mode, Message Terminator**
- **Front-Panel Status Indicators: REM (Remote), SRQ (Service Request), LOCK (Local Lockout)**
- **Compatible With All Other 2467B/2465B/2445B Options**
- **User-Generated SRQ: To Signal Controller During Program Control**
- **RQS Control: Optional Enable or Disable of SRQ Reporting**

Network the 2467B/2465B/2445B with your other equipment on the GPIB. Option 10 adds the ability to communicate over the GPIB. Contents of setup memory can be transferred between 2467B/2465B/2445B units without an external controller. Or use a host controller to assist the oscilloscope operator in performing a series of checks and measurements. Front-panel settings can be remotely set or changed, and the results of cursor, DMM, and CTT measurements communicated back over the bus to the controller, and displayed on the scope's CRT.

The 2467B/2465B/2445B GPIB-message structure conforms to Tektronix *Standard Codes and Formats*, ensuring that all GPIB messages are "human readable" and consistent in format. Selectable message termination characters allow scope use with most types of controllers. The new 2445B and 2465B are compatible with programs for their predecessors, the 2445A and 2465A.

Tektronix software development packages provide an environment for quickly and easily generating automated and semi-automated test procedures. Not only are they easy for nonprogrammers to use, they substantially reduce the amount of time required to create a test-program using previous programming methods and languages.

TEK EZ-TEST and EZ-TEK 2400 are automatic test program generators designed for use with the Tek PEP 301 controller. EZ-TEK 2400 PC runs on the IBM PC, XT, and AT. The TEK EZ-TEST generator programs the PEP 301 or other MS DOS systems to drive a wide variety of GPIB-compatible equipment. EZ-TEK 2400 is designed for systems that need only the capabilities found in 2467B/2465B/2445B oscilloscopes and their options. None of these generators require previous GPIB programming experience because they use simple, multilevel menus to develop sophisticated test programs.

The Tek GPIB User's Resource Utility (GURU II) is a utility package for IBM PCs. It includes a GPIB interface board for the PC, GPIB cable, software and instruction manual.

For more information on GURU II, see the Test and Measurement Software section.

External Clock

Option 1E

The External Frequency Reference option (Option 1E) offers frequency measurements with eight-digit resolution. Accuracy is equal to the external reference or one count in the Least Significant Digit of the eight-digit readout, whichever is greater.

Option 1E automatically accepts any one of the following frequencies as the external reference:

1.000000 MHz
3.579545 MHz (color burst frequency for video)
4.4331875 MHz
5.000000 MHz
10.000000 MHz

CHARACTERISTICS

Characteristics are common to the 2467B, 2465B, 2455B, 2445B and 2465B Special Editions except where indicated.

VERTICAL SYSTEM

Display Modes—CH 1, CH 2, CH 3, CH 4, Add (CH 1+CH 2); Invert (CH 2 only); Alternating and Chopped display switching for all channels, and 20 MHz bandwidth limiting.

CHANNEL 1 AND CHANNEL 2

Deflection Factor—2 mV/div to 5 V/div in a 1-2-5 sequence of 11 steps.

Deflection Factor Basic Accuracy—±2% (measured at a Volts/div setting with a four- or five-division signal, centered on screen)

ΔV Accuracy—±(1.25% of reading+0.03 div+signal aberrations). Basic accuracies apply for temperatures from +15 to +35°C. Add ±2% of reading for temperatures from −15 to +15°C and from +35 to +55°C. Add 1% of reading when 50 Ω input coupling is used. Add 1% of Channel 2 reading when inverted (measured with cursors anywhere on the graticule).

Variable Range—Continuously variable between Volts/div switch settings. Extends deflection factor to at least 12.5 V/div.

Frequency Response (−3 dB Bandwidth)

Instrument	15 to 35°C	−15 to +15°C 35 to 55°C
2467B/2465B	400 MHz*1 350 MHz*2	300 MHz —
2455B	250 MHz	200 MHz
2445B	150 MHz	150 MHz

All responses measured with standard accessory probe or internal 50 Ω termination.

1 ≥5 mV/div
2 2 mV/div

AC Coupled Lower −3 dB Point—10 Hz or less. 1 Hz or less.

Step Response—2467B/2465B: ≤1 ns. (≥5 mV/div:0.875 ns). 2455B: ≤1.4 ns. 2445B: ≤2.33 ns. (Rise times calculated from $t_r = 0.35/BW$.)

Common-Mode Rejection Ratio (Add Mode With CH 2 Inverted)—≥20:1 at 50 MHz for common-mode signals of 8 div or less, with Var Volts/div control adjusted for best CMRR at 50 kHz at any Volts/div setting.

Channel Isolation—≥100:1 attenuation of deselected channel at 100 MHz; ≥50:1 at nominal bandwidth. (Measured with an 8-div input signal and equal Volts/div switch settings on both channels from 2 to 500 mV/div.)

Displayed CH 2 Signal Delay With Respect to CH 1 Signal—Adjustable through a range of at least ±500 ps.

Input Z (1 MΩ)—1 MΩ ±0.5% shunted by 15 pF, ±2 pF. Maximum Input Voltage: 400 V (dc+peak ac); 800 V p-p ac at 10 kHz or less with coupling set to AC, DC, GND.

Input Z (50 Ω)—50 Ω ±1%. VSWR (2467B/2465B): ≤1.3:1 from dc to 300 MHz; ≤1.5:1 from 300 to 350 MHz. VSWR (2455B/2445B): ≤1.3:1 from dc to nominal bandwidth. Maximum Input Voltage: 5 VRMS, averaged for 1 s; ±50 V peak.

CHANNEL 3 AND CHANNEL 4

Deflection Factor—100 and 500 mV/div ±10%.

Frequency Response—Same as Channel 1 and Channel 2. (Responses measured only with standard probe.)

Step Response—Same as Channel 1 and Channel 2.

Signal Delay Between CH 1 and Either CH 3 or CH 4—±1.0 ns. (Measured at 50% points.)

Input Z—1 MΩ±1%, shunted by 15 pF±3 pF.

Maximum Input Voltage—400 V (dc+peak ac); 800 V p-p ac at 10 kHz or less.

Channel Isolation—≥50:1 attenuation of the deselected channel at 100 MHz. (Measured with an 8-div input signal.)

ALL CHANNELS

Bandwidth Limiter—Reduces upper 3 dB bandpass to a limit of 13 to 24 MHz.

Vertical Signal Delay—≥30 ns of sweep displayed before triggering event displayed with Sec/div settings ≥10 ns/div. ≥10 ns of sweep displayed before triggering event displayed with Sec/div set to 5 ns.

CHOP Mode Switching Rate—2.5 MHz±0.2% to sec/div settings of 20 to 2 μs/div; 1 MHz±0.2% all other sweep speeds. (The complete display cycle rate equals the CHOP mode switching rate divided by the number of channels displayed. The CHOP mode switching rate is modulated slightly to minimize waveform breaks with repetitive signals.)

HORIZONTAL SYSTEM

Display Modes—A (main sweep), A INTENSified, ALTernate A Intensified with B (delayed sweep), and B. In X-Y mode, Channel 1 provides X-axis (horizontal) deflection.

A Sweep Time Base Range—2467B/2465B: 500 ms/div to 5 ns/div in a 1-2-5 sequence of 25 steps. (X10 magnification extends fastest sweep rate to 500 ps/div.) 2455B and 2445B: 500 ms/div to 10 ns/div in a 1-2-5 sequence of 24 steps. (X10 magnification extends fastest sweep rate to 1 ns/div.)

B Sweep Time Base Range—2467B/2465B: 50 ms/div to 5 ns/div in a 1-2-5 sequence of 22 steps. (X10 magnification extends fastest sweep rate to 500 ps/div) 2455B/2445B: 50 ms/div to 10 ns/div in a 1-2-5 sequence of 21 steps. (X10 magnification extends fastest sweep rate to 1 ns/div.)

Variable Timing Control—Continuously variable and calibrated between sec/div settings. Extends slowest A sweep speed to 1.5 s/div.

ΔT Readout Resolution—2467B/2465B: Either 10 ps or 0.025% of full scale, whichever is greater. 2455B/2445B: Either 20 ps or 0.025% of full scale, whichever is greater

Sweep Delay Range—0 to 9.95 times the A sec/div setting, for settings from 500 ms/div to 10 ns/div (2467B/2465B) or from 500 ms/div to 20 ns/div (2455B/2445B). With A sec/div settings of 50 μs and faster, the A Sweep triggering event is observable on the B Sweep with zero delay setting.

Delay Jitter—2467B: Within 0.01% (one part or less in 10,000) of maximum available delay, plus 100 ps. 2465B/2455B/2445B: Within 0.004% (one part or less in 25,000) of maximum available delay, plus 50 ps.

ACCURACY SPECIFICATIONS FOR AUTOMATIC MEASUREMENTS*12

Period—0.5%+500 ps.

Volts—(5% +5 mV +1 LSD) to 1 MHz

Rise Time, Fall Time—5% +3 ns (for transition times greater than 10 ns). These rise and fall times are based on measurements at 20% and 80% extrapolated to 10% and 90%. Pulse overshoot, undershoot <5% of peak-to-peak signal.

Time A-B (from % to %)—0.5% +3 ns (add 0.5 ns if measuring from Ch 1 to Ch 2) +5% of start event and 5% of stop event transition times.

Time A-B (between two voltages)—0.5% +3 ns (add 0.5 ns if measuring from Ch 1 to Ch 2) +5% of start event and 5% of stop event transition times. Voltages must not be within 10% of either peak.

Pulse Width—0.5% +1 ns (transition times <10% of measured interval).

*1 *Based on noise less than 0.1% of Peak-to-Peak input signal.*
*2 *15 to 35°C.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

TRIGGERING

Trigger Sensitivity From CH 1 or CH 2 Source—DC Coupled: 0.35 div from dc to 50 MHz. Noise Reject Coupled: ≤1.2 div. HF Reject Coupled: 0.5 div from dc to 30 kHz from dc to 50 MHz. LF Reject Coupled: 0.5 div from 80 kHz to 50 MHz. AC Coupled: 0.35 div from 60 Hz.

Above 50 MHz: Triggering signal requirement increases to 1.5 div at 500 MHz (for 2467B, 2465B, and 2455B) and at 250 MHz (for 2445B) with dc, LF Reject, and ac coupling. For Noise-Reject coupling above 50 MHz, triggering signal requirement increases to 3 div @300 MHz and to 4.5 div at 500 MHz (for 2467B, 2465B, and 2455B) and at 250 MHz (for 2445B).

Trigger Sensitivity From ADD Source—2467B/2465B/2455B: Add 0.5 div to CH 1 or CH 2 source requirements at 500 MHz.

Trigger Sensitivity From CH 3 or CH 4 Source—2467B/2465B/2455B: One-half the CH 1 or CH 2 source requirements.

Maximum P-P Signal Rejected by Noise-Reject Coupling Within Vertical Bandwidth—CH 1 or CH 2 Source: ≥0.4 div (with Volts/div settings of 10 mV/div and higher. Maximum noise amplitude rejected is reduced at 2 and 5 mV/div settings). CH 3 or CH 4 Source: ≥0.2 div.

Level Control Range—CH 1 or CH 2: ±18 ×Volts/div setting; CH 3 or CH 4: ±9 ×Volts/div setting.

Level Readout Basic Accuracy—CH 1 or CH 2 Source: ±[3% of Level setting+3% of p-p signal+0.2 div+0.5 mV+(0.5 mV×probe attenuation factor)]. CH 3 or CH 4 Source: ±[3% of setting+4% of p-p signal+0.1 div+(0.5 mV ×probe attenuation factor)]. Basic accuracies apply from +15 to +35°C and are measured with triggering signals having transition times greater than 20 ns and dc trigger coupling. Add 1.5 mV×probe attenuation factor for temperatures from −15 to +15°C and from +35 to +55°C. Add ±1% of setting from 50 Ω input coupling. Add ±1% of setting with CH 2 Inverted. Add ±0.6 div for CH 1 or CH 2 Source with Noise Reject trigger coupling. Add ±0.3 div for CH 3 or CH 4 Source with Noise Reject trigger coupling.

Maximum Triggering Signal Period

A Sec/div Setting	AUTO LVL Mode	AUTO Mode
<10 ms	≥20 ms	≥80 ms
10 ms to 50 ms	≥4 times A sec/div	≥16 times A sec/div
>50 ms	≥200 ms	≥800 ms

Timing Accuracy

Parameter	For 100 ms/div and Faster Settings: 15 to 35°C	−15 to +15°C 35 to 55°C
Unmagnified		
A Sweep*1	±(0.7% of time interval +0.6% of full scale)	±(1.2% of time interval +0.6% of full scale)
ΔT Using Cursors*2	±(0.5% of time interval +0.3% of full scale)	±(0.7% of time interval +0.3% of full scale)
ΔT Using Sweep Delay*3	±(0.3% of time interval +0.1% of full scale)+200 ps	±(0.5% of time interval +0.1% of full scale)
Delay*4	±(0.3% of delay setting +0.6% of full scale) +(0 to −25 ns)	±(0.5% of delay setting +0.6% of full scale) +(0 to −25 ns)
Magnified		
A Sweep*5	±(1.2% of time interval +0.6% of full scale)	±(1.7% of time interval +0.6% of full scale)
ΔT Using Cursors*5	±(1.0% of time interval +0.3% of full scale)	±(1.2% of time interval +0.3% of full scale)

For the A sec/div settings of 200 ms and 500 ms, add ±0.5% of time interval or delay setting to preceding specifications.

*1 *Intervals are measured on center horizontal graticule line, and 0.6% of full scale is 0.06 division.*

*2 *Intervals are measured anywhere on the graticule.*

*3 *Intervals are measured with both delays at 1% or more of full scale from minimum delay (no "?" displayed in readout).*

*4 *Delay is from A Sweep trigger point to start of B Sweep.*

*5 *Exclude the first 0.5 division after sweep starts (first 0.5% of the full 100 division sweep).*

B Sweep Timing Accuracy—Add ±0.3% of time interval to the A Sweep Timing accuracy specifications for Sweep and for ΔT Using Cursors.

Variable Timing Accuracy—Add 2% of time interval to Timing Accuracy specifications for sweep when VAR control is out of detent.

X-Y OPERATION

X-Axis Deflection Factor Range, Variable Range, and Accuracy—Same as Channel 1.

X-Axis Bandwidth—DC to 3 MHz.

Input Z—Same as Channel 1.

Phase Difference Between X and Y (With Bandwidth Limiting Off)—≤1° from dc to 1 MHz. ≤3° from 1 to 2 MHz.

Z-AXIS INPUT

Sensitivity—DC to 2 MHz: Positive voltage decreases intensity; +2 V blanks a maximum intensity trace. 2 to 20 MHz: +2 V modulates a normal intensity trace.

Input Resistance—9 kΩ ±10%.

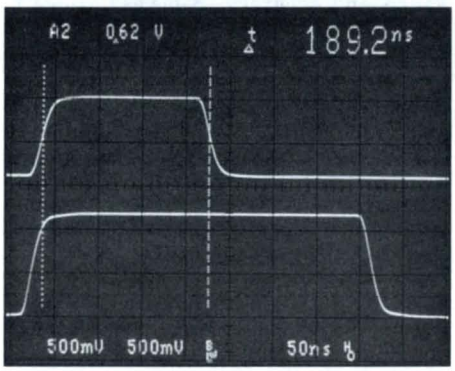
Maximum Input Voltage—±25 V peak; 25 V p-p ac at 10 kHz or less.

SIGNAL OUTPUTS

CH 2 Signal Out—Voltage: 20 mV/div ±10% into 1 MΩ. 10 mV/div±10% into 50 Ω. Offset: ±20 mV into 1 MΩ after dc balancing within ±5°C of the operating temperature.

A Gate Out and B Gate Out—Voltage: 2.4 V to 5 V positive-going pulse, starting at 0 V to 400 mV. Drive: Supplies 400 μA during high state; sinks 2 mA during low state.

CRT READOUT AND WAVEFORM INFORMATION



Your eyes never have to leave the screen to obtain front-panel settings and measurement results. In the CRT example above, the top area of the display provides trigger source, trigger voltage level, and Δtime results. The lower area displays the selected volts/div and seconds/div scale factors and that bandwidth limit and holdoff are activated.

CRT AND DISPLAY FEATURES

Standard CRT—2467B: 68×85 mm. 2465B/2455B/2445B: 80×100 mm (8×10 cm). Markings: Eight major div vertically and 10 major div horizontally, with auxiliary markings.
Standard Phosphor—GH (P31).
Visual Writing Speed—(2467B) With 20 lux=. Illumination Normal to CRT Faceplate (typical room light): ≥4 cm/ns (at maximum INTENSITY control setting).
Photographic Writing Speed—(2467B) ≥10 div/ns with C-30 Series camera and ISO 3000 film, without prefogging. (A single-shot trace of instrument rise time at 500 ps/div is recorded with high contrast at f/1.9.)
Display Intensity Limitation—(2467B) Display intensity is automatically reduced and eventually extinguished after periods of no front panel control activity. Operating any switch or the Intensity control restores the selected intensity setting.

POWER REQUIREMENTS

Line Voltage Ranges—115 V: 90 to 132 V ac; 230 V: 180 to 250 V ac.
Line Frequency—48 to 440 Hz.
Maximum Power Consumption—120 W (180 V ac) for fully-optioned instrument.
Fuse Rating—Either 2 A, 250 V, AGC/3AG, fast-blow or 1.6 A, 250 V, 5×20 mm, quick-acting (Each fuse type requires a different cap.)
Primary Circuit Dielectric Voltage Withstand Test—1500 V rms, 60 Hz, for 10 s without breakdown.
Primary Grounding—Type test to 0.1 Ω maximum. (Routine test to check grounding continuity between chassis ground and protective earth ground.)

ENVIRONMENTAL AND SAFETY

Environmental requirements qualify the electrical and mechanical specifications. When not rack mounted, the instrument meets the environmental requirements of MIL-T-28800C for Type III, Class 3, Style C equipment (humidity and temperature requirements defined in paragraphs 3.9.2.2, 3.9.2.3, and 3.9.2.4).
Ambient Temperature—Operating: −15° to +55°C. Nonoperating: −62° to +85°C.
Altitude—Operating: To 4600 m (15,000 ft). Maximum operating temperature decreases 1°C for each 1,000 ft above 1500 m (5,000 ft). Nonoperating: To 15,000 m (50,000 ft).
Vibration—Operating: 15 minutes along each of three axes at a total displacement of 0.025 inch p-p (4 g's at 55 Hz), with frequency varied from 10 to 55 Hz in one-minute sweeps. Held 10 minutes at each major resonance, or if none existed, held 10 minutes at 55 Hz (75 minutes total test time).
Packaged Transportation Vibration—Meets the limits of the National Safe Transit Association Test Procedure 1A-B-1; excursion of 1 inch p-p at 4.63 Hz (1.1 g) for 30 minutes per Tektronix Standard 062-2858-00.
Humidity—Operating and Nonoperating: Stored at 95% relative humidity for 5 cycles (120 hours) from +30° to +60°C, with operational performance checks at +30° and +55°C.
Shock—Operating and Nonoperating: 50 g's, half-sine, 11-ms duration, three shocks on each face; total of 18 shocks.
Electromagnetic Compatibility—Meets requirements of the following standards: MIL-T-28800C; MIL-STD-461B Part 4 (CE-03 and CS-02), Part 5 (CS-06 and RS-02), and Part 7 (CS-01, RE-02, and RS-03), limited to 1 GHz; VDE 0871 Category B; FCC Rules and Regulations Part 15, Subpart J, Class A; and Tektronix Standard 062-2866-00.
Electrostatic Discharge Susceptibility—Instrument does not change control states with discharges of less than 10 kV. Meets requirements of Tektronix Standard 062-2862-00.
Radiation—Meets requirements of Tektronix Standard 062-1860-00.
Safety—UL listed (UL 1244) and CSA certified (CSA 556B).
Drip Proof—With Cover On: Meets MIL-T-28800C para 4.5.5.5.3.
Transit Drop—Not in Shipping Package: 8-inch drop on each corner and each face (MIL-T-28800C, para 4.5.5.4.2).
Packaged Transportation Drop—Meets the limits of the National Safe Transit Association Test Procedure 1A-B-2; 10 drops of 36 inches per Tektronix Standard 062-2858-00.
Bench Handling—With and Without Cabinet Installed: MIL-STD-810C, Method 516.2, Procedure V (MIL-T-28800C, para 4.5.5.4.3).
Ordering Information—See page 170.

PHYSICAL CHARACTERISTICS

	2467B		2465B/2445B		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**
Width w/handle	338	13.3	338	13.3	483	19.0
Height w/feet, pouch	190	7.5	190	7.5	178	7.0
w/o pouch	160	6.3	160	6.3		
Depth w/front cover	472	18.6	434	17.1	419	16.5
handle extended	533	21.0	508	20.0		
Weight ≈	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
Net w/accessories and pouch	10.9	24.0	10.2	22.5	4.0*[1]	8.8*[1]
w/o accessories and pouch	9.3	20.5	9.3	20.5		
Shipping	14.6	32.1	12.8	28.2	6.3*[1]	13.8*[1]

*[1] *Weight of conversion kit only. Rear support kit weight is an additional 6.3 kg (13.8 lb).*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

CHARACTERISTICS

DIGITAL MULTIMETER (OPTION 01)

This option is unavailable for the 2467B. The set of characteristics is the same as specified for all other standard 2445B/2465B oscilloscopes and includes the following additions:

All accuracy specifications are stated with an operating temperature range of +18° to +28°C and a relative humidity of 95% or less.

DC VOLTAGE

Ranges—200 mV, 2 V, 20 V, 200 V, 500 V.
Resolution—1 part in 20,000 of FS, (except 0.1 V on 500 V range).
Accuracy—±(0.03% of reading +0.01% of full scale). For 500 V range ±(0.03% of full scale).
Input Resistance—1 GΩ or 10 MΩ on the 200 mV and 2 V ranges, 10 MΩ ±1% on the higher ranges. (Resistance can be changed to 10 MΩ on all ranges.)
Normal-Mode Rejection Ratio—≥ 60 dB at 50 and 60 Hz.
Common-Mode Rejection Ratio—>100 dB at dc; >80 dB at 50 and 60 Hz with 1 kΩ imbalance.
Maximum Input Voltage—500 V RMS; 700 V peak between inputs and ground.
Response Time—<2 s in Auto, <1 s in Manual.

AC RMS VOLTAGE

Ranges—200 mV, 2 V, 20 V, 200 V, 500 V.
Resolution—10 μV (4½ digits).
Accuracy—±(% of reading + % of full scale).

Input Frequency	200 mV to 200 V	500 V
20 to 40 Hz	±(0.7% +0.1%)	±(0.7% +0.2%)
40 Hz to 10 kHz	±(0.3% +0.1%)	±(0.3% +0.2%)
10 to 20 kHz	±(0.7% ±0.1%)	±(0.7% +0.2%)
20 to 100 kHz	±(5%+0.1%)	±(5%+0.2%)

Crest Factor—≤4 at full scale.
Common-Mode Rejection Ratio—≥60 dB at 50 and 60 Hz with 1 kΩ imbalance.
Response Time—<3 s in Auto, <2 s in Manual.
Input Impedance—1 MΩ in parallel with <100 pF.
Maximum Input Voltage—500 V RMS; 700 V peak between inputs and ground, not to exceed 10^7 V-Hz product.
dBV, dBm—Calculated reading of ac voltage measurements. dBV equals 20 Log (V_{UNK}/1 V). dBm is referenced 1 mW into 600 Ω.

HI Ω RESISTANCE

Ranges—2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, 20 MΩ.
Accuracy—±(0.1% of reading +0.01% of full scale) for 2 kΩ to 2 MΩ. ±(0.4% of reading) for 20 MΩ. Add 2% of reading for each 10% Relative Humidity above 70% when in 2 and 20 MΩ ranges.
Maximum Input Voltage—500 V RMS; 700 V peak.
Full-Scale Voltage—2 V.
Open-Circuit Voltage—<6V
Resolution—0.1 Ω (4½ digits).
Response Time—<2 s in Auto, <1 s in Manual, <5 s in 20 MΩ range.

LO Ω RESISTANCE

Ranges—200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ.
Accuracy—±(0.1% of reading +0.01% of full scale) for 200 Ω range. Subtract (0.09% of full scale) for 2 to 200 kΩ ranges. Add (0.15% of reading) and subtract (0.09% of full scale) for 2 MΩ range. Add 2% of reading for each 10% Relative Humidity above 70% when in 200 kΩ and 2 MΩ ranges.
Maximum Input Voltage—500 V RMS; 700 V peak.
Full-Scale Voltage—0.2 V.
Open-Circuit Voltage—<6 V.
Resolution—0.01 Ω
Response Time—<2 s in Auto, <1 s in Manual.
Continuity—An audible tone indicates <10 Ω. Reponse time is ≈0.1 s.

DC CURRENT

Ranges—100 μA, 1 mA, 10 mA, 100 mA, 1 A.
Accuracy—±(0.1% of reading +0.02% of full scale).
Burden Voltage—<150 mV up to 100 mA increasing to <500 mV at 1 A.
Resolution—10 nA.
Response Time—<2 s in Auto, <1 s in Manual.

AC (RMS) CURRENT

Ranges—100 μA, 1 mA, 10 mA, 100 mA, 1 A.
Accuracy—±(0.6% of reading +0.1% of full scale) from 20 Hz to 10 kHz.
Burden Voltage—<150 mV up to 100 mA increasing to <500 mV at 1 A.
Resolution—10 nA.
Response Time—<3 s in Auto, <2 s in Manual.

TEMPERATURE

Range—−62° to +230°C.
Accuracy—±(2% of reading +1.5°C).
Resolution—0.1°.
Readout—Selectable in either °C or °F.

OTHER CHARACTERISTICS

Reading Rate—Three readings/s nominal except 1.5 readings/s on 20 MΩ range.
Temperature Coefficient—≤0.1 ×the accuracy specification/°C from −15 to +18°C and from +28 to +55°C.
GPIB Compatibility for Semiautomatic Measurement Systems—When combined with Option 10, the DMM (Option 01) oscilloscope combination is fully programmable. Complies with Tektronix *Standard Codes and Formats.*

Ordering Information—See page 170.

CHARACTERISTICS

VIDEO WAVEFORM MEASUREMENT SYSTEM (OPTION 05)

The set of characteristics is the same as specified for standard 2467B/2445B/2465B oscilloscopes and includes the following additions:

VERTICAL SYSTEM (CHANNEL 1 AND CHANNEL 2)

Frequency Response—Applicable for volt/div settings between 5 mV and 0.2 V with Var volt/div control in calibrated detent and using a 5 div, 50-kHz reference signal from a 50 or 75 Ω system.

Range	With Full BW
50 kHz to 5 MHz*1	±1%
>5 to 10 MHz	+1%, −2%
>10 to 30 MHz	+2%, −3%
>30 MHz	*1

*1 *With BW Limit operating, frequency response is +1%, −4% from 50 KHz to 50 MHz.*

Square wave Flatness—1% p-p for both 60 Hz and 15 kHz square waves, from a 50 or 75 Ω system using a 1.0 V input with a 50 mV/div setting and using a 0.1 V input at 20 mV/div setting. 1.5% p-p using a 0.1 V input with 5 and 10 mV/div settings. Exclude first 50 ns following step transition. For signals with rise times ≤10 ns, add 2% p-p between 155 and 165 ns after step transition.
Television Blanking-Level Clamp (Back-Porch) 60 Hz Rejection (CH 2 Only)—≥18 dB at 60 Hz; with calibrated Volt/div settings between 5 mV and 0.2 V, and a 6 div reference signal.
Television Blanking-Level Clamp (Back-Porch) Reference—Within 1.0 div of ground reference.

TRIGGERING

Sync Separation—Stable sync separation from sync-positive or sync negative composite video on systems with 525 to 1280 lines/frame, 50 or 60 Hz field rate, interlaced or noninterlaced scan.
Trigger Modes—LINES, FLD 1, FLD 2, and ALT (FLD 1-FLD 2).
Input Signal Amplitude for Stable Triggering—CH 1 and CH 2: 1.0 div for composite video and 0.3 div for composite-sync signals (dc+peak video-signal amplitude must be within 18 div of input ground reference).

CH 3 and CH 4: 0.5 div for composite video and 0.25 div for composite-sync signals (dc peak video-signal amplitude must be within 9 div of input ground reference).
GPIB Compatibility for Semiautomatic Measurement Systems—When combined with Option 10, the TV Waveform Measurement Systems (Option 05) oscilloscope combination is fully programmable. Complies with Tektronix *Standard Codes and Formats.*

CHARACTERISTICS

CTT (OPTION 06) CTT/WR (OPTION 09)

The set of characteristics is the same as specified for standard 2445B/2465B oscilloscopes and includes the following additions:

Sensitivity—Signal input requirements for Frequency, Period, Totalize, Delay-by-Events and Logic Trigger.

Input	Displayed Signal	Frequency Range
CH 1, CH 2	1.5 div	DC (0.5 Hz for Frequency and Period(to 50 MHz
CH 3, CH 4	0.75 div	
CH 1, CH 2	4.0 div	50 MHz to ≥150 MHz
CH 3, CH 4	2.0 div	

Source—A trigger or word recognizer for Frequency, Period, and Totalize.

FREQUENCY

Range—Autoranging over input frequency from 0.5 Hz to 150 MHz.

Resolution— $\pm\left[\text{LSD}+1.4\ F^2\left(\frac{\text{TJE}}{N}\right)\right]$

Display—7 digits, updates twice per second or every two periods, whichever is slower.

Accuracy—Resolution ±0.001% of reading over entire temperature range of −15 to +55 °C.

PERIOD

Range—Autoranging over an input period from 6.666667 ns to 2 s.

Resolution— $\pm\left[\text{LSD}+\left(1.4\times\frac{\text{TJE}}{N}\right)\right]$

Display—7 digits (Updates twice per second or every two periods, whichever is slower.)

Accuracy—Resolution ±0.001% of reading over entire temperature range of −15 to +55 °C.

ACCURACY AND RESOLUTION DEFINITIONS

F = Input Frequency in Hz

LSD = Least Significant Digit (0.1 ppm of full scale)

TJE = Trigger Jitter Error

N = Number of cycles of measured frequency during measurement interval (0.5 s or 1 period of the input signal, whichever is greater)

TJE (Trigger Jitter Error) =

$$\frac{\sqrt{(en1)^2+(en2)^2}}{\text{Input Slew Rate}}$$

Where: en1 = RMS noise of vertical system in divisions on screen

en2 = RMS noise voltage of input signal in divisions

Volts/div	en1 Trigger Coupling DC and Noise Rej	en1 Trigger Coupling HF Reject
2 mV	0.15 div	0.05 div
5 mV to 5 V	0.1 div	0.05 div

ΔTIME, 1/ΔTIME

Trigger After Delay Accuracy—±(LSD+0.01 ×B Time/div)+(0.001%×A Sec/div+0.001% of reading+50 ps). Measured with visually superimposed signal transitions, >0.1 div/ns trigger-signal slew rates, and with channel-to-channel delay mismatch corrected by the CH 2 DLY match adjustment from the front panel. Independent Slope and Level settings for ΔREF and ΔB triggers allow visual superposition of any pair of points within the center 80% of transitions having at least 5 div amplitude.

Run After Delay Accuracy—±(LSD+0.0008 ×A Sec/div)+(0.01×B Time/div+83 ps). B Time/div includes 10X mag.

Display Update Rate—Auto resolution, twice per second or every four sweeps, whichever is slower. (Depends on trigger and sweep rates with selectable resolution.)

DELAY TIME

Trigger After Delay Accuracy—±(LSD + 0.001% of reading +0.5 ns +A trigger-slew error +B trigger-slew error). Add 0.5 ns for dual-channel measurements.

Where: Trigger-slew error equals trigger-level control readout accuracy ÷ trigger signal slew rate at the trigger point.

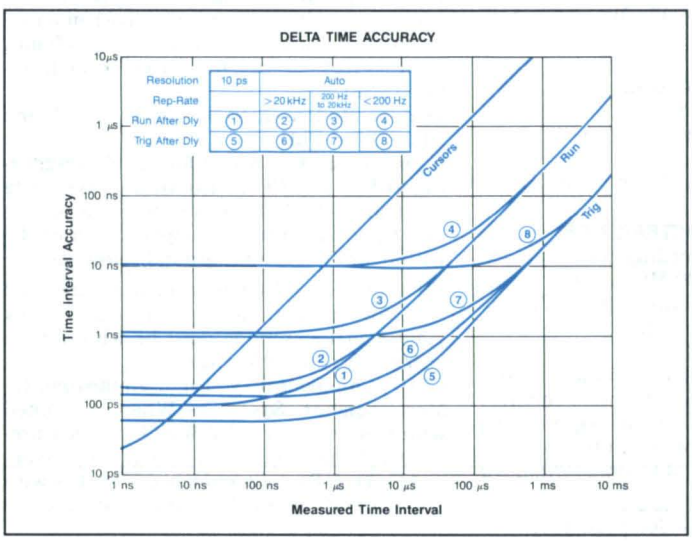
Run After Delay Accuracy—±(LSD +0.0012 ×A Sec/div+0.03×B Time/div +50 ns). (B Time/div includes 10X mag.)

Trigger After Delay and Run After Delay Accuracies Using Word Recognizer on the B Trigger—Add 100 ns if using external clock. Add 200 ns if not using external clock.

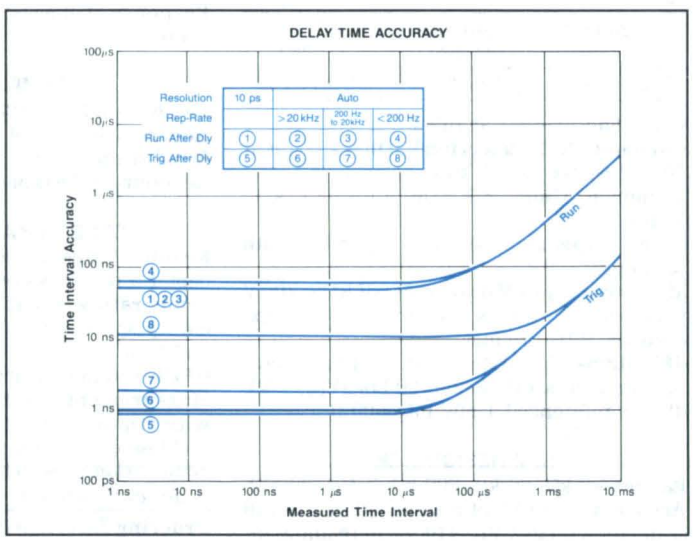
Display Update Rate—Auto, twice per second or once for each sweep, whichever is slower. Depends on trigger and sweep rate for selectable resolution.

Selectable Resolution

A Sec/Div	Selected Resolution	LSD
10 ns to 1 s	AUTO	See Auto Resolution below
10 ns to 5 μs	10 ps 100 ps 1 ns	10 ps 100 ps 1 ns
10 to 50 μs	10 or 100 ps 1 ns	100 ps 1 ns
100 to 500 μs	10 ps to 1 ns	1 ns
1 to 5 ms	10 ps to 1 ns	10 ns
10 to 50 ms	10 ps to 1 ns	100 ns
100 to 500 ms	10 ps to 1 ns	1 μs
1 s	10 ps to 1 ns	10 μs



Input Signal is five vertical div with a 2 ns rise time.
Measured times are four horizontal div.
TJE is negligible for Slew Rates >0.1 div/ns.
ΔTime Trigger After Delay assumes visual superposition.



Input Signal is five vertical div with a 2 ns rise time.
Measured times are four horizontal div.
TJE is negligible for Slew Rates >0.1 div/ns.
ΔTime Trigger After Delay assumes visual superposition.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

Auto Resolution

A Sec/Div	Trigger Repetition Rate	LSD
10 ns to 2 μs	>20 kHz	100 ps
10 ns to 2 μs	200 Hz to 20 kHz	1 ns
5 to 200 μs	>200 Hz	1 ns
10 ns to 200 μs	<200 Hz	10 ns
500 μs to 5 ms	Any	10 ns
10 to 50 ms	Any	100 ns
100 to 500 ms	Any	1 μs
1 s	Any	10 μs

2445B Sec/div settings range from 20 ns to 1 s. 2465B Sec/div settings range from 10 ns to 500 ms.

TOTALIZE

Maximum Count—To 9,999,999 events.

DELAY BY EVENTS

A or B Sweep—The A trigger or 17-bit word recognizer defines start events. The B trigger or 17-bit word recognizer defines delay events. With A sweep in the delayed-by-events mode, the B sweep is delayable by time.
Maximum Delay Count—Up to 4,194,303.
Minimum Time From Start Event to Any Delay Event—≥4 ns.
Minimum Pulse Width—≥3.3 ns.

LOGIC TRIGGER

Combination Trigger—A sweep can be triggered from logical combinations of A and B triggers (A and B) or (A or B), or the word recognizer. B sweep can be triggered from the word recognizer.
Minimum Time to Satisfy Logic Combinations—≥4 ns.

WORD RECOGNIZER

Input—P6407 Word Recognizer Probe, 17 bits plus clock. (No CRT display from P6407.)

All Inputs	Threshold	Load	Safe Limit
High	<2.0 V	<20 μA	5.5 V
Low	>0.6 V	>−0.6 mA	−0.5 V

Display Radix—Hexadecimal, octal, binary.
Data Rate—0 to ≥20 MHz with clock, 0 to ≥10 MHz without clock.
Data Set-Up Time—25 ns.
Data Hold Time—0 ns.
GPIB Compatibility for Semiautomatic Measurement Systems—When combined with Option 10 the CTT/WR (Option 09) Oscilloscope combination is fully programmable. Complies with Tektronix *Standard Codes and Formats.*

Ordering Information—See page 170.

CHARACTERISTICS

GPIB INTERFACE (OPTION 10)

The set of characteristics is the same as specified for standard 2467B/2445B/2465B oscilloscopes and includes the following additions:

Standard Interface Functions Implemented—SH1, AH1, T6, L3, SR1, RL1, DC1, E1 DT0 C0, PP0.
Vertical Position Accuracy—CH 1 and CH 2 (Noninverted): ±[0.3 div +3% of distance (in divisions) from center screen +0.5 mV divided by the Volt/div setting]. For −15 to +55°C (excluding +15 to +35°C) add 1.5 mV divided by the Volt/div setting. For CH 2 Inverted add 0.2 div.

CH 3 and CH 4: ±[0.7 div +3% of distance (in div) from center screen].

Ordering Information—See page 170.

CHARACTERISTICS

EXTERNAL CLOCK (OPTION 1E)

FREQUENCY

Range—Autoranging over input frequency from 0.5 Hz to 150 MHz.

Resolution— $\pm \left[\text{LSD} + 1.4\ F^2 \left(\frac{\text{TJE}}{\text{N}} \right) \right]$

Display—Seven digits; updates twice per second or every two periods, whichever is slower.
Accuracy—Resolution ±[accuracy of reference×reading]
Definitions:
F=Input frequency in Hz.
LSD=Least Significant Digit (0.1 ppm of full scale.

TJE=Trigger Jitter Error=

$$\frac{\sqrt{(\text{en1})^2+(\text{en2})^2}}{\text{Input Slew Rate}}$$

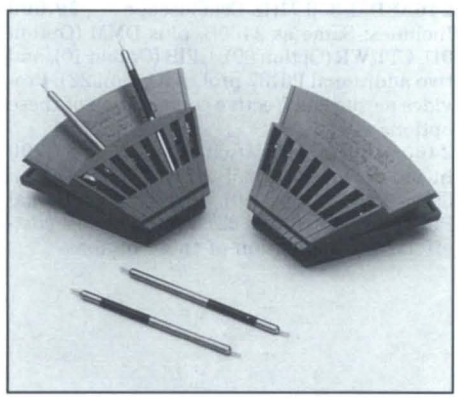
N=Number of cycles of measured frequent interval (0.5× or 1 period of input signal, whichever is greater).
en1=RMS noise of vertical system is divisions on screen.
en2=RMS noise of input signal in divisions.

CHARACTERISTICS

RACKMOUNT (OPTION 1R)

ENVIRONMENTAL

Rackmounting changes the temperature, vibration, and shock capabilities. The rackmounted oscilloscope meets or exceeds the requirements of MIL-T-18800C with respect to Type III, Class 5, Style C equipment, when installed as directed. It also meets or exceeds Tektronix Standard 062-2853-00, Class 5 requirements.
Ambient Temperature—Operating: −15 to +55°C. Measured at the instrument's air inlet, fan exhaust temperature should not exceed +65°C.
Vibration—Operation: Same as standard instrument, except total displacement is 0.015 inch p-p (2.3 g's at 55 Hz).
Shock—Operating and Nonoperating: Same as standard instrument, except shocks are 30 g's.



KLIPKIT makes high speed IC testing easy. For use directly with P6130 family probes or others vis the included signal pins.

ORDERING INFORMATION

2467B[*4] 400 MHz Oscilloscope **$11,990**
Includes: MCP CRT; four P6137 10X 1.3 m probes with accessories; 2 A, 250 V fuse (159-0021-00); zip lock accessory pouch (016-0537-00); blue plastic CRT filter (378-0199-03); clear plastic CRT filter; snap accessory pouch (016-0692-00); front cover; power cord (161-0104-00); Operator's Manual (070-5854-01).

2465B 400 MHz Oscilloscope **$5,850**
Includes: Two P6137 10X 1.5 m probes with accessories (P6136); 2 A, 250 V fuse (159-0021-00); zip lock accessory pouch (016-0537-00); blue plastic CRT filter (378-0199-03); clear plastic CRT filter; snap accessory pouch (016-0692-00); front cover; power cord (161-0104-00); Operator's Manual (070-6014-00).

2455B 250 MHz Oscilloscope **$5,350**
Includes: Same as 2465B.

2445B 150 MHz Oscilloscope **$3,695**
Includes: Same as 2465B, except two P6136 Option 25 10X 1.5 m probes; Option 01, 1.3 m probe

2465BDV 400 MHz Oscilloscope **$9,900**
Includes: Same as 2465B, plus DMM (Option 01), TV (Option 05), CTT/WR (Option 09), GPIB (Option 10), and two additional P6137 probes (Option 22). Provides most cost-effective combination of these options.

2465BDM 350 MHZ Oscilloscope **$9,000**
Includes: Same as 2465B, plus DMM (Option 01), CTT/WR (Option 09), GPIB (Option 10), and two additional P6137 probes (Option 22). Provides most cost effective combination of these options.

2465BCT 400 MHz Oscilloscope **$7,700**
Includes: Same as 2465B, plus CTT/WR (Option 09), GPIB (Option 10), and two additional P6137 probes (Option 22). Provides most cost-effective combination of these options.

INSTRUMENT OPTIONS

Option 01[*3*4]—Digital Multimeter **+ $1,550**
Includes: Same as standard instruments, plus probe set (012-0941-00); temperature probe (P6602); probe set accessories (020-0087-00).

Option 05—TV Waveform Measurement System **+ $1,150**
Includes: Same as standard instruments, plus CCIR graticule CRT filter (378-0199-04); NTSC graticule CRT filter (378-0199-05); polarized collapsible viewing hood (016-0180-00).

Option 06— Counter/Timer/Trigger **+ $1,050**
Includes: Same as standard instruments, plus 20 grabber tips (206-0222 00); two 10 inch 10 wide comb (012-0747-00).

Option 09[*1*2]—Counter/Timer/Trigger and Word Recognizer **+ $1,450**
Includes: Same as standard instruments, plus a word recognizer probe (010-6407-01); 20 grabber tips (206-0222-00); two 10 inch 10 wide comb (012-0747-00).

Option 10—IEEE-488 GPIB Interface **+ $930**
Includes: Same as standard instruments, plus Instrument Interface Guide.

Option 1E—External Clock **+ $200**

MULTIPLE OPTION ALLOWANCE (MOA)

When a 2467B or 2465B instrument is ordered with more than two of the above options, a special price allowance is applied. This allowance is not applicable to the 2465BDV, 2465BDM, or the 2465BCT.

Option 2A—MOA for combining two of the above options. **– $250**

Option 3A—MOA for combining three of the above options. **– $500**

Option 4A—MOA for combining four of the above options. **– $750**

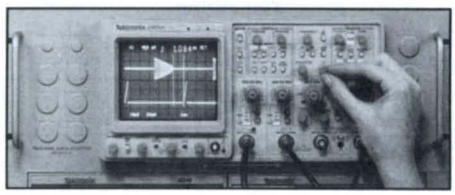
OTHER INSTRUMENT OPTIONS

Option B1—Service manual. (For 2445B/2455B/2465B/2467B) Standard manual. **+ $50**

(For Options/Special Editions) Includes standard manual plus options manual. **+ $50**

Option 1R[*3]—Configure Oscilloscope for Rackmount. **+ $320**
Includes: Same as bench model instrument (except pouch) plus rackmount hardware and slide-out assemblies.

Option 2R—Rackmount for instruments equipped with Option 01 **+ $45**



Option 1T—Transit Case. **+ $185**

Option 11[*1]—Rear Panel Probe Power. **+ $195**

Option 22—Two additional matching probes. **+ $320**

[*1] *Option 11 may not be ordered with Option 09 or the 2445B.*

[*2] *Option 09 includes Option 06.*

* *Option 1R may not be ordered with Option 01, 2465BDM, or 2465BDV. For rackmounting instruments equipped with Option 01, order Option 2R.*

[*4] *Option 01 is not available with the 2467B.*

NOTE: Options are not retrofittable with field upgrade kits.

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

WARRANTY-PLUS SERVICE PLANS

See page 562

M1—(2467B/2465B/2455B 2 Calibrations. **+ $144**
M1—(2445B) 2 Calibrations. **+ $144**
(Special Editions) 2 Calibrations **+ $167**
M2—(2455B) 2 Years Service. **+ $360**
M2—(2467B/2465B) 2 Years Service. **+ $367**
M2—(2445B) 2 Years Service. **+ $302**
(Special Editions) 2 Years Service **+ $374**
M3—(2455B) 2 Years Service and 4 Calibrations. **+ $695**
M3—(2465B/2467B) 2 Years Service and 4 Calibrations. **+ $655**
M3—(2445B) 2 Years Service and 4 Calibrations. **+ $590**
(2455B) 5 Calibrations **+ $399**
(Special Editions) 2 Years Service and 4 Calibrations. **+ $709**
M4—(2467B/2465B) 5 Calibrations. **+ $344**
M4—(Special Editions) 5 Calibrations. **+ $399**
(2455B) 5 Calibrations **+ $1,075**
M5—(2467B/2465B) 9 Calibrations and 2 Years Service. **+ $983**
M5—(Special Editions) 9 Calibrations and 2 Years Service. **+ $1,089**
M5—(2445B) 9 Calibrations and 2 Years Service. **+ $918**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

OPTIONAL ACCESSORIES

Rackmount Conversion Kit—Not compatible with Option 01. Order 016-0825-01 $395

Probe Power Extender Cable for Rackmount Instrument With Option 11—Order 020-0104-00 $490

Word Recognizer Extender Cable for Rackmount Instrument With Option 09 and 2465B CT—Order 020-0103-00 $350

GPIB Cables—Double shield, low EMC.
(1 m) Order 012-0991-01 $140
(2 m) Order 012-0991-00 $160
(4 m) Order 012-0991-02 $210

Viewing Hoods—
(Polarized Collapsible) Order 016-0180-00 $60
(Folding Light Shield) Order 016-0592-00 $15
(Folding Binocular) Order 016-0566-00 $21

Protective Waterproof Vinyl Cover—Order 016-0720-00 $25

Carrying Case—Order 016-0792-01 $221

Carrying Strap—Order 346-0199-00 $17.50

DC Power
1105 $2,090
1106 $1,580

DC Inverter—1107 $1,175

RECOMMENDED PROBES

P6137—10X Passive Probe for use with 2467B, 2465B, 2455B, 2445B. $160

P6202A—10X FET Probe. $735

P6230—10X Bias/Offset Probe. $420

P6056—10X, 500Ω Passive Probe for 50 Ω inputs. $200

P6057—100X, 5000 Ω passive probe for 50 Ω input. $195

P6602—Temperature Probe. $260

Current Probes—
A6302 $625
A6303 $1,180
P6021 $450
P6022 $495

A6901—Ground Isolation Monitor $760

A6902B Voltage Isolator—For floating measurements. $1,980

DIGITIZING CAMERA SYSTEM

DCS01 Option 2A—Digitize waveforms from scope screen. $6,605

S58DC02—2467B/DCS Interface GPIB Driver. $295

RECOMMENDED CAMERAS

C-30BP Option 01—General Purpose. $1,665

C-5C Option 02—Low Cost. $465

RECOMMENDED CART

K212—For on-site mobility. $350

SERVICE MANUALS

(2467B/2465B) Order 070-6863-00 $50
(2455B/2445B) Order 070-6862-00 $50
(Options) Order 070-6864-00 $25

SOFTWARE

For additional information see the Test and Measurement Software section.

EZ-TEK 2400 PC Test Program Generator—For instruments with GPIB; used with IBM PC/XT/AT and compatibles. Requires GURU hardware. Order S49F103 $250

GPIB User's Resource Utility (GURU)—Includes GPIB-PC interface board, GPIB cable, software, and documentation. Order S3FG100 $995

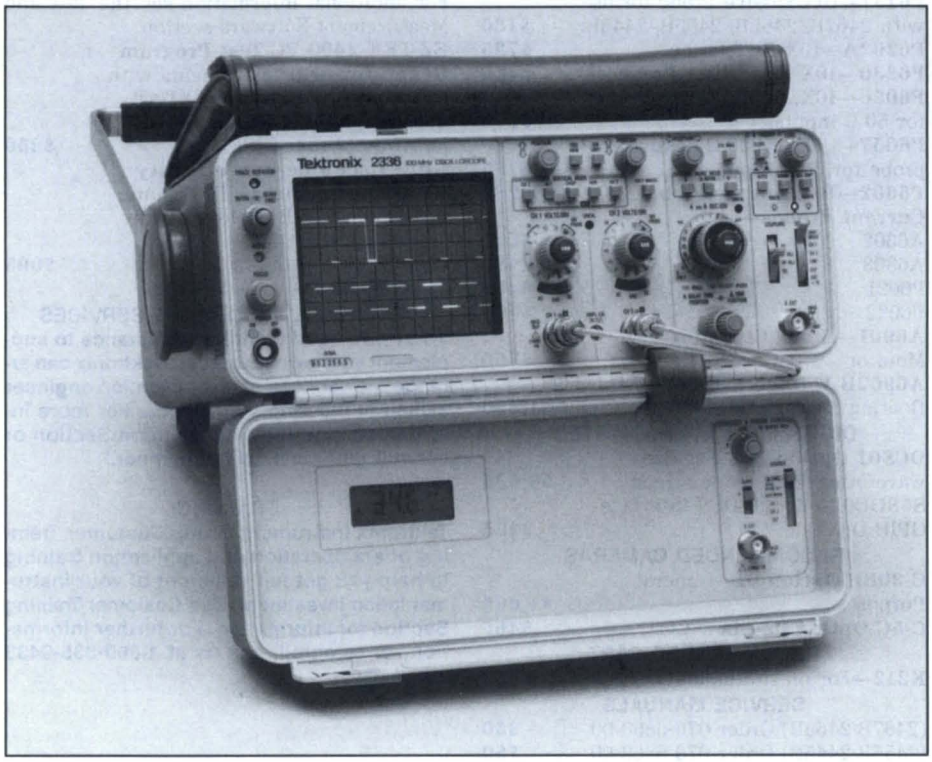
TECHNICAL ASSISTANCE SERVICES

When you need technical assistance to supplement your own resources, Tektronix can arrange the services of an application engineer skilled in meeting your needs. For more information, see the total solution Section or consult you local sales engineer.

TRAINING

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. See Customer Training Section for information. For further information, or to enroll, call us at 1-800-835-9433 ext. 430.

2300 Series Portable Analog Oscilloscopes



2336 shown above.

2335/2336/2336YA/2337

TYPICAL APPLICATIONS

- **Rugged Field Service**
- **Computer Peripheral Service**
- **Communication Equipment Service**

BENEFITS

- **Three-Year Warranty—Five Year Option**
- **UL Listed, CSA**

FEATURES

- **DC to 100-MHz Bandwidth**
- **5 mV/Div to 5 V/Div**
- **5 ns/Div Sweep Rate**

Designed for Field Service

The 100 MHz 2300 Series oscilloscopes are the most rugged and durable instruments in their bandwidth. Offering a one-piece case, fliptop cover, scratch resistant front panels, the ability to withstand shocks of 50 g's, and meet the environmental specifications for Class 3 instrumentation as prescribed in MIL-T28800, in an industry standard size make these the ultimate field-service oscilloscopes.

Flexibility

All 2300 Series oscilloscopes are dual channel, dual trace, and delayed sweep dc to 100 MHz oscilloscopes. The 2336 and the 2336YA feature DELTA TIME on the fliptop front cover, while the 2337 features DELTA TIME as well as a DMM. The controls for these features are conveniently and logically located in the cover as well. The DELTA TIME and DMM readouts emanate from a backlighted LCD for clear viewing at any angle. The CRT produces bright, highly visible traces that are viewable in most light conditions. The 2335 is rackmountable for system configurations. The 2336YA also features a 5000 hour elapsed time indicator (ETI), extra manuals, and an extra set of probes.

Ease of Operation

The front panel layout features logical groupings of switches and knobs to avoid errors and delays during operation. Autotrigger allows triggering on waveforms with repetitive rates down to approximately 10 Hz. Vertical deflection factors range from 5 mV/div to 5 V/div with a variable control to increase the sensitivity to at least 2 mV/div. Variable sweep speeds range from 0.5 s/div to 50 ns/div, with a X10 magnifier that can increase the sweep speed to 5 ns/div.

National Stock Numbers are assigned for all 2300 Series oscilloscopes. Check the Logistics Data Book for information.

CHARACTERISTICS

The following characteristics are common to the 2335, 2336, 2336YA, and 2337 oscilloscopes except where indicated.

VERTICAL SYSTEM (Two Identical Channels)

Bandwidth and Rise Time

−15 to +40°C	40 to 55°C
dc to at least 100 MHz, 3.5 ns	dc to at least 85 MHz, 4.15 ns

Bandwidth Limit—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. 1-2-5 sequence. Accuracy ±3%. Uncalibrated: Continuously variable between steps and to at least 2 mV/div.
Display Modes—CH 1, CH 2, Add CH 2 (normal and inverted), Alternate, Chopped (≈275 kHz rate).
Common-Mode Rejection Ratio (common-mode signals of 6 div or less)—2335, 2336, 2337: ≥25:1 at 10 MHz; 10:1 at 100 MHz.
Channel Isolation—>100:1 at 25 MHz.
Input R and C—1 MΩ ±2% paralleled by 20 pF ±10%.
Maximum Input Voltage—AC or dc coupled, 400 V (dc + peak ac) or 500 V p-p ac at 1 kHz or less.

HORIZONTAL SYSTEM

Time Base A—0.05 μs/div to 0.5 s/div (1-2-5 sequence). X10 magnifier extends maximum sweep rate to 5 ns/div.
Time Base B—0.05 μs/div to 50 ms/div (1-2-5 sequence). X10 magnifier extends maximum 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.

Time Base A and B Accuracy*1

	20 to 30°C	−15 to +55°C
Unmagnified	±2%	±3%
Magnified	±3%	±4%

*1 *Full ten divisions.*

Display Modes—A, A intensified by B, B delayed.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

CALIBRATED SWEEP DELAY

Delay Time Range—Continuous from 50 ns to at least 5 s after start of delaying sweep.

Differential Time Measurement Accuracy*1

	15 to 30°C	−15 to +55°C
2335	0.75%+0.015 major dial div	1.5%+0.015 major dial div
2336/2337 2336YA	±1% of reading ±1 count	±2.5% of reading ±1 count

*1 *2336YA only: 10 to 55°C is 2% of reading ±1 count.*

Jitter—One part or less in 20,000 (0.005%) of 10 times the A Sweep Time/Div setting.

TRIGGERING

A Trigger Mode—Normal: sweep runs when triggered. Automatic: sweep free-runs in absence of a triggering signal and for signals below 30 Hz. Single Sweep: sweep runs once on first triggering event after reset selector is pressed. (LED indicates when sweep is triggered and when single sweep is ready.)

A and B Trigger Sensitivity

2335,2336 2337	Internal	External*1	External ÷10*1
20 MHz	0.3 div	50 mV	500 mV
100 MHz	1.1 div	150 mV	1.5 V
2336YA			
25 MHz	0.3 div	50 mV	500 mV
100 MHz	1.0 div	150 mV	1.5 V
150 MHz	1.1 div	300 mV	3 V

*1 *External B Trigger sensitivity is not applicable to the 2335.*

Trigger Coupling—AC (−3 dB 20 Hz), dc, LF REJ attenuates signals above 50 kHz. B Trigger coupling is ac only.

A Trigger Holdoff—Adjustable control permits stable presentation of repetitive waveforms

ΔTime B Trigger Modes—(2336, 2336YA and 2337 only): Provides two intensified zones on CRT trace for differential time measurements. Time difference between two intensified zones determined by B Delay Time Position and ΔTime Position controls, and is displayed on LCD readout.

Runs After Delay—B Sweep starts immediately after the delay time selected by the Delay Time Position control and is independent of B trigger signal.

Triggerable After Adjustable Delay Time—B Sweep Trigger sourced from a composite of CH 1 and CH 2; CH 1 only, CH 2 only or from the Ext Trigger input connector.

Jitter—2335, 2336, 2337: 1.0 ns or less at 100 MHz. 2336YA: 0.5 ns at 100 MHz.

A Trigger View—A spring-loaded pushbutton overrides other vertical controls to display the signal used to trigger the A Sweep. This control provides quick verification of the (trigger) signal and permits a time comparison between the vertical input signal and the trigger signal. Deflection Factor is 100 mV/div ±40% (1 V/div with Ext÷10).

Level and Slope—Internal: Permits selection of triggering at any point on positive or negative slope of vertical input signal. Level adjustment: Through at least ±1 V in Ext; through at least ±10 V in Ext÷10.

A Sources—Vertical Mode, CH 1, CH 2, Line, Ext, Ext÷10.

B Sources—(2336, 2336YA and 2337 only) ΔTime runs after delay, Vertical Mode, CH 1, CH 2, Ext (all modes ac coupled).

External Inputs—R and C: 1 MΩ ±10%, 20 pF ±30%. 400 V (dc+peak ac) or 500 V ac p-p at 1 kHz or less.

X-Y OPERATION

Full Sensitivity X-Y (CH 1 Horizontal, CH 2 Vertical)—5 mV/div to 5 V/div (1-2-5 sequence), accurate ±5% from 0 to +40°C, accurate ±8% from −15 to +55°C. X axis bandwidth: dc to ≥2 MHz. Y-axis bandwidth: dc to >100 MHz. Phase difference between amplifiers: ≤3° dc to 200 kHz.

CRT AND DISPLAY FEATURES

CRT—8×10 div (8 mm/div) display. Horizontal and vertical centerlines further marked in 0.2 div increments. Accelerating potential: 18 kV. GH (P31) phosphor.

Graticule—Internal, nonparallax, nonilluminated; markings for measurement of rise time.

Beam Finder—Compresses trace to within graticule area to locate an offscreen signal.

Z-Axis Input—Positive-going, dc coupled signal decreases intensity; 5 V p-p signal causes noticeable modulation at normal intensity; dc to 20 MHz.

OTHER CHARACTERISTICS

Amplitude Calibrator—0.2 V accurate ±1% from 0 to 40°C, ±1.5% from −15 to +55°C.

POWER REQUIREMENTS

Line Voltage Ranges—100 to 132 V ac and 200 to 250 V ac. Option 03: 90 to 115 V ac or 180 to 230 V ac.

Line Frequency—48 to 440 Hz.

Maximum Power Consumption—35 W at 115 V, 60 Hz.

ENVIRONMENTAL

The 2335 Oscilloscope meets environmental capabilities for Class 3, type 3, style D instruments as prescribed in MIL-T-28800C. The 2336, 2336YA and 2337 Oscilloscopes meet the environmental capabilities for Class 3, Type 3, Style D instruments as prescribed by MIL-T-28800 except as indicated herein to avoid potential damage to the LCD readout.

Temperature (Forced-air ventilation during normal operation)—2335 Operating: −15 to +55°C. Nonoperating: −62 to +85°C.

2335 Option 1R (Rackadapted)—Operating temperature inside equipment rack: −15 to +55°C. Max exhaust-fan temperature: +65°C. Nonoperating: −62 to +85°C.

2236/2237 Operating: −15 to +55°C. Nonoperating: −40 to +80°C.

Altitude—Operating: Sea level to 4600 m (15,000 ft). Nonoperating: Sea level to 15 000 m (50,000 ft).

Vibration—Test samples subjected to sinusoidal vibration in X, Y, and Z-axes; frequency varied from 10 to 55 to 10 Hz in one minute cycles for 15 minutes. Total displacement: 0.025 in. p-p (4 g's at 55 Hz).

Humidity Operating and Nonoperating—2335: 95%, five cycles (120 hours), referenced to MIL-T-28800B Paragraph 3.9.2.2.

2336, 2336YA and 2337—Operating: 90% (72 hours) at +55°C.

2336, 2336YA, 2337 and DMM: Operating: 90% (24 hours) at +35°C and 70% (24 hours) at +50°C.

2336, 2336YA, 2337 and DMM: Nonoperating: 90% (72 hours) at +60°C.

Shock—Operating: 50 g's, ½ sine, 11-ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.

Electromagnetic Compatibility (EMC)—Test samples in compliance with the Class 3 requirements of MIL-STD-461B using procedural steps outlined in MIL-STD-462. Increase RS03 requirements from 1 V/m to 10 V/m. For RE01, use 500 Hz to 30 kHz in place of 30 Hz to 30 kHz.

PHYSICAL CHARACTERISTICS

	2335, 2336, 2336YA, 2337 Cabinet		2335 Option 1R Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	274	10.8	483	19.0
w/handle	315	12.4		
Height			133	5.2
w/feet/pouch	210	8.3		
w/o pouch	135	5.3		
Depth			378	14.9
w/o front cover	430	17.0		
handle extended	528	20.8		

	2335		2336, 2336YA, 2337			
Weight ≈	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
Net (w/o accessories or pouch)	7.7	17.0	8.0	17.8	11.7	25.8
Net (w/accessories & pouch)	8.6	19.0	8.9	19.6	12.6*1	27.8*1
Shipping	10.6	23.5	10.9	24.1	16.9	37.3

*1 *No pouch for 2335 Option 1R.*

2337 With Digital Multimeter

The following characteristics are unique to the 2337.

DC VOLTAGE

Full Scale Ranges—2 V (autoranging to 200 mV); 200 V (autoranging to 20 V); and 500 V.
Resolution—100 μV at 200 mV full scale.

Accuracy

15 to 35°C	Within ±0.15% of reading ±1 count
−15 to +15°C	Add ±0.01% for every °C below +15°C
35 to 55°C	Add ±0.01% for every °C above +35°C
>80% Relative Humidity	Add ±0.25% of reading ±3 counts

Input Resistance—10 MΩ ±0.25%.
Rejection Ratio—Normal-Mode: 60 dB minimum at 50 and 60 Hz. Common-Mode: 100 dB minimum at dc, 60 dB minimum at 50 and 60 Hz.
Response Time—Within 3 s (no autorange); within 9 s (up range); within 7 s (down range).
Maximum Input Voltage—500 V (dc+peak ac) at 60 Hz (between positive and negative inputs or between either input and ground).

AC VOLTAGE

Full Scale Ranges—2 V (autoranging to 200 mV); 200 V (autoranging to 20 V); and 350 V.
Crest Factor (When peak voltage input is <3 times full scale)—6.

Accuracy[*1]

15 to 35°C	Within ±3%, ±6 counts[*1], 20 Hz to 20 kHz
−15 to +15°C	Add ±0.05% for every °C below +15°C
35 to 55°C	Add ±0.05% for every °C above +35°C

[*1] *Nonsine waves: Derate below 50 Hz. For crest factors >3, add +0, −1% of reading.*

Input Impedance—Resistance 10 MΩ ±0.25% in series with input blocking cap. Capacitance (20 V, 200 V, and 350 V range) <150 pF; (200 mV, 2 V range) <220 pF.
Common-Mode Rejection Ratio—60 dB minimum at 50 and 60 Hz, 2 V range; 53 dB minimum at 50 and 60 Hz, 200 V and 300 V ranges.
Response Time—Within 3 s (no autorange); within 9 s (up range); within 7 s (down range).
Maximum Input Voltage—500 V (dc+peak ac) at 60 Hz (between positive and negative inputs or between either input and ground).

RESISTANCE

Full Scale Ranges—2 kΩ (autoranging to 200 Ω); 200 kΩ (autoranging to 20 kΩ); 20 MΩ (autoranging to 2 MΩ).
Resolution—0.1 Ω.

Accuracy

15 to 35°C	Within ±0.5% ±2 counts +0.4 Ω
−15 to +15°C	Add ±0.05% for every °C below +15°C
35 to 55°C	Add ±0.05% for every °C above +35°C
>80% Relative Humidity	Add ±1% of reading ±8 counts

Response Time—<4 s.
Maximum Input Voltage—500 V (dc+peak ac) at 60 Hz (between positive and negative inputs or between either input and ground).

ORDERING INFORMATION

2335 Oscilloscope $3,940
Includes: Two P6108A 10X probes; accessory pouch (016-0674-00); zip lock accessory pouch (016-0537-00); clear CRT implosion shield (337-2781-00); installed, blue CRT implosion shield (337-2760-00); two 1 A fuses (159-0022-00); ½ A fuse (159-0025-00); power cord (161-0104-00); operator manual (070-4115-00).
2336 Oscilloscope With ΔTime $4,270
Includes: Same as 2335, instruction manual (070-4117-00) instead.
2336YA Oscilloscope With ΔTime, Elapsed Time Meter, Extra Accessories and Manuals $4,490
Includes: Same as 2336 plus P6101A probe; three probe tip adaptors (103-0051-01); three spring tip adaptors (206 0060-00); operator manual (070-5010-00); service manual (070-5011-00).
2337 Oscilloscope With ΔTime and DMM $4,700
Includes: Same as 2335, instruction manual (070-4119-00) instead.

OPTIONS

Option 03—100 V/200 V, ac nominal, 48 to 440 Hz. NC
Option 1R—(2335 only) Rack Conversion. +$375

CONVERSION KIT

Rackmount Conversion— 2335 only. Order 016-0468-00 $390

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

WARRANTY-PLUS SERVICE PLANS

See Customer Service Section

M1—(2335) 2 Calibrations. +$153
M1—(2336/2336YA) 2 Calibrations. +$184
M1—(2337) 2 Calibrations. +$205
M2—(2335) +2 Years Service. +$171
M2—(2336/2336YA) +2 Years Service. +$202
M2—(2337) +2 Years Service. +$254
M3—(2335) +2 Years Service & 4 Calibrations. +$477
M3—(2336/2336YA) 2 Years Service & 4 Calibrations. +$569
M3—(2337) 2 Years Service & 4 Calibrations. +$664
M4—(2335) 5 Calibrations. +$366
M4—(2336/2336YA) 5 Calibrations. +$437
M4—(2337) 5 Calibrations. +$490
M5—(2335) 9 Calibrations +2 Years Service. +$826
M5—(2336/2336YA) 9 Calibrations +2 Years Service. +$985
M5—(2337) 9 Calibrations +2 Years Service. +$1,131

OPTIONAL ACCESSORIES

Battery Pack—Order 1106 $1,580
DC Power—Order 1107 $1,175

RECOMMENDED PROBES

See Signal Acquisition Section for complete descriptions.
P6108A—10X probe. $75
P6202A—10X FET probe. $735
P6022— Current probe. $495
P6062B—1X/10X probe. $175
A6902B Voltage Isolator—For floating measurements, see page 543. $1,980

RECOMMENDED CAMERA

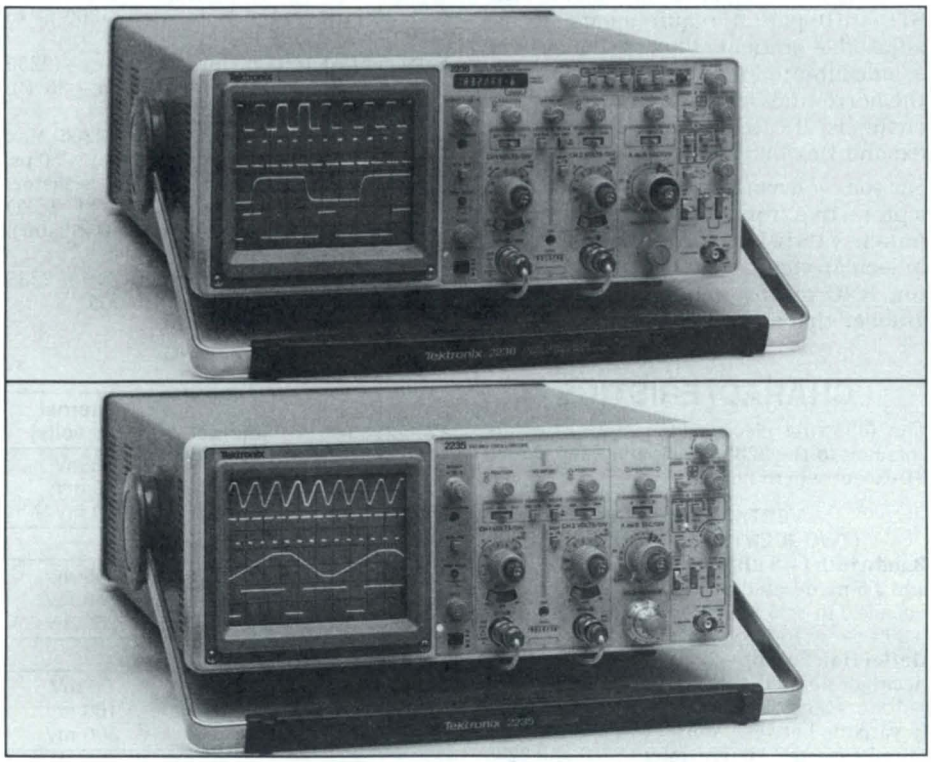
C-5C Option 04—Includes 016-0359-01 adaptor and flash (camera mount not provided). $495

RECOMMENDED CART

K212 Portable Instrument Cart—For on-site mobility. $350

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

2200 Series Portable Analog Oscilloscopes



2236

TYPICAL APPLICATIONS

- Digital Design and Testing
- Field Service
- Amplifier Design and Testing

BENEFITS

- Gated Counter Measurements/ΔTime
- UL Listed, CSA
- Channel 1 AC and DC Volts
- Full Function DMM—5000 Counts
- Three-Year Warranty—Five-Year Option

FEATURES

- DC to 100-MHz Bandwidth
- Integrated Counter/Timer/DMM
- Lightweight, Easy to Use
- 2-mV Sensitivity
- 5-ns/Div Sweep Rate
- 100-MHz Counter

The 100-MHz 2236 introduces a new concept in waveform measurement: a 100-MHz counter/timer/DMM, integrated into the scope's vertical, horizontal, and trigger systems. This convenient feature simplifies setups (by allowing consolidated set-ups and combinations of measurements), heightens measurement confidence, and expands the scope's versatility. The 2236 replaces mental gymnastics and roundabout problem-solving with simple, direct, accurate digital readouts that supplement your analog measurements.

The Tek 2236 provides easy, accurate, and versatile measurements through microprocessor-driven waveform analysis. Autoranged and autoaveraged counter/timer measurements are made on the signal triggering the A sweep or, in gated modes, on the signal triggering the B sweep. Autoranged DMM measurements are made through floating DMM side inputs and up-range at 5000 counts. Channel 1 voltage measurements made on Channel 1 signal include: dc, relative dc, relative and true ac RMS voltages self-testing includes power-on and user interactive routines.

The 2236 uses intensified markers on-screen to define the area to be measured on a burst or short duration pulse train. Gated counter measurements are made via the B trigger with operator prompting and automatic digital readout of results (see Figures 1, 2, 3). With period averaging, the 2236 can make low-frequency measurements instantly, in contrast to the several seconds delay encountered on conventional counter/timers.

The scope and DMM can be applied simultaneously, with concurrent CRT and digital-readout displays. The same probe feeds data to the scope and provides information to the DMM, thus eliminating tangled leads and extra set-up time required to obtain true ac RMS or dc voltage readings (see Figure 4).

DMM autoranging simplifies set-up. An ohmmeter range of 2 GΩ—one hundred times the range of most such devices—allows service technicians to quickly pinpoint even small amounts of transformer leakage, or designers to accurately check the insulating property of capacitors (see Figure 7).

Frequency, period, and width measurements are pushbutton simple, with accuracies to 0.001% and beyond. On-screen operator prompts further ensure failsafe set-up (see Figure 8).

An audible, automatic diode/junction detection and continuity signal saves both time and interpretation errors by allowing the operator to concentrate on probing rather than on observing the front panel (see Figure 9).

In strong testimony of the incomparable reliability of the 2000 Family of oscilloscopes, Tek offers a three year warranty: labor and parts (including CRT), excluding probes. Beyond the "basic three years" of warranty coverage, Tek will extend your service coverage up to five years, offering you a choice of three practical service plans to meet your specific service needs.

2235

TYPICAL APPLICATIONS

- Field Service
- Design
- Component Testing

BENEFITS

- Large, Bright CRT
- 10X Probes Included
- Three-Year Warranty—Five-Year Option
- UL Listed, CSA Certified

FEATURES

- DC to 100 MHz Bandwidth
- Lightweight, Easy to Use
- 2-mV Sensitivity
- 5-ns/Div Sweep Rate
- Advanced Trigger System
- Trigger View
- Delayed Sweep Measurements

The 100-MHz 2235 offers high value and high performance. The low price is made possible by the 2200 Series innovative architecture. Yet it has the needed features, operational simplicity, and (not least) solid reliability. And all are backed by a three-year warranty on all parts and labor, including the CRT (excluding probes).

The 2235 ensures measurement quality and reliability while reducing instrument cost.

Tek started with the innovative architecture of the 2200 Series: fewer boards, fewer mechanical parts, less cabling and electrical connectors. This approach, plus advanced circuit design and a focus on essential features, has provided a scope that's more accurate, more reliable, lighter and more serviceable—and simpler to use—than any other 100 MHz scope.

The 2235 delivers 2% vertical and horizontal accuracy in normal operation. Accuracy of 3% or better is maintained across a wide range of environmental extremes. Trace noise, chop noise, vertical aberrations, and sweep interference have been reduced to a minimum. Delay jitter of 1:20,000 ensures excellent timing measurement resolution. Triggering is sensitive to 0.3 div at 10 MHz. There's a trigger view for simplifying set-ups; single sweep for photographing transients; bandwidth limit for noisy environments; and a bright, high-resolution 14 kV dome mesh CRT.

2235 Option 01

(AN/USM-488)

BENEFITS

- **DC to 100-MHz Bandwidth**
- **National Stock No. 6625-01-187-7847**
- **UL Listed, CSA Certified**

FEATURES

- **Meets or Exceeds MIL-T-28800C and MIL-STD-461B Part 4 for EMC/EMI**

Comparable in performance to the standard 2235, the 2235 Option 01 version has impressive features. It meets the rigid environmental capabilities for Class 5 instruments as prescribed in MIL-T-28800C. Electromagnetic interference is improved over the standard 2235, and meets MIL-STD-461B part 4 requirements. It has adjustable graticule illumination as well as uncalibrated indicator lights for both the horizontal time base and the vertical channels. HF REJ and LF REJ filtering expand flexibility for trigger coupling.

For your convenience we've also included a protective front-panel cover, accessory pouch, P6101A 1X 2-meter probe, binocular viewing hood, BNC T connector, BNC male-to-binding post, two IC grabber tips and a service manual.

CHARACTERISTICS

The following electrical characteristics are common to the 2236, 2235, and 2235 Option 01 except where noted.

VERTICAL SYSTEM (TWO IDENTICAL CHANNELS)

Bandwidth (– 3 dB) and Rise Time—100 MHz and 3.5 ns, derated to 90 MHz at 2 mV/div and outside 0 to +35 °C. Bandwidth Limit: 20 MHz ±20%.

Deflection Factor—2 mV to 5 V/div at ±2%. Accuracy derated ±3% outside +15 to +35 °C (+10 to +35 °C, 2235 Option 01). Continuously variable between steps by at least 2.5:1.

Step Response Aberrations—2235 and 2235 Option 01: +4%, −4%, 4% p-p (2 mV to 0.5 V/div).
2236: +4%, −4%, 4% p-p (5 mV to 0.5 V/div), +5%, −5%, 5% p-p (2 mV/div).

Display Modes—CH 1, CH 2, CH 2 Invert, Add, Alternate, Chop (500 kHz).

Common-Mode Rejection Ratio—At least 10:1 at 50 MHz for signals of 6 div or less (10:1 at 80 MHz 2235 Option 01).

Input R and C—2235 and 2235 Option 01: 1 MΩ, 20 pF. 2236: 1 MΩ, 22 pF.

Maximum Input Voltage (ac and dc Coupled)—400 V (dc+peak ac) or 800 V (p-p to 10 kHz).

Channel 1/Channel 2 Isolation—100:1 at 50 MHz.

HORIZONTAL SYSTEM

Sweep Rate—A Time Base: 0.05 μs to 0.5 s/div. 10X Mag: 5 ns/div. B Time Base: 0.05 μs to 50 ms/div in 1-2-5 sequence. 10X Mag: 5 ns/div.

Sweep Linearity—±5% over any two of center eight divisions.

Accuracy[*1]

	15 to 35°C	0 to 50 °C
Unmagnified	±2%	±3%
Magnified	±3%	±4%

[*1] *10 to 35°C for 2235 Option 01.*

Display Modes—A, Alternate (A Intensified and B Delayed), and B.

CALIBRATED SWEEP DELAY

Delay Time Range—Continuously variable with 10-turn control from <0.5 +300 ns to >10 div.

Differential Delay Time Accuracy—(2235 and 2235 Option 01) ±1% (+15 to +35 °C); ±2% (0 to +50 °C).

ΔTime Measurement Accuracy—(2236) Max accuracy equal to time base accuracy ±50 ps. Time Base Accuracy With Standard Oscillator: 10 ppm (0.001%); with Option 14 TCXO (Temperature Compensated Crystal Oscillator): 0.5 ppm (0.00005%).

Delay Jitter—2236: 10,000:1 (0.01%). 2235 and 2235 Option 01: 20,000:1 (0.005%).

TRIGGERING

A Trigger Sensitivity

2235/2235-01	Internal	External (p-p volts)
10 MHz	0.3 div[*1]	35 mV
60 MHz	1.0 div	120 mV
100 MHz	1.5 div[*1]	200 mV[*2]
2236		
10 MHz	0.35 div	40 mV
60 MHz	1.2 div	150 mV
100 MHz	1.5 div	250 mV
2236 CTM		
10 MHz	0.5 div	50 mV
60 MHz	1.5 div	160 mV
100 MHz	2.0 div	300 mV

B Trigger (Internal Only) Sensitivity

	10 MHz	60 MHz	100 MHz
2235 & 2235 Opt 01	0.35 div	1.0 div	1.5 div
2236	0.4 div	1.2 div	1.5 div
2236 CTM	0.5 div	1.5 div	2.0 div

[*1] *0.35 div for 2235 Option 01.*
[*2] *150 mV for 2235 Option 01.*

TV Trigger Sensitivity—TV Field: 1.0 div of composite sync. TV Line: 0.3 div (2235); 0.35 div (2236 and 2235 Option 01).

Bandwidth Limiting (bandwidth limit switch depressed)—20 MHz.

High-Frequency Reject (2235 Option 01 only)—Attenuates signals above 40 kHz.

Low Frequency Reject (2235 Option 01 only)—Attenuates signals below 40 kHz.

Trigger System Operating Modes—Normal, p-p automatic, TV line, TV field, and single sweep.

Trigger View System—Same deflection factors as vertical channels with internal sources; 100 mV/div with ac and dc external, and 1 V/div with dc÷10 external. Accuracy: ±20%. Delay difference between trigger view (EXT input) and either vertical channel: <2.0 ns.

External Trigger Input—Coupling: ac, dc, or dc÷10.

Variable Holdoff Control—Increases A sweep holdoff time at least 10:1.

Characteristics continued on page 178.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

GATED FREQUENCY MEASUREMENT

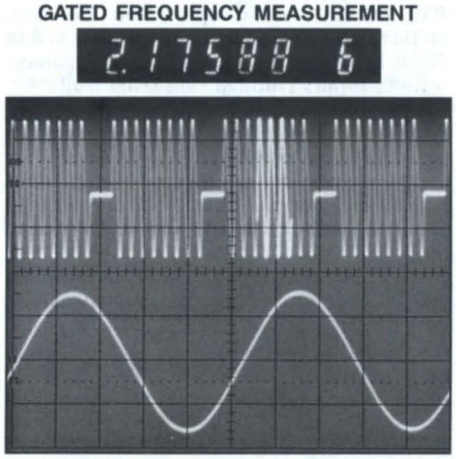


Figure 1. With the B sweep triggered, the frequency within the intensified zone on the A sweep is measured.

GATED PERIOD MEASUREMENT

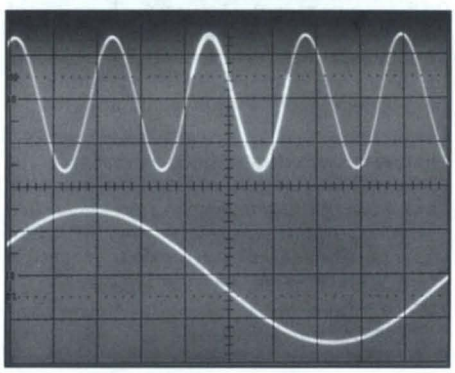


Figure 2. With the B sweep triggered, the period within the intensified zone on the A sweep is measured.

GATED WIDTH MEASUREMENT

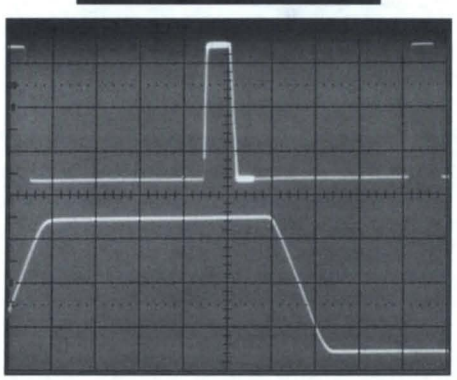


Figure 3. With the B sweep triggered, the width to be measured is within the intensified zone and polarity is selected by the B trigger slope control.

CHANNEL 1 VOLTS MEASUREMENT

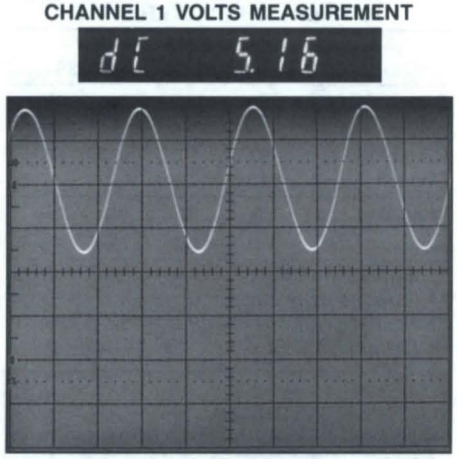


Figure 4. The average dc or true ac RMS component of a waveform is measured directly through channel 1 or from the floating DMM input.

DELAY TIME MEASUREMENT

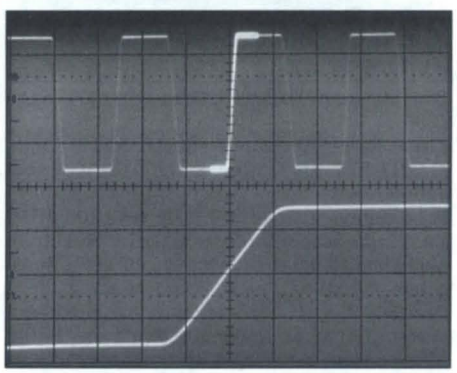


Figure 5. Delay time is measured from the start of the A sweep to the start of the intensified zone.

DELTA TIME MEASUREMENT

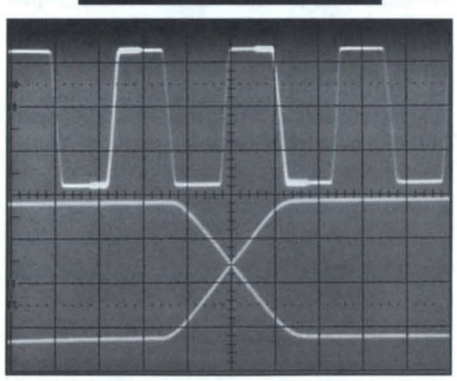


Figure 6. The time between the two intensified zones on the A sweep is measured with up to 10-picosecond resolution.

EXTENDED RANGE RESISTANCE MEASUREMENT

Figure 7. 0Ω (with 0.01 Ω resolution) to 1.99 GΩ, to find hard-to-trace problems like leaky capacitors or defective transformers.

OPERATOR PROMPTING

Figure 8. Error messages and prompts make counter/timer/DMM measurements easier.

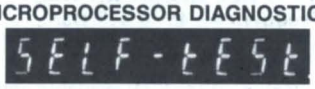
DIODE DETECTION AND TEST

Figure 9. Automatic junction detection during normal resistance measurements first displays "DIODE" and then the forward voltage drop to 1%.

TEMPERATURE MEASUREMENT

With optional P6602 Probe: From −62 to +230°C (−80 to +446°F); resolution to 0.1° (either range).

MICROPROCESSOR DIAGNOSTICS



Automatic power-up and user-interactive diagnostic routines simplify CTM service.

ACCURATE TIME MEASUREMENT

Time base error only 10 ppm (0.001%) standard, and only 0.5 ppm (0.00005%) with optional temperature compensated crystal oscillator.

MEASUREMENT EASE AND ACCURACY

See the measurement you make on the CRT, read the result with digital accuracy on the 9-digit display.

GATED TOTALIZE MEASUREMENT

With the B sweep triggered, the events within the intensified portion of the A sweep are totalized. A single events count can be made using single sweep.

CONTINUITY MEASUREMENT

For Continuity Measurement Resistances >5 Ω, the message "OPEN" is displayed. <5 Ω, a tone is generated and the message "SHORT" is displayed.

X-Y OPERATION

Deflection Factors—Same as vertical system (V/div switch in calibrated detent).

Accuracy

	Y-Axis	X-Axis
+15 to +35°C	±2%	±3%
0 to +50°C	±3%	±4%

Bandwidth—Y-Axis: same as scope's vertical system. X-Axis: 2.5 MHz.

Phase Difference Between X-Axis and Y-Axis Amplifiers—±3° from dc to 150 kHz with dc coupled inputs.

CRT AND DISPLAY FEATURES

CRT—8×10 cm display; internal unilluminated graticule (2235 Option 01 is illuminated). Accelerating potential: 14 kV. GH (P31) phosphor standard.

Controls—Beam Finder, Focus, Separate A and B Sweep Intensity, Trace Rotation. 2235 Option 01 also has Variable Scale Illumination.

Z-Axis Input—DC coupled, positive-going signal decreases intensity; 5 V p-p signal causes noticeable modulation; dc to 20 MHz.

OTHER CHARACTERISTICS

Probe Adjust Signal—(2235/2236) Square wave, 0.5 V ±5%, 1 kHz ±20%.

Amplitude Calibrator—(2235 Option 01 only) Square wave, 0.5 V ±2%, 1 kHz ±20%.

POWER REQUIREMENTS

Line Voltage Range—90 to 250 V ac. (No line switches or fuse changes needed.)

Line Frequency—48 to 440 Hz.

Maximum Power Consumption—2235: 40 W, 70 VA. 2236: 60 W, 110 VA.

DC Operation—12 to 30 V available with 1105, 1106, and 1107.

ENVIRONMENTAL

Ambient Temperature—Operating: 0 to +50°C (except 2236 CTM ac RMSV, DCV, and Ω Modes: 0 to +40°C) Nonoperating: −55 to +75°C.

Altitude—Operating: To 4600 m (15,000 ft). Maximum operating temperature decreased 1° C/1,000 ft (5,000 to 15,000 ft). Nonoperating: To 15 000 m (50,000 ft).

Vibration—Operating: 15 minutes along each of the major axes. 0.015-in. p-p displacement 10 to 55 to 10 Hz in one minute cycles. Held for 10 minutes at 55 Hz (2.4 g's at 55 Hz).

Humidity—Operating and Nonoperating: 95%, five cycles (120 hours) referenced to MIL-T-28800C, Paragraph 4.5.5.1.2.2.

Shock—Operating: 30 g's, ½ sine, 11-ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.

EMC—Meets Class B requirements per VDE 0871B for radiated and conducted emission. 2235 Option 01 AN/USM 488 Only: Meets requirements of MIL-STD-461B Part 4, CE03, CS01, CS02, CS06, RE02 (to 1 GHz), and RS03 (1 V/meter to 1 GHz).

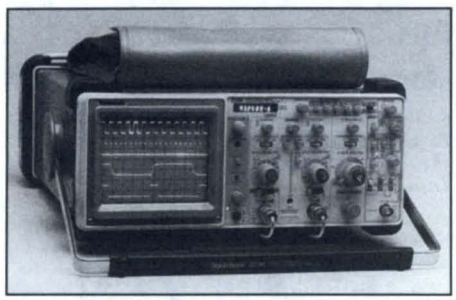
PHYSICAL CHARACTERISTICS

	2235 & 2235 Opt 01		2236	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width*1	328	12.9	328	12.9
Height*3	137	5.4	137	5.4
Depth*2	440	17.3	440	17.3
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	6.1	13.5	7.3	16.2

*1 *Without handle.*

*2 *Without front cover.*

*3 *2235 Option 01 height with pouch is 150 mm (5.9 in.).*



2236 with Counter/Timer/Multimeter

The following characteristics are unique to the 2236.

Time Base Accuracy—Standard: 10 ppm (0.001%). With Option 14 TCXO: 0.5 ppm (0.00005%).

Frequency—Range: ≤0.2 Hz to ≥100 MHz. Maximum Resolution: 0.00001 Hz. Maximum Accuracy: Equal to time base accuracy. Can be gated.*1*2

Period—Range: ≥5 s to ≤10 ns. Maximum Resolution: 10 ps. Maximum Accuracy: Equal to time base accuracy. Can be gated.*1*2

Width—Range: ≥5 s to ≤5 ns. Maximum Resolution: 10 ps. Maximum Accuracy: Equal to time base accuracy ±10 ns. Can be gated.*1*2

Delay Time—Range: ≥2.5 s to ≤500 ns. Maximum Resolution: 10 ps. Maximum Accuracy: Equal to time base accuracy ±20 ns.*2

ΔTime—Range: ≥2.5 s to ≤1 ns. Maximum Resolution: 10 ps. Maximum Accuracy: Equal to time base accuracy ±50 ps.*2

Totalize—Over 8,000,000 events. Can be gated.

DC Volts—Range: 0 to 500 V. Maximum Resolution: 100 μV. Accuracy: ±0.1%. Input: Through side DMM leads.*2

RMS AC Volts—AC Coupled: True RMS with 20 Hz to 20 kHz frequency range. Range: 0 to 350 V. Maximum Resolution: 100 μV. Accuracy: ±1.0%. Input: Through side DMM leads.*2

CH 1 Volts—Measures average dc voltage (with CH 1 dc coupling) or true RMS voltage (with CH 1 ac coupling); 1X/10X ranged by coded probes: Single Sweep button zeros display and permits relative dc and ac RMS measurements. Range, dc and ac Volts: 0 to 50 V (500 V dc/350 V ac with P6121 10X Probe). Maximum Resolution, dc and ac Volts: 100 μV (1 mV with P6121). Maximum Accuracy, dc Volts (18 to 28°C): ±0.3% with 1X probe, ±0.5% with 10X probe. Maximum Accuracy, ac Volts with 1X probe (18 to 28°C): ±2%, 50 to 100 Hz, ±1%, 100 Hz to 20 kHz. Maximum Accuracy, ac Volts with 10X Probe: ±2%, 20 Hz to 20 kHz, with proper probe compensation.*2

Resistance—Range: 0 Ω to 1.99 GΩ. Maximum Resolution: 0.01 Ω. Accuracy: To 0.15%. Automatic diode detection displays forward voltage drop to ±1%; continuity mode activates tone if resistance is <5 Ω.*2

Temperature—Uses Optional Tektronix P6602 Temperature Probe. Temperatures in C or F selected with Freq/ΔTime button. Range: −62 to +230°C (−80 to +446°F). Resolution: To 0.1° (either range). Accuracy: To ±2% of reading ±1.5°C; ±2% of reading ±2.70°F.

Multimeter Inputs—Isolated from oscilloscope ground. Input Z: 10 MΩ. Maximum Input Voltage: 500 V (dc+peak ac), for all functions.

*1 *Ranges, resolutions, and accuracies can be degraded due to gating errors and a smaller number of automatic averages made during a gated frequency, period, or width measurement. For complete formula specifications see operator's manual.*

*2 *For complete accuracy and resolution error formula specifications see operator's manual.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

2236 Oscilloscope With Counter/Timer/Multimeter **$2,995**
Includes: Two P6109 10X voltage probes; DMM leads; Reference Guide; Operator Manual (070-4205-00).

2235 Oscilloscope **$1,595**
Includes: Two P6109 10X voltage probes; Operator manual (070-4207-00).

2235 Option 01 Oscilloscope (AN/USM-488) Order 2235L **$2,395**
Includes: Two P6122 10X Voltage Probes; P6101A 1X Voltage Probe; viewing hood (016-0566-13); BNC T-connector (103-0030-00); BNC male to binding post (103-0033-00); front panel cover (200-2520-00); accessory pouch (016-0677-02); two grabber tips (013-0191-00); Operator Manual (070-4976-00); Service Manual (070-4977-00).

OPTIONS

Option 02—(2235, 2236 only) Front panel cover and accessory pouch. **+$50**

Option 14—(2236 only) TCXO Temperature-Compensated Crystal Oscillator, 0.5 ppm accuracy. **+$315**

Option 33—Travel Line Package
Includes rubber molding, accessory pouch, front panel cover, carrying strap.
(2235) **+$295**
(2236) **+$295**

CONVERSION KITS

Rackmount Adapter—
Includes: Rackmount depth extenders, all mounting hardware, labels, instruction manual.
(2335) Order 016-0466-00 **$145**
(2235 Option 01) Order 016-0833-00 **$155**
(2236) Order 016-0015-00 **$230**

TCX0 Retrofit Kit—(2236 only) Temperature compensated crystal oscillator, 0.5 ppm accuracy.
Order 040-1136-00 **$370**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz. Order 020-0859-00. **$26**

Option A2—UK 240 V, 50 Hz. Order 020-0860-00. **$37**

Option A3—Australian 240 V, 50 Hz. Order 020-0861-00. **$27**

Option A4—North American 240 V, 60 Hz. Order 020-0862-00. **$30**

Option A5—Switzerland 220 V, 50 Hz. Order 020-0863-00. **$19**

WARRANTY-PLUS SERVICE PLANS
See Customer Service Section

M1—(2235/2235 Option 01) 2 Calibrations. **+$130**
M1—(2236) 2 Calibrations. **+$151**
M2—(2235/2235 Option 01) +2 Years Service. **+$169**
M2—(2236) +2 Years Service. **+$191**
M3—(2235/2235 Option 01) 2 Years Service & 4 Calibrations. **+$428**
M3—(2236) 2 Years Service & 4 Calibrations. **+$493**
M4—(2235/2235 Option 01) 5 Calibrations. **+$308**
M4—(2236) 5 Calibrations. **+$361**
M5—(2235/2235 Option 01) 9 Calibrations +2 Years Service. **+$721**
M5—(2236) 9 Calibrations +2 Years Service. **+$837**

OPTIONAL ACCESSORIES

Front Panel Cover and Accessory Pouch[*1] —Order 020-0672-02 **$55**

Front Panel Cover[*1] —
Order 200-2520-00 **$5**

Accessory Pouch[*1] —
Order 016-0677-02 **$45**

Viewing Hoods—
(Collapsible) Order 016-0592-00 **$15**
(Binocular) Order 016-0566-00[*1] **$21**
(Polarized) Order 016-0180-00 **$60**

Carrying Strap—
Order 346-0199-00 **$17.50**

Carrying Case[*2] —
Order 016-0792-01 **$225**

Rackmount Adaptor Kits—
(2235) Order 016-0466-00 **$145**
(2235 Option 01)
Order 016-0833-00 **$155**
(2236) Order 016-0015-00 **$230**

CRT Light Filter—
(Clear[*1]) Order 337-2775-01 **$1.95**
(Blue) Order 337-2775-00 **$3.80**

1107 Mounting Kit—
Order 016-0785-00 **$60**

1107 DC Inverter—See page 316 **$1,175**

1106 Battery Pack—See page 315 **$1,580**

1105 Power Supply—See page 315 **$2,090**

A6901 Ground Isolation Monitor—See Signal Acquisition Section. **$760**

A6902B Voltage Isolator—
See Signal Acquisition. **$1,980**

RECOMMENDED PROBES

See Signal Acquisition for additional probes.

P6109 Probe—Opt. 01 for 2236/2235. **$58**
P6062B—1X, 10X Switchable Probe. **$175**
P6130—10X Subminature Probe. **$130**
P6121—10X Probe. **$100**
P6122—10X Probe. **$58**
P6420—DMM RF. **$155**
40 kV DMM—Order 010-0277-00 **$185**
P6602 Temperature Probe—For use with 2236 CTM. **$260**

RECOMMENDED CAMERAS

C-5C—See Instrument Documentation Devices Section.
(2235 Option 01) C-5C Option 02 **$465**
(2235, 2236) C-5C Option 04 **$495**

C-7—
(2235, 2236) C-7 Option 02 **$610**
(2235 Option 01) Option 03 **$580**

C-4—(2235 Option 01) **$410**

RECOMMENDED CART

K212—For on-site mobility. See Cart Section. **$350**

SERVICE MANUALS

(2235) Order 070-4206-00 **$26**
(2236) Order 070-4204-00 **$34**

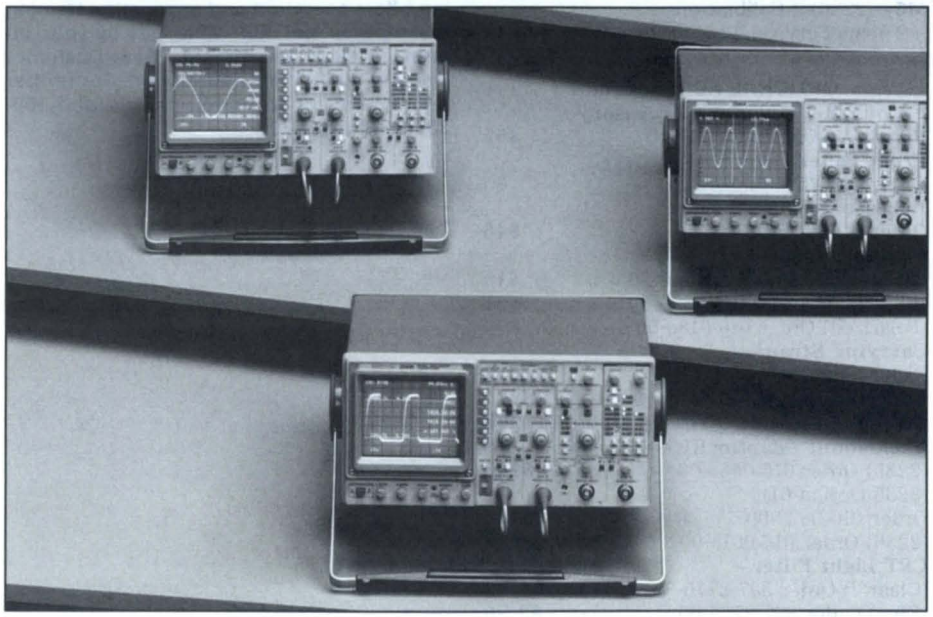
[*1] *Standard with the 2235 Option 01 (AN/USM-488).*

[*2] *Recommend use with front panel cover (200-2520-00).*

TRAINING

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. See Customer Training Section for information. For further information, or to enroll, call us at 1-800-835-9433 ext. 430.

2240 Series Portable Analog Oscilloscopes



NEW 2245A/ 2246A/2247A

TYPICAL APPLICATIONS

- Logic Design and Repair
- Communications
- Power Supply Design
- Manufacturing

BENEFITS

- 3 Year Warranty—5 Year Optional
- UL Listed, CSA Certified
- Measurement Productivity

FEATURES

- 100 MHz Bandwidth, 4 Channels
- Auto Setup
- On-Screen Scale-Factor Readouts
- SmartCursors™ Track Voltmeter Measurements and Trigger Level and Ground (2246A/2247A)
- Time Measurements with Cursors
- Store/Recall of 20 Front-Panel Setups (2246A/2247A)
- Volt, Time, 1/Time Cursors
- Meets or Exceeds MIL-T-28800D for Harsh Environments (2246 Opt 1Y and 2246 Mod A)
- Hands-Off Voltmeter Measurements ±Peak, Peak to Peak Gated ±Peak, Gated Peak to Peak, DC (2246A/2247A)
- Automatic Rise/Fall Time Measurements (2247A)
- Automatic Propagation Delay Time Measurements (2247A)
- Integrated Counter Timer (2247A)
- Gated Counter Measurements (2247A)
- Delayed Sweep Cursors (2247A)
- Frequency Ratio Measurements (2247A)
- Operator Error Messages

Higher Performance, Lower Price

The performance/price ratio for portable oscilloscopes has been substantially upgraded. No other portable scope can offer the range of productivity enhancing features and performance characteristics at a comparable low price as that offered by the Tektronix 2245A, 2246A and 2247A.

Features That Promote Productivity

Auto setup of the front panel automatically adjusts vertical, horizontal, triggering and display controls to display the waveform, no matter where they were previously set. Store and recall 20 battery-backed front panel configurations, which aid in repetitive measurements (2246A and 2247A).

More Triggering Flexibility

Hands-free triggering, made possible by the Auto-Level mode, automatically places a stable display of almost any waveform on screen. The LF, HF, and Noise Reject modes, together with a 10-to-1 holdoff range, deliver stable triggering on complex waveforms. The built-in TV Line and TV Field triggering capability extends measurements to most video-related applications with performance for the broadcast industry.

Performance Plus

The New 2245A, 2246A, and 2247A oscilloscopes have low-noise vertical systems that produce sharp, bright traces. Their 2-ns time base and 100-MHz bandwidth bring out the details on high-speed signals and render measurements with good timing resolution.

Low-level signal measurements are easily managed by the 2 mV/div vertical sensitivity (2 mV bandwidth is 90 MHz) and by trigger sensitivity that extends to 0.35 div at 25 MHz (1.0 div at 150 MHz).

Voltage Measurements With the Push of a Button

A pushbutton-activated measurement system on the 2246A and 2247A enhances productivity even more. This scope quickly turns out virtually hands-off measurements of +peak, −peak, peak-to-peak, dc, and gated volts, all with the convenience of on-screen readout of values.

If more visual indication is desired, the unique cursor system can provide feedback showing exactly where on the waveform an automatic measurement is being made. These feedback cursors, when selected, even show ground and trigger-level locations.

There is also the ability to use cursors manually to make point-to-point time and voltage measurements. This includes time-interval measurements between a point on the reference waveform and a point on any of four other displayed waveforms.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

Counter/Timer Productivity

The new 2247A delivers the crystal controlled timing accuracy and extra measurement productivity power you need for digital systems. Frequency, period, and width are measured directly from the scope's vertical inputs. Time intervals can be measured with push-button ease. The 2247A is easily set up to perform gated time measurements; this allows the user to select specific start and stop points for the counter measurement.

Automatic measurements are key in improving measurement productivity. The 2247A can automatically measure rise and fall times (both 10-90% and 20-80%) and propagation delay times. These measurement setups can be saved in the scope's store/recall memory, either to be recalled later or used as part of a sequence. Recalled measurements are then completely automatic and require no operator intervention.

With the Totalize mode, you can record the passing of unusual events or verify a burst of events on any vertical channel. Frequency Ratio can be useful in comparing the frequencies of two input signals.

Cursors after delay are possible on the 2247A, allowing accurate measurements to be made of expanded waveforms.

Coupled with all these advanced measurement capabilities are user aids to further simplify operation, such as; user prompting and providing status and error messages to guide instrument setup.

The 2247A provides high accuracy and resolution measurements. It also provides an external time base input so you can provide your own time base standard to further increase accuracy.

Three-Year Warranty

The 2245A, 2246A, and 2247A are covered by the Tektronix three-year instrument warranty, making ownership more cost effective than ever.

CHARACTERISTICS

Characteristics are common to the 2245A, 2246A and 2247A, except where indicated.

VERTICAL SYSTEM

Display Modes—CH 1, CH 2, CH 3, CH 4, Add (CH 1+CH 2), Invert (CH 2), Alternate and Chopped display switching for all channels, and 20-MHz bandwidth limiting

CHANNEL 1 AND CHANNEL 2

Frequency Response (−3 dB Bandwidth)—100 MHz: 0 to 35 °C; 90 MHz: 35 to 50 °C (100 MHz 35 to 55 °C).*1

AC Coupled Lower −3 dB Frequency—10 Hz or less with 1X probe. 1 Hz or less with standard accessory 10X probe.

Rise Time—≤3.5 ns for temperatures from 0 to +35 °C. ≤3.9 ns for temperatures from +35 to +50 °C (rise times calculated from: $t_r = 0.35/BW$).

Deflection Factor Range—2 mV/div to 5 V/div in a 1-2-5 sequence of 11 steps.

Maximum Error—±2% 15 to 35 °C (add ±1% from 0 to 15 °C and from 35 to 50 °C).

Variable Range—Continuously variable between Volts/Div step settings. Increases step setting by at least 2.5 V/div.

Uncalibrated Indicators—>symbol appears on-screen when deflection factor is between calibrated Volts/Div step settings.

Channel Isolation—50 dB or more attenuation of deselected channel at 10 MHz. 34 dB or more at 100 MHz (measured with an eight div input signal and equal Volts/Div settings on both channels from 2 mV/div to 0.5 V/div).

CH 2 Signal Delay With Respect to CH 1—<200 ps difference (400 ps*1).

Input Characteristics—1 MΩ ±1% (2%*1) shunted by 20 pF ±0.5 pF (±2 pF*1). Maximum Input Voltage: 400 V (dc+peak ac); 800 V ac p-p at 10 kHz or less.

Common-Mode Rejection Ratio (ADD Mode With CH 2 Inverted)—At least 10:1 at 50 MHz. (for common-mode signals of eight div or less and with Var Volts/Div control adjusted for best CMRR at 50 kHz at any Volts/Div setting). (25:1 at 10 MHz; 10:1 at 100 MHz*1).

Trace Drift—Between Volts/Div Step Settings: 0.2 div or less. Var Volts/Div Rotated Between Extremes: 1 div or less. Inverting CH 2: 1 div or less. Between Gnd and DC Input Coupling: <0.5 mV from 0 to +35 °C; <2 mV from 35 to 50 °C.

Position Range—At least ±11 div from graticule center (±10 div*1).

CHANNEL 3 AND CHANNEL 4

Frequency Response—Same as CH 1 and CH 2.

Rise Time—Same as CH 1 and CH 2.

Deflection Factor—Settings: 0.1 V/div and 0.5 V/div.

Maximum Error—Same as CH 1 and CH 2.

CH Isolation—34 dB or more attenuation of deselected channel at 100 MHz (measured with an eight div input signal).

CH 4 Signal Delay With Respect to CH 3—<200 ps difference (<400 ps*1).

Input Characteristics—1 MΩ ±1% (2%*1) shunted by 20 pF ±0.5 pF (±2pF*1). Max Input Voltage: 400 V (dc+peak ac); 800 V p-p ac at 10 kHz or less.

Trace Shift—Between Volts/Div Settings: 1 div or less.

Position Range—Same as CH 1 and CH 2.

*1 *2246 Option 1Y/2Y (Mod A)*

ALL CHANNELS

Low Frequency Linearity—≤0.06 div compression or expansion of a 2 div, center-screen signal when positioned anywhere within the graticule area.

Bandwidth Limit—Reduces upper −3 dB bandpass to a limit of 17 to 23 MHz. (15 to 25 MHz*1).

Trace Separation Range—±4 div.

Chop Mode Switching Rate—625 kHz±10%.

CH 3 or CH 4 Signal Delay With Respect to Either CH 1 or CH 2—<400 ps difference. (800 ps*1).

HORIZONTAL SYSTEM

Display Modes—A (main sweep), A Alternate with B (delayed sweep), and B. In X-Y mode, CH 1 provides X-axis (horizontal) deflection.

A Sweep Time Base Range—0.5 s/div to 20 ns/div in a 1-2-5 sequence of 24 steps. X10 magnification extends fastest sweep rate to 2 ns/div.

B Sweep Time Base Range—5 ms/div to 20 ns/div in a 1-2-5 sequence of 21 steps. X10 magnification extends fastest sweep rate to 2 ns/div.

Variable Timing Range—Continuously variable between Sec/Div calibrated step settings. Extends slowest A sweep and B sweep speeds by a factor of a least 2.5 times. Affects the A Sec/Div setting with the A display mode; affects the B Sec/Div setting with the Alt and B modes.

A Sweep Timing Accuracy*2

Range	Unmagnified	Magnified
+15 to +35°C	±2%	±3%
0 to +15°C +35 to +50°C	±3%	±4%

Linearity—±5% over any two of the center eight div, on both unmagnified and magnified displays (2245A/46A/47A only).

Delay Time—Range: <0.1 div to >10 div of the A sweep. (Maximum value does not exceed end of the A sweep.) Jitter: 1:20,000 p-p (0.005%) (viewed over two seconds).

ΔTime—Range: 0 to >9.9 div to right of the delay time setting (does not exceed end of the A sweep) Accuracy: ±0.5% of reading +1% of one A sweep div (±1% of reading + 1% of one A sweep div).*1

TRIGGERING

Trigger Sensitivity from CH 1, CH 2, CH 3, CH 4 Source.

DC Coupled—0.35 div or greater triggers from dc to 25 MHz, increasing to 1 div at 150 MHz (100 MHz*1).

Noise Reject Coupled—0.8 div or more triggers; 0.5 div or less does not trigger.

HF Reject Coupled—0.35 div or greater triggers from dc to 50 kHz; 0.25 div or less does not trigger above 50 kHz.

LF Reject Coupled—0.35 div or greater triggers from 100 kHz to 25 MHz; 0.35 div or greater does not trigger from dc to 10 kHz.

*1 *Applies over the center eight div. Excludes the first 0.25 div of the magnified sweep and sweep beyond the 100th magnified div.*

AC Coupled—0.35 div or greater triggers from 50 Hz and 25 MHz; 0.35 div or less does not trigger from dc to 5 Hz.

For dc, LF Reject, and ac coupling above 25 MHz, triggering signal requirement increases to 1.0 div at 150 MHz (100 MHz*1).

Trigger Sensitivity From TV Line or TV Field Source—0.5 div or more of composite sync achieves stable display.

Lowest Usable Frequency With Auto Level Function—10 Hz.

Level Control Range—±20 div (referenced to the selected source).

Level Readout Accuracy—±(0.3% of reading +0.1 div).

Variable Holdoff Range—Increases the A sweep holdoff time by at least a factor of 10 (factor of 2*1).

X-Y OPERATION

Deflection Factors—Same as vertical system (Var Volts/Div in calibrated detent).

Maximum Error

Range	Y-Axis	X-Axis
15 to 35°C	±2%	±3%
0 to +15°C 35 to 50°C	±3%	±4%

X-Axis −3 dB Bandwidth—3 MHz or more.

Phase Difference Between X and Y—≤3° (for dc coupled signals from dc to 50 kHz with bandwidth limit off) (100 kHz*1).

FRONT PANEL DISPLAY

Auto Set Up—Adjusts Vertical, Horizontal, Trigger, and Intensity controls for all displayed channels (2245A/46A/47A only).

Controls—Separate A Intensity, B Intensity, Readout Intensity, Focus, Beam Finder, Trace Rotation, and Scale Illumination.

CRT—8×10 cm internal graticule. Markings: 8 major div vertically and 10 major div horizontally, with auxiliary markings.

Standard Phosphor—GH (P31).

Y-Axis Orthogonality—≤0.1 div over eight vertical div; no adjustment.

FRONT PANEL SETUP MEMORY (2246A/2247A only)

Lithium Battery—Memory retains ≥3 years.

Memory—20 front panel setups max. Can be configured in multiple sequences.

CURSOR FUNCTIONS

Function	Accuracy
Sec; 1/Sec; Phase; ΔTime; Δ1/Time; ΔPhase	±0.5% of reading +0.02 horizontal div
Volts; Ground Volts (2246A/2247A/*1)	±0.5% of reading +0.02 vertical div+HF display errors
Track Measurement, Trig Level, Ground	±0.05 vertical div

*1 *2246 Option 1Y, 2Y, and Mod A.*

EXTERNAL Z-AXIS INPUT

Active Region Lower Threshold—≤1.8 V.

Signal Required to Blank Sweep-Related L Trace—≥3.8 V; +V decreases sensitivity.

Input Resistance to Ground—10 kΩ ±10%.

Maximum Input Voltage—30 V (dc+peak ac) or ≤30 V ac p-p at 1 kHz.

CALIBRATOR OUTPUT

Voltage Into 1-MΩ Load—0.5 V ±2% (±0.1*1).

Repetition Range—1 kHz +10%.

Overshoot—≤0.1%.

POWER REQUIREMENTS

Line Voltage Range—90 to 250 V ac.

Line Frequency—48 to 445 Hz.

Fuse Rating—2 A, 250 V, slow-blow.

Maximum Power Consumption—100 W (155 VA).

ENVIRONMENTAL

Environmental requirements qualify the electrical and mechanical specifications. When not rackmounted, the instrument meets the applicable environmental capabilities of a Type III, Class 3, Style D instrument as prescribed by MIL-T-28800D.

Ambient Temperature—Operating: 0 to +50°C. Nonoperating: −50 to −75°C.

Altitude—Operating: To 4500 m (15,000 ft). Maximum operating temperature decreases 1°C for each 300 m (1,000 ft) above 1500 m (5000 ft). Nonoperating: to 15 250 m (50,000 ft).

Vibration—Operating: 15 minutes along each of three axes, 0.025 inch p-p displacement. 10 to 55 Hz in one minute sweeps. Held for 10 minutes at 55 Hz (4.0 g's at 55 Hz).

Humidity—Operating and Nonoperating: 95%, five cycles (120 hours) referenced to MIL-T-28800D, Paragraph 4.5.5.1.2.2 for Type III, Class 3.

Shock—Operating and Nonoperating: 30 g, half sine, 11-ms duration; three shocks on each face, for a total of 18 shocks, MIL-T-28800D.

Bench Handling Test—4 inch drop per MIL-7-28800-D par 4.5.5.4.3.

Transportation Drop and Vibration—Meets the limits of National Safe Transit Assoc. procedure 14-13-1.

EMC—Meets VDE0871B for radiated and conducted emissions.

1Y/Mod A EMC—Improved EMC performance available in Opt 1Y-Mod A (Refer to Operator's manual).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width w/handle	362	14.6
Height w/feet & pouch	177	7.0
w/o pouch	164	6.4
Depth w/front cover	445	17.5
w/handle extended	521	20.5
Weight ≈	**kg**	**lb**
Net w/accessories & pouch	8.9	19.6
w/o accessories & pouch	7.9	17.4

*2 *Cursor position on waveform vs readout displayed value.*

NEW 2246A/2247A

With Voltmeter

DC Volts—Accuracy: ±0.3% of reading (+0.02 div). Normal Mode Rejection Ratio: >50 dB at 50 and 60 Hz.

+Peak and −Peak Volts—Accuracy: ± (2% of reading +0.1 div)[±(2% of reading +15% of one vert div +1.5 mV)*1] for signals from 25 Hz to 25 MHz. Gated Region Minimum Width: ≤(0.2div +50 ns).

P-P Volts—Accuracy: (±2% of reading +0.1 div)[±(2% of reading +15% of one vert div +1.5mV)*1]. For signals from 25 Hz to 25 MHz. −3dB from 25 to 100 MHz. Gated Region Minimum Width: ≤(0.2 div +50 ns).

NEW 2247A

With Counter/Timer

Time Base Accuracy—Short-term error: 10 ppm (0.001%). Long-term drift: 2 ppm change per year.

Frequency—Range: 0.01 Hz to 100 MHz. Maximum resolution: 0.00000001 Hz. Maximum accuracy: Up to time base accuracy. Can be gated.*3*4

Period—Range: 100 s to 10 ns. Maximum resolution: 0.1 fs. Accuracy: Up to time base accuracy. Can be gated.*3*4

Width—Range: 100 sec to 5 ns. Maximum Resolution: 1 ps. Maximum accuracy: Up to time base accuracy ±2 ns. Can be gated.*3*4

Totalize—Range: 0 to 999999999 events.

Gated Events—Range: 0.000001 to 999999999.0, averaged*4

Frequency Ratio—Range 0.00000001 to 99999999.

Delta Time—Counter/Timer is used when the horizontal mode is ALT or B. Range: 0 to >±5 sec. Maximum resolution: 1 ps. Maximum accuracy: Up to time base accuracy ±100 ps.*4

1/Delta Time—Counter/Timer is used when the horizontal mode is ALT or B. Range 0.2 Hz to 10 GHz.*4

Rise/Fall Time—Range: 0 to >5 sec. Maximum Resolution: 1 ps. Accuracy: Up to time base accuracy ±2 ns.*4

Propagation Delay Time—Range: 0 to >±5 sec. Maximum Resolution: 1 ps. Maximum accuracy: Up to time base accuracy ±100 ps. Selectable set zero reference.*4

External Clock Input—10.1 kΩ, ac coupled. Sensitivity: 1 Vp-p. Max input V: 35 V dc peak ac. Allowable frequencies: 1.0, 5.0, and 10.0 MHz.

*3 *Ranges, resolutions, and accuracies can be degraded due to gating errors and a smaller number of automatic averages made during a gated frequency, period, or width measurement. For complete formula specifications see operator's manual.*

*4 *For complete accuracy and resolution error formula specifications see operator's manual.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

2245A—100 MHz Oscilloscope with Cursors $1,895
Includes:—Two P6109 Option 1 10X voltage probes, Operators Manual (070-6558-00), Operators Guide (070-6718-00).

2246A—100 MHz Oscilloscope with Voltmeter $2,395
Includes: Two P6109 Option 1 10X voltage probes, Operators Manual (070-6556-00), Operators Guide (070-6576-00).

2247A—100 MHz Oscilloscope with Counter/Timer. $2,795
Includes: Two P6109 Option 1 10X voltage probes, Operators Manual (070-6373-00), Operators Guide (070-6688-00).

2246 Option 1Y—Commercial version of military instrument.*1
Includes: Two P6109 2m 10X probes; 1 6101 2 m 1X probe; improved EMC performance; two service manuals (070-7062-00); two operators manuals (070-7061-00); 2 user Reference Guides (070-7063-00); silver oxide battery (replaces lithium battery); Accessory Pouch with mounting plate (016-0857-01); front panel cover (200-3232-00); Does not include Store/Recall and Auto Setup. National Stock Number 7Z6625-01-260-6908.

2246 Mod A—Commercial version of military instrument. Order 2246 Option 2Y. *1
Includes: Two P6109 2 m 10X probes; one 6101 2 m 1X probe; improved EMC performance; Operator manual (070-7061-00); Reference Guide (070-7063-00); Accessory Pouch with mounting plate (016-0857-01); front panel cover (200-3232-00). Does not include Store/Recall and Auto Setup. National Stock Number 6625-01-275-4766.

OPTIONS

Option 1C—C-5C Option 02 Camera. +$465
Option 1K—K212 Portable Instrument Cart. +$350
Option 1R—19 inch Rackmounted Instrument. +$350
Option 1T—Transit Carrying Case.*1 Option 02—Front Panel Cover and Accessory (020-1515-00) Pouch. +$50
Option 17—Include P6408 Logic Probe. +$350
Option 22—Two P6109 Option 1 10X voltage probes. +$116
Option 23—Two P6062B 1X/10X voltage probes 6 feet. +$350

FIELD RETROFIT KITS

2240F1R—Rackmount Conversion. $350

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

WARRANTY-PLUS SERVICE PLANS

M1—(2245A) 2 Calibrations. +$145
M1—(2246A) 2 Calibrations. +$167
M1—(2247A) 2 Calibrations +$191
M2—(2245A) Plus 2 Years Service. +$175
M2—(2246A) Plus 2 Years Service. +$187
M2—(2247A) Plus 2 Years Service +$194
M3—(2245A) 2 Years Service and 4 Calibrations. +$465
M3—(2246A) 2 Years Service and 4 Calibrations. +$522
M3—(2247A) 2 Years Service and 4 Calibrations. +$576
M4—(2245A) 5 Calibrations. +$335
M4—(2246A) 5 Calibrations. +$399
M4—(2247A) 5 Calibrations +$461
M5—(2245A) 9 Calibrations plus 2 Years Service. +$770
M5—(2246A) 9 Calibrations plus 2 Years Service. +$902
M5—(2247A) 9 Calibrations plus 2 Years Service. +$1,026

OPTIONAL ACCESSORIES

Service Manuals—
(2245A) Order 070-6557-00 $25
(2246A) Order 070-6555-00 $25
(2247A) Order 070-6367-00 *1
Padded Suitcase—Order 016-0792-01. $225
Accessory Pouch—Order 016-0857-00. $48
Accessory Pouch—Order 016-0677-02 $45
Protective Front Panel Cover—Order 200-3232-00. $5.25
Carrying Strap—Order 346-0199-00 $17.50
Rain Cover—Order 016-0848-00 $16.25
Viewing Hoods—
(Collapsible) Order 016-0592-00. $15
(Polarized) Order 016-0180-00. $60
(Binocular) Order 016-0566-00. $21
CRT Light Filter, Clear—Order 337-2775-01. $1.95

*1 *Contact your local sales office*

Portable Power Supply—Order 1105. See page 315. $2,090
Battery Pack—Order 1106. See page 315. $1,580
DC Inverter—Order 1107. See page 316. $1,175
DC Inverter Mounting Kit—Order 016-0785-00. $60
Isolators—
A6901—Ground Isolation Monitor. $760
A6902B—Isolation Amplifier. $1,980

RECOMMENDED PROBES

P6121—10X Probe. $100
P6122—10X Probe. $58
P6130—10X Subminature Probe. $130

Passive Voltage Probes
P6008—10X Probe. $260
P6062B—Switchable 1X/10X. $175
P6101A—Non Attenuating 1X. $53

High Voltage Probes
P6009—1.5 kV 100X Probe. $205
P6015—20 kV 1000X Probe. $725

Active Voltage Probes
P6201—1X FET Probe. $1,280
P6202A—10X FET Probe. $735
P6230—10X Bias/Offset Probe. $420
P6046—Differential Probe. $1,895

Current Probes
P6021—AC Current Probe. $450
P6022—AC Current Probe. $495
A6302—DC/AC 20 A Current Probe (Requires TM500 Mainframe and AM503 Current Amplifier. $625
A6303—DC/AC 100 A Current Probe (Requires TM500 Mainframe and AM503 Current Amplifier. $1,180
CT-4—AC 1000 A Current Transformer. $1,320

RECOMMENDED CARTS

K212—Portable Instrument Cart. $350

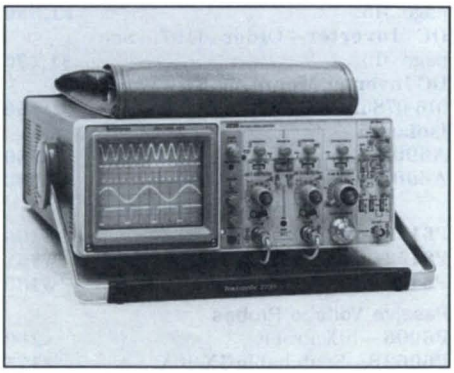
RECOMMENDED CAMERAS

See Instrument Documentation Section
C 5C Option 02— $465
C 7 Option 03— $580
C 4— $410

TRAINING

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your Instrumentation investment. See Customer Training Section for information. For further information, or to enroll, call us at 1-800-835-9433 ext. 430.

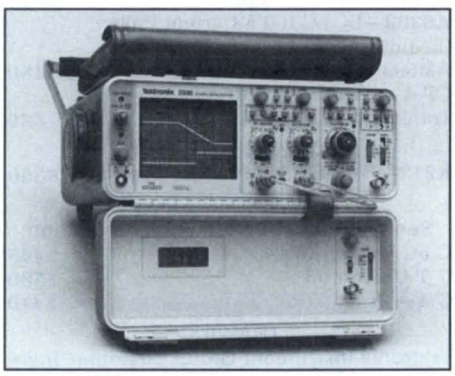
MILITARY AND SPECIAL SERVICE OSCILLOSCOPES



2235 Option 01

- DC to 100 MHz Bandwidth
- Fully Provisioned Through the U.S. Army System
- Meets or Exceeds MIL-T-28800C and MIL-STD-461B Part 4 for EMC/EMI
- Three Year Warranty—Five Year Option
- National Stock Number 6625-01-187-7847
- UL Listed CSA

For complete description see page 175.



2336YA

- DC to 100 MHz Bandwidth
- 5 mV/Div to 5 V/Div
- 5-ns/Div Sweep Rate
- Rugged for Field Service
- Three Year Warranty—Five Year Option
- Meets MIL-T-28800C, Class 3
- National Stock Number 6625-01-172-6119
- UL Listed, CSA

For complete description see page 172.

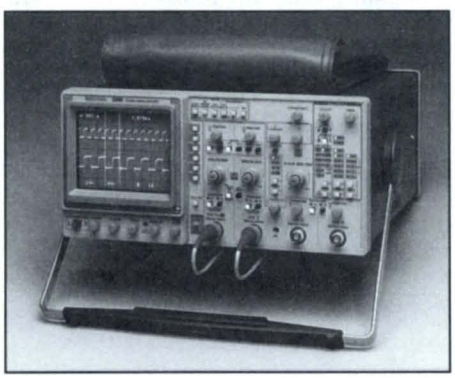
2430M/ NEW 2432M/ NEW 2440M Digital Oscilloscopes

GPIB IEEE-488

The 2430M complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

- Embedded CIIL/MATE Capabilities
- 300-MHz Bandwidth at Probe Tip
- 150 MHz (2430M)
- 5-ns/Div Sweep Speed
- 500 MS/s (2440M)
- 250 MS/s (2432M)
- 100 MS/s (2430M)
- Simultaneous Acquisition of Two Channels
- Envelope Mode With 2-ns Glitch Capture
- 8-Bit Resolution Over 10 Divisions
- Save on Delta (Tek Patented Feature) Provides Unattended Pass/Fail Testing and Babysitting Against a User Defined Reference or Envelope

For complete description see page 220.



2246 Option 1Y/2Y (Mod A)

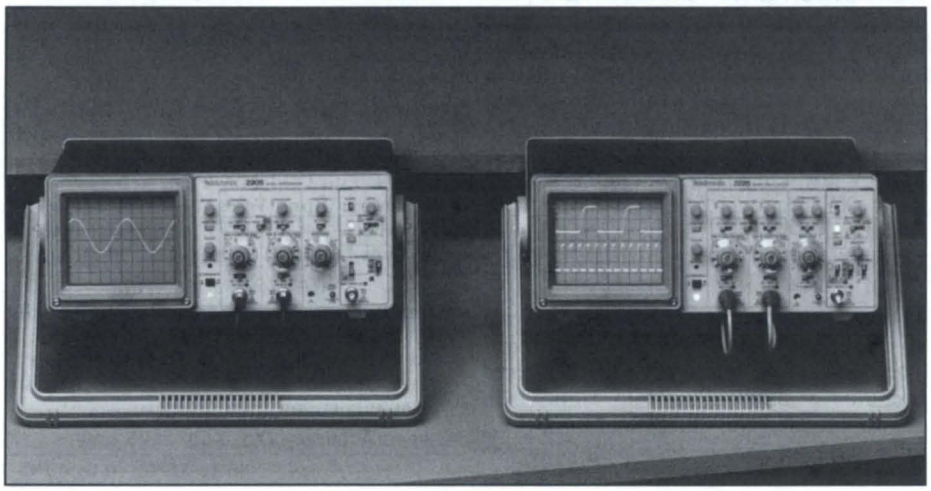
- DC to 100 MHz Bandwidth
- 4 Independent Channels
- 2 ns/Div Time Base
- 2 mV to 5 V/div
- Voltmeter Measurements
- Tracking Smart Cursors
- ΔTime with Cursors or Alternate Sweep
- Meets MIL-STD-461C for EMI
- Meets MIL-28800C, Type III, Class 3
- UL Listed
- Three-Year Warranty

For complete description see page 180.

TRAINING

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. See Customer Service Section for information. For further information or to enroll, call us at 1-800-835-9433 ext 430.

2200 Series Portable Analog Oscilloscopes



2225

TYPICAL APPLICATIONS

- Digital Design and Testing
- Field Service
- Amplifier Design and Testing
- Component Testing
- Communications Equipment
- Component Testing

BENEFITS

- 3 Year Warranty—5 Year Option
- UL Listed, CSA Certified

FEATURES

- DC to 50-MHz Bandwidth
- Alternate Magnification
- 500-μV/Div Sensitivity
- HF/LF Reject Trigger Filters
- Lightweight—Easy to Use
- P-P Auto Triggering
- 5 ns/Div Maximum Sweep Rate
- Front Panel Z-Axis Input

Tektronix' innovation redefines the meaning of value with the 50-MHz 2225. The 2225 continues in the 2200 Series tradition of high performance, reliability, and quality.

The technology that made the 2200 Series the most successful oscilloscopes in the world has been utilized in the 2225. The use of fewer mechanical parts, cables, connectors, and components contributes to improved reliability, serviceability, and cost. The result is a high performance easy-to use scope that costs less to build, buy, and own. You will significantly improve your utility while lowering your cost-of-ownership.

In this day and age when everything is becoming more complex, the 2225 has made strides to increase operational simplicity. This is a big plus in education, field service, and manufacturing production-test environments.

All this and new features too. Features like Alternate Magnification, 500 μV/div vertical sensitivity with X10 magnification, independent trigger coupling, high- and low-frequency reject, front-panel Z-axis input, and a new improved bright, crisp CRT.

Alternate Magnification is an exciting new concept in performing waveform expansion and detailed signal analysis. Dual time base types of measurements can be performed with the simple flip of a switch. The CRT alternately displays both the unmagnified and magnified sweeps. Magnification can be selected in three levels: X5, X10, and X50. Measurements like digital signal timing can be performed with little effort, quickly and accurately.

The new low noise vertical system can operate at 500 μV/div (4 times the maximum sensitivity of the previous 2200 Series). X10 vertical magnification provides benefits similar to those usually associated with the horizontal axis. Vertical waveform expansion is made easy with a pull knob. Independent channel bandwidth limiting (5 MHz) is performed with this function. Now you can selectively limit either channel's bandwidth without affecting the other.

All the features and performance you've come to expect in more expensive instruments is available on the 2225: flexibility and high sensitivity of the trigger system, the convenience of hands-free triggering with Peak-to-Peak Auto, independent selection of TV Line or Field triggering at any sweep speed, variable Holdoff for triggering on complex waveform periods, and a 5 ns/div (maximum) horizontal system that is accurate as well as linear.

The 2225 also includes two new P6103 10X modular probes that complement its performance. They incorporate a new ruggedized probe tip and eliminate the usual bulky compensation box at the front of the scope.

Also consider the world-renowned Tektronix service and support organization. You can find support in any area you need from expert sales support, training materials, application assistance, service and calibration, as well as long-term support for a minimum of 6 years after the product is discontinued.

Tektronix backs the reliability of the 2225 with a three-year instrument warranty that includes all parts and labor including the CRT. Beyond the "basic three years," Tek offers you a choice of five practical service plans to further reduce your cost-of-ownership.

NEW 2205

TYPICAL APPLICATIONS

- **Education**
- **Field Service**
- **Production Test**

BENEFITS

- **LIght Weight**
- **Easy to Use**
- **UL Listed, CSA Certified**

FEATURES

- **DC to 20 MHz Bandwidth**
- **5 mV/div Sensitivity**
- **P-P Auto Triggering**
- **10 ns/div Maximum Sweep Rate**
- **Front Panel Z-Axis Input**
- **1 Year Warranty—3 Year Option**

The 20 MHz 2205 Dual Trace Oscilloscope is Tekronix's most basic 2200-Series analog scope. It features a well organized, easily learned front panel, full size CRT, hands-off triggering and low-noise vertical system for clear viewing of low-level signals. Simple, rugged, X1 oscilloscope test leads are included as standard accessories.

The perfect measure of economy plus performance in a true industrial-quality instrument. The 2205 is built to Tektronix standards for ruggedness and environmental performance. It has been designed for safe operation, is U.L. Listed and CSA Certified, and backed by a one year Tektronix warranty that can economically be extended to 3 years.

The 2205 is built on the proven architecture of the 2225, which has served a large portion of the world's oscilloscope market. This architecture makes possible a scope that is more accurate, more reliable, more serviceable and costs less to own, thus continuing the winning tradition with performance that you'd expect to find only in more expensive instruments.

The 2205 has an excellent feature set that includes a sensitive 5 mV/div vertical, fast 10 ns/div horizontal, and flexible trigger system. The trigger system includes single sweep and P-P Auto. P-P Auto enables the trigger system to be operated virtually hands-free. Television servicing was also considered with the 2205, so TV field and TV line triggering is included as standard. XY mode is featured along with front panel access to the Z-axis input, making applications requiring this front panel easy.

The 2205 also is part of Tektronix' lowest cost package for education customers. This package is called the CRS2205 and includes a 2205, Function Generator, Digital Multimeter, and Power Supply all at a package price. See page 136 for details.

Whether your application is industrial or educational, the 2205 is a cost effective solution.

CHARACTERISTICS

(2205 and 2225)

All specifications are rated over all environmental extremes except where noted.

VERTICAL SYSTEM

(Two Identical Channels)

Bandwidth (–3 dB) and Rise Time

2225	5 to 35°C	0 to 40°C
5V to 5 mV/div	50 MHz (7.0 ns)	40 MHz (8.8 ns)
2205	**0 to 35°C**	**0 to 40°C**
5 V to 5 mV/div	20 MHz (17.5 ns)	15 MHz (23.3 ns)

Bandwidth in X10 MAG is reduced to 5 MHz ±20% (2225 only).

Bandwidth Limit (–3 dB)—5 MHz ±20% via X10 MAG (2225 only).

Deflection-Factor Accuracy

	2225/2205	2205
5 mV to 5 V/div	0 to 40°C) ±3% (2225) ±5% (2205)	15 to 35°C ±3%
X10 Magnification	±5%	N/A

Uncalibrated Variable—Continuously variable between steps by at least 2.5:1.

Step Response Aberrations—+5%, –5%, 5% p-p(5 mV to 0.5 V/div (2225 only).

Vertical System Operating Modes—CH 1, CH 2, CH 2 Invert, Add, Alt, Chop (500 kHz).

Common-Mode Rejection Ratio—For signals of 6 divisions or less, at least 10:1 at 20 MHz (2225); 10 MHz (2205).

Input R and C—1 MΩ, 25 pF.

Maximum Input Voltage—400 V (dc+peak ac) or 800 V p-p to 10 kHz (ac and dc coupled).

Channel Isolation—>100:1 at 20 MHz.

HORIZONTAL SYSTEM

Time Base—0.05 μs (0.1 μs 2205) to 0.5 s/div in 1-2-5 sequence. Maximum sweep rate: 5 ns/div (10 ns/div 2205 and in X10 magnification.) Uncalibrated Variable: Continuously variable between steps by at least 2.5:1.

Sweep Accuracy (X5, X50, 2225 only)

	15 to 35°C	0 to 40°C
Unmagnified X1	±3%	±4%
Magnified X5, X10	±4%	±5%
Magnified X50	±5%	±8%

Sweep Linearity—Specified over any 2 of the center eight divisions (0 to 40°C). Unmagnified X1: ±5%. Magnified X5, X10 (X10 only on 2205): ±7%. Magnified X50: ±9%.

Display Modes—X1, Alternate Magnification, Magnified (X1 and X10 only, 2205).

Alternate Magnification—Display alternates between unmagnified (X1) and magnified sweep. Magnification Levels: X5, X10, and X50. Magnifier Registration: Expansion occurs at center vertical graticule line (2225 only).

Magnification Range—Magnification performed over any portion of the X1 (unmagnified) sweep.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

TRIGGERING

Trigger Sensitivity

	Internal	External
5 MHz	0.3 div	40 mV
30 MHz (2205)	1.0 div	150 mV
50 MHz (2225)	1.0 div	150 mV

TV Trigger Sensitivity—TV Field: 1.0 div of composite sync. TV Line: 0.3 div or 40 mV p-p external.
Trigger Operating Modes—Peak-to-Peak Automatic, Normal, TV Field, TV Line, Single Sweep.
Trigger Sources—Internal CH 1, CH 2, Vert Mode, Line, External, and External ÷10.
Trigger Coupling—2225: AC, DC, HF REJ (attenuates signals above 30 kHz), LF REJ (attenuates signals below 30 kHz). 2205: DC coupled only.
Variable Holdoff—Increases X1 Sweep holdoff time by at least 8:1 (2225 only).

X-Y OPERATION

Deflection Factors—Same as vertical deflection system.
Accuracy (0 to +40 °C)—Y-Axis: ±3% (2225), ±5% (2205). X-Axis: ±5%.
Bandwidth—Y-Axis: Same as vertical deflection system. X-Axis: dc to 2.0 MHz (dc to 2.5 MHz, 2205).
Phase Difference Between X and Y axis—Amplifiers: ±3° dc to 150 kHz (dc to 50 kHz, 2205).

CRT AND DISPLAY FEATURES

CRT Display—8×10 cm; internal graticule; P31 phosphor (2205 and 2225). Accelerating potential 12.6 kV (2225), 1.8 kV (2205).
Z-Axis—Sensitivity: 5 Volts causes noticeable modulation, positive voltage decreases intensity. Usable frequency range is dc to 5 MHz.
Display Controls—Intensity, Focus, Beam Find, Trace Rotation.

POWER REQUIREMENTS

Line—Voltage: One line switch 95 to 128 V/190 to 250 V operation. Frequency: 48 to 440 Hz. Power: 40 W (60 V A); 50 W (90 VA) for 2205. Dc power operation with Option 07 (11 to 30V) or Option 30. 1107, 1106, and 1105 are compatible. Power-On light provided.

OTHER CHARACTERISTICS

Amplitude Calibrator—Squarewave, 0.5 V ±5%, 1 kHz ±20%.
Safety—UL Listed, CSA Certified.

ENVIRONMENTAL AND SAFETY

Altitude—Operating: 4,500 m (15,000 feet). Maximum operating temperature decreased 1°C per 1,000 feet above 5,000 feet. Nonoperating: 15,000 m (50,000 feet).
Humidity—Operating and Nonoperating: 95% relative humidity. 5 cycles (120 hours). Spec may be referenced to MIL-T-28800C paragraph modified 4.5.5.1.2.2. (2225 only).
Humidity—Operating and Nonoperating: 85% relative humidity. Four hour test, referenced to Tektronix Standard 062-2847-00 (2205 only).
EMI/EMC—Radiated and conducted emissions meets requirements per VDE 0871 Class B.
Vibration—Operating: 15 minutes along each of 3 major axis at a total displacement of 0.015 inch p-p (2.4 g's at 55 Hz) with frequency varied from 10 Hz to 55 Hz to 10 Hz in one minute sweeps. Hold for 10 minutes at 55 Hz in each of the 3 major axis.
Shock—Operating and Nonoperating: 30 g's, half-sine, 11-ms duration, 3 shocks per axis each direction, for a total of 18 shocks.

PHYSICAL CHARACTERISTICS

	2205/2225	
Dimensions	**mm**	**in.**
Width		
w/handle	385	15.2
w/o handle	327	12.9
Height	138	5.4
Depth	443	17.4
w/handle	516	20.3

	2205		2225	
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	6.7	14.8	6.5	14.3
Shipping	9.1	20.1	8.5	18.7

ORDERING INFORMATION

2205—20-MHz Oscilloscope $695
Includes: Two each oscilloscope test leads (103-0275-00), Operators Manual (070-6717-00).
2225—50 MHz Oscilloscope $1,095
Includes: Two P6103 10 X voltage probes with accessories Operators Manual (070-6298-01).

OPTIONS

Option 02—Front panel cover and accessory pouch (020-1514-00). +$50
Option 07—Internal DC power $195
Option 30—Includes Option 07 and 1104 Battery Pack $495
Option 1C—C5C Option 04 camera. +$495
Option 1K—K212 Portable Instrument Cart. +$350
Option 1R—Rackmount Kit (016-0819-00). +$150
Option 1T—Carrying Case. +$215
Option 1V—Operators Video Tape (VHS-NTSC) +$29
Option 23—Two each P6062B 1X/10X probe +$350
Option 22—With 25 oscilloscope test leads. $60
Option 24—(2205 Only) 2 each P6103 10X probes. +$70

CONVERSION KIT

Rackmount Adapter—Order 016-0819-00. $190

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

WARRANTY-PLUS SERVICE PLANS

M1—(2205) 2 Calibrations. $193
M1—(2225) 2 Calibrations. $106
M2—(2225 only) +2 Years Service. $126
M3—(2225 only) +2 Years Service and 4 Calibrations. $338
M4—(2225 only) +5 Calibrations. $253
M5—(2225 only) +2 Years Service and 9 Calibrations. $580
M9—(2205 only) 2 Years Service. $110

OPTIONAL ACCESSORIES

Service Manuals—
(2205) Order 070-6717-00. $25
(2225) Order 070-6299-00. $25
Padded Suitcase—Order 016-0792-01. $225
Oscilloscope Test Leads Pack of 24*[1]
Accessory Pouch—Order 016-0677-02. $45
Front Panel Cover—Order 200-3397-00 $5
Accessory Pouch and Front Panel Cover—Order 020-1514-00. $55
Viewing Hoods—
(Collapsible) Order 016-0592-00 $15
(Polarized) Order 016-0180-00 $60
(Binocular) Order 016-0566-00 $21
CRT Light Filter, Clear—Order 337-2775-01. $1.95
Portable Power Supply—Order 1105, see page 315. $2,090
Battery Packs—
(1104) +$350
(1106) +$1,580
1107—External DC Inverter $1,175
External DC Inverter Mounting Kit—Order 016-0785-00 $60

RECOMMENDED PROBES

Passive Voltage Probes
P6008—10X probe. $260
P6062B—Switchable 1X/10X probe. $175
P6101A—Non-attenuation 1X probe. $53
P6122—Attenuating 10X probe. $58
High Voltage Probes
P6009—1.5 kV 100X probe. $205
P6015—20 kV 1000X probe. $725
Current Probes
P6021—AC Current Probe. $450
P6022—AC Current Probe. $495
DC/AC 20 A Current Probe—requires TM500 Mainframe and AM503 Current Amplifier.*[1]
DC/AC 100 A Current Probe—requires TM500 Mainframe and AM503 Current Amplifier.*[1]
AC 1000 A—Current Transformer.*[1]

FLOATING MEASUREMENTS

A6901—Ground Isolator Monitor. $760
A6902B—Isolation Amplifier. $1,980

*[1] *Contact your local sales office.*

TRAINING

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. See Customer Training Section for information. For further information, or to enroll, call us at 1-800-835-9433 ext. 430.

305 Oscilloscope

TYPICAL APPLICATIONS

- **Electromechanical Measurements**
- **Medical Electronics Maintenance**
- **Automotive/Motor Vehicle**

FEATURES

- **5 MHz at 5 mV/Div**
- **Dual Trace/DMM**
- **Internal Battery Pack**
- **Full X-Y Display**
- **Low Weight ≈10.6 lb**

The 305 DMM/Oscilloscope is the ideal oscilloscope for those who demand portability and multifunction versatility in their test instrumentation.

CHARACTERISTICS

VERTICAL SYSTEM

Bandwidth—DC to at least 5 MHz. For ac coupling, the lower 3 dB point is ≈10 Hz.
Deflection Factor—5 mV/div to 10 V/div (1-2-5 sequence) accurate ±3% from 0 to +40°C, ±4% through remainder of operating range. Uncalibrated, continuously variable between steps and to at least 25 V/div.
Display Modes—CH 1, CH 2, Chopped, Alternate, Added, Invert CH 2, and X-Y. Bandwidth in Add mode is dc to at least 4.5 MHz.
Input R & C—1 MΩ ±2%, paralleled by ≈47 pF.
Maximum Input Voltage—AC or dc coupled, 250 V (dc+peak ac), or 250 V p-p at <1 kHz.

HORIZONTAL SYSTEM

Time Base—500 ms/div to 1 μs/div (1-2-5 sequence). X10 magnifier extends sweep rate to 0.1 μs/div.
Variable Time Control—Uncalibrated, continuously variable between steps and to at least 1.25 s/div.

Time Base Accuracy*[1]

	0 to 40°C	−15 to +55°C
Unmagnified	±3%	±4%
Magnified	±5%	±6%

*[1] *Center 8 divisions (excludes first 10 divisions and all sweep past 90 divisions in X10 magnifier).*

TRIGGERING

Modes—Normal and Auto (p-p).
TTL Triggering—TTL position of trigger level control presets for optimum triggering from TTL levels, in 50 mV, 0.1 V, and 0.2 V/div or external trigger signals.
Trigger Sources—Internal CH 1, internal CH 2, external. TTL Threshold voltage, internal (with 10X probe) 1.4 V within ±0.3 V, External (with 10X probe) 1.4 V within ±0.2 V.

Trigger Sensitivity in Normal Mode

Coupling	To 0.5 MHz	At 5 MHz
DC Internal	0.3 div	0.75 div
DC External	15 mV	50 mV
AC	Requirements increase below 60 Hz	

P-P Auto Operation Sensitivity

Coupling	500 Hz to 0.5 MHz	0.5 to 5 MHz
DC, AC Internal	0.5 div	1.0 div
DC, AC External	35 mV	70 mV

External Trigger—Maximum Input Voltage: 250 V (dc+peak ac) at 1 kHz or less (same as vertical). Input R and C: ≈1 MΩ paralleled by ≈47 pF.

X-Y OPERATION

Input—X-axis input is via the CH 1 connector; Y-axis input is via the CH 2 connector.
X-Y Characteristics—Same as stated for vertical deflection, except deflection factor accuracy is ±4% from 0 to +40°C over the center 8 div.
X-Axis Bandwidth—DC to 150 kHz.

CRT AND DISPLAY FEATURES

CRT—8×10 div (0.632 cm/div) display. Accelerating potential is 2 kV. GH (P31) phosphor standard.
Graticule—Internal, nonilluminated.

DMM
DC VOLTAGE

Ranges—2, 20, 200, and 1000 V (autoranging).
Accuracy—Within 0.1% of reading, ±2 counts.
Common-Mode Rejection—>100 dB at dc, 80 dB at 60 Hz with 1 kΩ imbalance.
Normal-Mode Rejection—>30 dB at 60 Hz increasing 20 dB per decade to 2 kHz.
Response—<1 s plus range step time (<1 s/step).
Input R—10 MΩ ±2%.
Maximum Input Voltage—±1000 V (dc+peak ac) between HI and LO inputs or between HI and chassis. ±500 (dc+peak ac) between LO and chassis (LO Floating Voltage).

AC VOLTAGE

Ranges—2, 20, 200, and 700 V (autoranging).
Accuracy—Within 0.5% of reading, ±10 counts, 40 to 500 Hz.
Response Time—<5 s plus range step time (<1 s/step).
Input Impedance—10 MΩ paralled by ≈70 pF.
Maximum Input Voltage—700 V RMS if sinusoidal. ±1000 V (dc+peak ac) between HI and LO inputs or between HI and chassis. ±500 V (dc component) between HI and LO inputs. ±500 V (dc+peak ac) between LO and chassis (LO Floating Voltage).

RESISTANCE

Ranges—2, 20, 200, and 2000 kΩ.
Accuracy—Within 0.6% of reading ±3 counts.
Response Time—<5 s plus range step time (<1 s/step).
Maximum Input Voltage—±100 V (dc+peak ac) between HI and LO inputs. 500 V (dc+peak ac) between LO and chassis (LO Floating Voltage).

OTHER CHARACTERISTICS

Amplitude Calibrator—0.3 V, accurate ±1% from 20 to 30°C, ±2% from −15 to +55°C.

POWER REQUIREMENTS

Line-Voltage Range—90 to 132 V ac or 180 to 250 V ac.
Line Frequency—48 to 440 Hz.
Maximum Power Consumption—17 W.
External DC Source—+9 to +32 V.
Charge Time—At least 16 hours for full charge.
Operating Time—Internal NiCad batteries provide ≈1.6 hours of scope and DMM operation, 10 hours of DMM-alone operation, or two hours of scope-alone operation at maximum trace intensity and 20 to 25°C operating temperature.

ENVIRONMENTAL

Ambient Temperature—Operating: −15 to +55°C (Oscilloscope), 0 to +55°C (DMM). Nonoperating: −25 to +75°C.
Altitude—Operating: To 9000 m (30,000 ft) maximum, decrease maximum temperature by 1°C/1000 ft from 5,000 to 30,000 ft. Nonoperating: To 15 000 m (50,000 ft) maximum.
Vibration—15 minutes along each of the 3 major axes, 0.025 in. (0.06 cm) 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-E-16400G. Omit freezing and vibration and allow a post-test drying period at +25, ±5°C and 20 to 80% relative humidity.
Shock—Operating and Nonoperating: 30 g's, ½ sine, 11-ms duration. Total of 12 shocks.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width, w/handle	236	9.3
Height	112	4.4
Depth, handle not extended	371	14.6
Depth, handle extended	458	18.0
Weight ≈	**kg**	**lb**
Net, w/o accessories	4.8	10.6
Shipping	7.8	17.1

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

305 DMM/Oscilloscope **$3,150**
Includes: Two P6149A 10X probes; carrying case (016-0401-00); carrying case cover (200-2260-00); carrying strap assembly (346-0131-02); DMM probe package; clear CRT filter (331-0394 01); blue CRT filter (378-2016-01); external dc cable assembly (012 0406-00); service manual (070-2423-01); operator manual (070-2424-00).

The SONY®/TEKTRONIX® 305 DMM/Oscilloscope is manufactured and marketed in Japan by Sony/Tektronix Corporation, Tokyo, Japan. Outside of Japan, the 305 is available from Tektronix, Inc., its marketing subsidiaries and distributors.

OPTIONAL ACCESSORIES

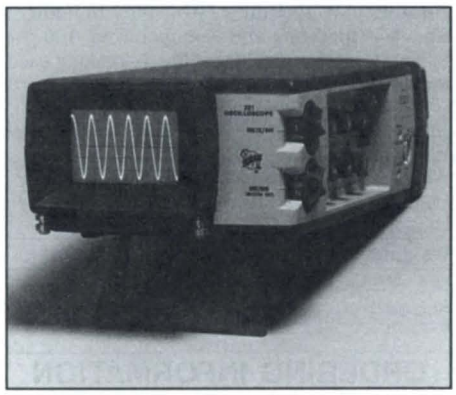
Viewing Hood—Order 016-0297-00 **$2.10**
Adapter Connector—BNC to binding post. Order 103-0033-00 **$6.50**

RECOMMENDED CAMERA

C-30BP Option 01—General purpose camera. **$1,665**
Camera Adapter—Required to mount the C-30BP Camera to the 305. Order 016-0327-01 **$175**

RECOMMENDED CART

K212 Portable Instrument Cart—For on-site mobility. See Cart section. **$350**



221 Oscilloscope

221 Series Miniscopes

TYPICAL APPLICATIONS

- **Communication Equipment Service**
- **Electromechanical Measurements**
- **Industrial Plant Maintenance**

FEATURES

- **5 MHz, 5 mV/Div to 100 V/Div**
- **0.2 μs/Div Sweep Rate**
- **Internal Battery Pack**
- **Integral 2 MΩ Probe**
- **Weighs ≈1.6 kg (3.5 lb)**

The 200 Series Miniscopes are the smallest offered by Tektronix. All 3 (212, 214 and 221) weigh less than 3.8 pounds and measure less than 3×5.2×9 inches.

Internal NiCad rechargeable batteries and integral probes make these scopes truly portable. Packaging in impact resistant plastic makes them durable as well.

Floatability

In applications where it is necessary to electrically *float* the oscilloscope to make measurements, 200 Series scopes can be elevated to 700 V (dc + peak ac) above ground when operated from batteries.

Features

Offering bandwidths from 5 MHz (221) to 500 kHz (212), neckstraps for convenient viewing and single side mounted control knobs make miniscopes ideal for most industrial maintenance applications where portability is a must.

The versatile 221 Miniscope has a 5-MHz bandwidth, 5-mV/div sensitvity, and 0.1 μs/div sweep rate (using X10 magnifier).

Internal rechargeable batteries allow at least two hours operation away from external power sources. 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 X10 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 easily accessible.

CHARACTERISTICS

VERTICAL SYSTEM

Bandwidth (−3 dB point)—DC to 5 MHz at all calibrated deflection factors. Lower −3 dB point ac coupled is ≈2 Hz.
Deflection Factor—5 mV/div to 100 V/div, accurate ±3% from 0 to +40°C and ±5% from −15 to 0°C and +40 to +55°C. Uncalibrated; Continuously variable between steps to at least 300 V/div.
Input R and C—≈1 MΩ paralleled by ≈29 pF via attached signal-acquisition probe.
Maximum Input Voltage—600 V (dc+peak ac), 600 V p-p ac, 5 MHz or less.

HORIZONTAL SYSTEM

Time Base—1 μs/div to 200 ms/div, accurate ±3%.
Magnifier—Increases all sweep speeds X10 with a maximum sweep speed of 0.1 μs/div.
Variable Time Control—Extends minimum sweep rate to ≈0.5 s/div. Continuously variable between calibrated settings.

TRIGGERING

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

Source	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.
Maximum External Horizontal Input Voltage—200 V (dc+peak ac), 200 V (p-p ac) to 500 kHz, decreasing to 20 V p-p ac at 5 MHz.
Input Impedance—≈0.5 MΩ paralleled by ≈30 pF.

CRT AND DISPLAY FEATURES

CRT—6×10 div (0.52 cm/div) display. Accelerating potential: 1 kV. Standard phosphor: GH (P31).
Graticule—Internal, black line, nonilluminated.

OTHER CHARACTERISTICS

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 times line + (dc+peak ac) not to exceed 350 V).

Power Sources—Internal NiCad batteries provide at least 2 hours operation at maximum trace intensity for a charging and operating temperature between +20 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 ≈10 V to protect batteries against deep discharge. Full recharge requires ≈16 hours. Extended time charges will not damage the batteries. An expanded-scale battery meter indicates full, low, and recharge.

POWER REQUIREMENTS

Line-Voltage Range—90 to 250 V ac or 80 to 250 V dc.

Line Frequency—48 to 62 Hz.

Maximum Power Consumption—5 W.

ENVIRONMENTAL

Ambient Temperature—Operating (Battery only): −15 to +55°C. Charging or Operating from AC Line: 0 to +40°C. Nonoperating: −40 to +60°C.

Altitude—Operating: 7600 m (25,000 ft), decrease maximum temperature by 1°C/1000 ft above 15,000 ft. Nonoperating: 15 000 m (50,000 ft).

Vibration—Operating and Nonoperating: 15 minutes along each of the 3 major axes, 0.06 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—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.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	133	5.2
Height	76	3.0
Depth	228	9.0
Weight ≈	**kg**	**lb**
Net, w/o accesssories	1.6	3.5
Shipping	3.6	8.0

ORDERING INFORMATION

221 Oscilloscope **$2,715**

Includes: Integral probe, batteries, viewing hood (016-0199-01); carrying case (016-0512-00); neck strap (346-0104-00); two spare fuses (159-0080-00); service manual (070-1573-01); operator manual (070-1572-00).

OPTIONAL ACCESSORIES

Alligator Clip Kit—Pair of alligator clips that connect probe and ground lead to large (up to 3/8 inch) conductors. Includes: red clip (015-0229-00); yellow clip (015-0230-01); 6-32 to probe adapter (103-0051-01).
Order 015-0231-00 **$32**

Probe Tips—To BNC Adapters
(Panel Connector Adapter)
Order 013-0084-01 **$9.75**
(Cable Adapter) Order 103-0096-00 **$14**

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 **$9.25**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

212 Oscilloscope

TYPICAL APPLICATIONS

- **Electromechanical Measurements**
- **Biomedical**

FEATURES

- **500 kHz, 1 mV/Div to 50 V/Div**
- **Internal Battery Pack**
- **Integral 1 MΩ Probe**
- **Weighs ≈1.6 kg (3.5 lb)**

The 212 is lightweight (only 3.5 pounds), compact (3×5.25×9.5 inches), and built of impact-resistant plastic and fully self-contained. It permits "floating" measurements since it is double insulated, and can be elevated to 700 V (dc+peak ac) above ground when operated from batteries.

CHARACTERISTICS

VERTICAL SYSTEM

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 ≈2 Hz.

Deflection Factors—1 mV/div to 50 V/div (1-2-5 sequence). Accuracy: ±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 (chop rate ≈50 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—≈1 MΩ paralleled by ≈160 pF from 1 mV/div to 50 mV/div; and 140 pF from 100 mV/div to 50 V/div.

Maximum Input Voltage[*1]

1 to 50 mV/div	600 V (dc +peak ac), ac not over 2 kHz.
0.1 to 50 V/div	600 V (dc +peak ac), 600 V p-p ac 5 MHz or less

[*1] *1X probe only.*

HORIZONTAL SYSTEM

Time Base—5 μs/div to 500 ms/div ±5%.

Variable Magnifier—Increases each sweep rate X5 with a maximum 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 <3°. Input characteristics same as CH 1.

Maximum External Horizontal Input Voltage and Impedance—Same as for vertical inputs.

TRIGGERING

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. In dual-channel operation at a setting of 1 mV/div, a bright baseline may not appear in the Auto Trigger Mode.

Trigger Sensitivity and Coupling

DC Coupling	To 500 Hz
Internal w/composite trigger source	0.2 div
Internal w/CH 2 trigger source	0.2 div
External	1 V

Maximum External Trigger Input Voltage—8 V (dc+peak ac), 16 V (p-p ac) at 500 kHz or less.

Input Impedance—R and C, 1 MΩ paralleled by ≈30 pF.

CRT AND DISPLAY FEATURES

CRT—6×10 div (0.52 cm/div) display. Standard phosphor: GH (P31).

Graticule—Internal, black line, nonilluminated.

OTHER CHARACTERISTICS

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.

Power Sources—Internal NiCad batteries provide ≈three to five hours operation for a charging and operating temperature between +20 and +30°C. Internal charger charges the batteries when connected to an ac line with instrument turned off. Battery operation is automatically interrupted when battery voltage drops to ≈10 V to protect batteries against deep discharge. Full recharge requires ≈16 hours. Extended charge times will not damage the batteries. A pilot light battery-charge indicator light will extinguish when oscilloscope has about ten minutes of operating time remaining in the batteries.

POWER REQUIREMENTS

Line-Voltage Range—110 to 126 V ac. Can be operated at 104 to 110 V ac with resulting slow discharge of internal batteries. Option 01 is 220 to 250 V. Option 02 is 90 to 110 V.

Line Frequency—58 to 62 Hz. Options 01 and 02 are 48 to 52 Hz.

Maximum Power Consumption—3 W.

ENVIRONMENTAL

Ambient Temperature—See 221, page 190 for description.

Altitude—See 221, page 189 for description.

Vibration—See 221, page 190 for description.

Humidity—95%, five cycles (120 hours). Referenced to MIL-T-28800C, par 4.5.5.1.2.2.

Shock—See 221, page 190 for description.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	133	5.2
Height	76	3.0
Depth	241	9.5
Weight ≈	**kg**	**lb**
Net, w/o accessories	1.6	3.5
Shipping	3.2	7.0

ORDERING INFORMATION

212 Dual-Trace Oscilloscope **$2,095**
Includes: Integral probes, batteries, viewing hood (016-0199-01); carrying case (016-0512-00); two 4-A fuses (159-0121 00); identification tags (000-7983-00); identification tag (334-2614 00); carrying strap (346-0104-00); service manual (070-5053-00); operator manual (070-5052-00).

OPTIONS

Option 01—For 220 to 250 V (48 to 52 Hz). **NC**
Includes: Batteries.

Option 02—For 90 to 110 V (48 to 52 Hz). **NC**
Includes: Batteries.

OPTIONAL ACCESSORIES

10X Attenuator Package—Tip to provide lower circuit loading (4.4 MΩ, ≈20 pF) and higher maximum 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 **$75**

Alligator Clip Kit—See 221, page 190 optional accessories for description. Order 015-0231-00 **$32**

Probe Tips—To BNC Adapters (Panel Connector) Order 013-0084-01 **$9.75**
(Cable Adapter) Order 103-0096-00 **$14**

Power Cable Adapter Assembly—See 221, page 90 optional accessories for description. Order 161-0077-01 **$9.25**

LABORATORY ANALOG OSCILLOSCOPES

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LABORATORY INSTRUMENTS

There are two basic configurations for test-and-measurement instruments: modular and integrated. Modular instruments, also called "plug-in" or "laboratory" models, combine a mainframe and one or more interchangeable plug-in subassemblies.

Tektronix modular design oscilloscopes include the state-of-the-art 11000 Series, the high-performance 7000 Series and the 5000 Series, which continues the concept of flexibility and expandability with a line of plug-ins and mainframes for the cost-conscious user.

Modular Design Advantages

Versatility is the prime advantage of a modular instrument. Many more functions than could be economically or practically combined in a single unit are available by choosing the right plug-ins. Plug-ins can also extend the original instrument's range of functions. Digital counter/timers, curve tracers, and spectrum analyzers are just a few examples of the many specialized plug-ins Tektronix offers for modular oscilloscope mainframes.

Performance is another advantage, In the case of the 11000-Series and 7000-Series instruments, modularity gives you the maximum performance available in an oscilloscope. Also, modularity allows you to upgrade your instruments to take advantage of advances in technology.

Modular instruments can often be very cost effective too, because within a given product line, they can be shared. A few high-performance laboratory plug-ins from the 7000 Series can be shared among several 7000-Series mainframes.

Consider the versatility and performance advantages as you read about the wide range of Tektronix modular instruments.

LABORATORY NONSTORAGE OSCILLOSCOPES

Product	Bandwidth*2	Minimum Deflection Factor	Number of Channels	Maximum Sweep Rate	Price*3
7104/R7103	1 GHz	10 mV/div at BW	Up to 4	200 ps/div	$27,275/$26,695
7904A/R7903	500 MHz	10 mV/div at BW; 10 μV/div;1 mA/div	Up to 4	500 ps/div	$11,530/$10,980
11302A*1	500 MHz 750 MHz (counter/timer)	10 mV/div at BW 1 mV/div at 250 MHz	Up to 8	500 ps/div	$12,950
11301A*1	400 MHz 750 MHz (counter/timer)	10 mV/div at BW 1 mV/div at 250 MHz	Up to 8	500 ps/div	$8,550
R7844	400 MHz	20 mV/div at BW 10 μV/div; 1 mA/div	Up to 4 Dual-Beam	1 ns/div	$18,335
7603/R7603	100 MHz	5 mV/div at BW 10 μV/div; 1 mA/div	Up to 4	5 ns/div	$3,995/$4,910
5440/R5440	50 MHz	5 mV/div at BW 10 μV/div;0.5 mA/div	Up to 8	5 ns/div	$4,220/$4,300
5110/R5110	2 MHz	1 mV/div at BW 10 μV/div; 0.5 mA/div	Up to 8	100 ns/div	$2,305/$2,405

*1 *Programmable via GPIB or RS-232C; useful in automated test applications.*
*2 *Bandwidths are real time. Sampling plug-ins that extend bandwidths to 14 GHz are available for most 7000-series mainframes.*
*3 *Price does not include plug-ins.*

11000-SERIES PROGRAMMABLE ANALOG OSCILLOSCOPES

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Tek's versatile 11000 Series plug-in analog oscilloscopes have a 10-digit precision, 750-MHz built-in Universal Counter/Timer, and other features for faster, easier waveform analysis.

Universal Counter/Timer
750-MHz performance lets you see what you are measuring, increases confidence, particularly with complex pulse trains and gated bursts. Make gated width measurements, simultaneously measure period and frequency. Use up to 8 input channels with wide dynamic range, low noise, switchable input impedance, and excellent sensitivity.

High Bandwidth
Choice of 500 MHz (11302A) or 400 MHz (11301A).

High Display Brightness With 6 cm/ms Visual Writing Rate
The microchannel plat e CRT (11302A) allows viewing intermittent glitches in the midst of bright repetitive signals at full oscilloscope bandwidth.

Open Architecture
Allows for future updates and expansion. Software features will be added to extend measurement sets through option ROMs and firmware updates. Six amplifier plug-ins include four channel, dual channel, single channel, and differential comparator.

Display Flexibility
From up to eight high-bandwidth plug-in channels, two triggerable delayed sweeps or window waveforms, counter-view trace, and template waveforms stored in memory.

Dual Time Base
Lets you see not only the original bursts, but detailed information inside these bursts, all at the same time. You can also easily view inconsistent pulse trains.

Full Programmability
Provides control from either IEEE-488 (GPIB) or RS-232C interface, both of which are standard.

Intuitive User Interface
Screen menus and touch screen control for immediate numeric entry of scale factors, hold off events, offsets, counter/ timer, cursor null references, etc.

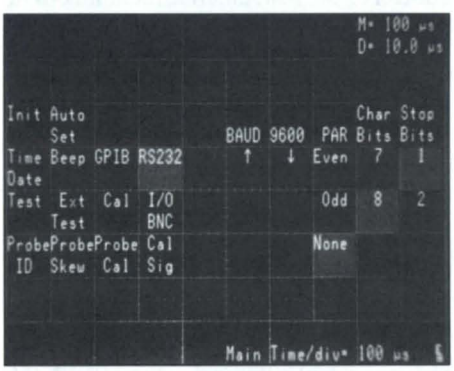
FEATURE-PACKED, TOP-OF-THE-LINE OSCILLOSCOPES

High Accuracy
Automatic self-calibration, choice of standard or high-stability time base.

TEKPROBE™ Interface
Convenient power and communication link between probe and oscilloscope, plus high-quality signal path.

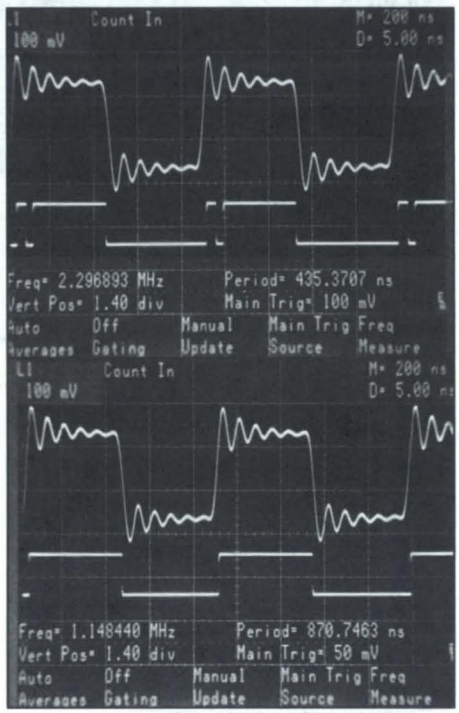
Complete Accessories Line
Passive and active probes, optical-electrical converters, carts and recording devices complement your measurement system.

On-site Warranty-Plus Service
This option provides fast response to keep you productive.

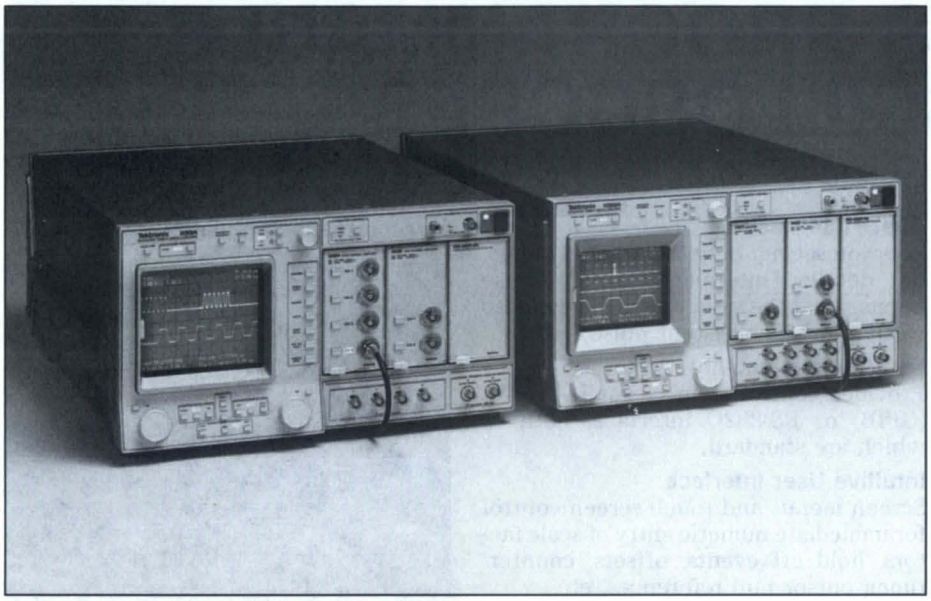


The 11301A and 11302A are fully programmable over either GPIB or RS-232C. Setup of the GBIB or RS232 (above) is done directly through a touch-screen menu.

Measurement Confidence



Built-in counter/timer and oscilloscope increases confidence of measurement. Top photo shows miscounting due to ripple on top signal. Count-In trace (lower waveform in both photos) confirms propper triggering (and measurement results) in lower photo.



11301A 400 MHz Oscilloscope with integral 750 MHz counter/timer and 11302A 500 MHz Oscilloscope with micro-channel Plate CRT and integral 750 MHz counter/timer.

11300A Series

GPIB IEEE-488 The 11300A Series complies with IEEE Standard 488.1-1987, RS-232C, and with Tektronix *Standard Codes and Formats.*

TYPICAL APPLICATIONS

- **Timing Analysis of Complex Signals**
- **Waveform Characterization**
- **Component Evaluation**

BENEFITS

- **Greatest Timing Accuracy**
- **Improved Measurement Confidence**

FEATURES

- **Built-In 750-MHz Universal Counter/Timer with Counter View**
- **Up to 8 Traces Displayed Simultaneously**
- **Menu-Driven Touch-Screen Operation**
- **Automatic Display of Selected Signals**
- **Automatic Time and Amplitude Measurements**
- **Dual Delayed Sweeps**
- **6-cm/ns Visual Writing Rate (11302A)**
- **Large 6.5-Inch Display (11301A)**
- **Fully Programmable via IEEE-488 & RS-232C**

The 11301A and 11302A are easily the world's most versatile counter/timer analog oscilloscopes. These oscilloscopes are fully programmable via either IEEE-488 or RS-232C, with any RS-232 equipped personal computer. They are equally at home in the most complex automated production-test system or in smaller scale computer-assisted testing and data-logging applications in the engineering environment. For manual operation, the menu-driven touch-screen operator interface places the 11301A and 11302A a step beyond anything presently available in convenience of use. Manual control of the instruments, including their plug-ins and probes, is accomplished by means of a few pushbuttons and two user-definable knobs located in the vicinity of the cathode-ray tube and the touch-panel CRT screen itself. Operator menus on the screen guide the user through the selection of the functions to be performed; selection is made by touching the designated areas of the screen.

CRT readout displays oscilloscope and plug-in settings, as well as numeric readout of desired measurements; no more need to count or interpolate between graticule divisions. Using IEEE-488 or RS-232C, up to eight lines of user-generated text (50 characters per line) can be displayed on the CRT for operator prompts, measurement annotation, and computer-generated menus. The large CRT screen provides clear, crisp display of both text and traces.

Wide Choice of Plug-Ins

A choice of five amplifier plug-ins provides display of up to eight traces at 250-MHz bandwidth, four traces at 400 MHz, or two traces at 500 MHz. The differential-comparator amplifier unit provides fast overdrive recovery from signals as high as 8 V at 1-mV/div sensitivity.

The 11301A and 11302A each accept up to three of the 11000-Series plug-in units. Signals from the amplifier plug-ins may be directed to either the vertical or horizontal system of the oscilloscope where they may be time shared with main or delayed sweeps. This allows an almost unlimited number of combinations of X-Y and Y-T traces to be displayed simultaneously to provide detailed views of signal relationships. Timed X-Y traces may be displayed through the application of delayed sweeps to X-Y displays.

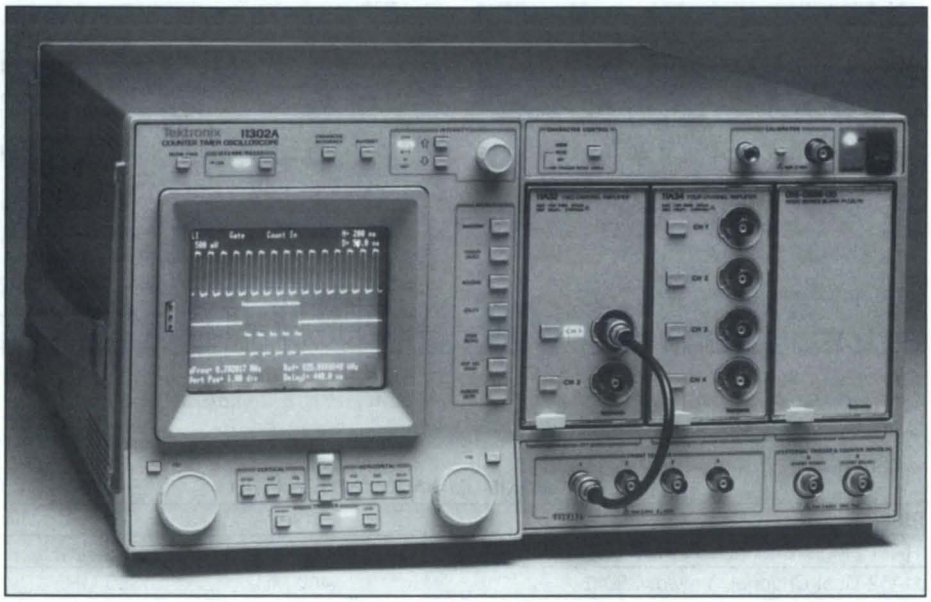
Each of the inputs on each of the plug-ins is supported by the new TEKPROBE™ interface which, in addition to the high-quality signal path, also provides probe power for active probes and a communication link between the probe and the oscilloscope.

Built-In 750-MHz Universal Counter/Timer

The built-in 750-MHz Universal Counter/Timer, with its 2-ns single-shot resolution, performs as an integral part of the 11301A/11302A. This combination of high-performance counter and high-performance oscilloscope greatly simplifies the most difficult counter/timer measurements and provides measurement capabilities not possible with conventional counter/timers. A counter-view trace indicates to the operator exactly what portions of a signal are being measured by the counter/timer. This completely eliminates the concern that usually accompanies the measurement of complex signals with a conventional counter, whether what is being measured is really what the operator thinks is being measured.

The combination of integral oscilloscope and counter/timer allows you to make counter/timer measurements on any of 12 plug-in input channels or on the signals at the A and B External Trigger/Counter Inputs. Use of the A and B External Trigger/Counter Inputs allows the use of the counter/timer without tying up the oscilloscope functions of the instrument.

TEKPROBE is a trademark of Tektronix, Inc.



11302A 500 MHz Oscilloscope with Micro-channel Plate CRT and integral 750 MHz Counter/Timer.

High-Writing-Rate CRT in 11302A

The microchannel-plate CRT of the 11302A provides 6-cm/ns visual writing rate, bright enough to view the fastest single-shot transient in normal ambient room light. This allows viewing of intermittent glitches in the midst of bright repetitive signals at the full bandwidth of the scope.

Automatic Display Setup

The Autoset feature provides scaled, triggered display of the selected signal immediately, automatically, with the simple press of a button on the front panel or at the probe tip where the user's attention is focused.

Automatic Measurements

The press of a front-panel pushbutton and a touch of the touch screen provides automatic time and amplitude measurements, without further operator intervention. This automatic measurement sequence can also be invoked via the probe-tip pushbutton, allowing the operator to display the results of up to eight measurements without removing hands or attention from the circuit under test.

Cursors

Both vertical and horizontal cursors can be displayed to aid in making amplitude and timing measurements. Cursor scaling permits percentage, dB, and degree comparisons without the need for calculations. The results of the measurements are always displayed numerically on the screen, with appropriate units of measure.

Built-In Time Bases

Two built-in time bases provide sweep rates to 500 ps/div. The dual delayed sweeps provide magnification of any portion of the displayed waveforms and allow precise comparison of two signals occurring at different times in the same or different signal paths.

Display Versatility

The versatile and convenient trace definition capability of the 11301A and 11302A permits up to eight traces to be displayed simultaneously in a wide variety of signal combinations. Signals from separate plug-ins can be added or subtracted; YT and XY signals can be displayed simultaneously.

A nonvolatile time and date clock can be displayed for documentation of photographs. The clock setting is constantly available over the bus for time documentation of accumulated data in automated testing situations.

Holdoff

Holdoff provides the means of holding off the occurrence of the main sweep until a selected amount of time or number of events has occurred. This capability is essential in inspecting groups of pulses or events, particularly when they are not synchronized with any controllable framing pulse.

The 11301A and 11302A offer several modes of holdoff. Holdoff by time is settable either as a function of main-sweep time/division or in 2-ns increments up to 0.99 seconds. Holdoff by events is settable up to 500,000 events.

The Countdown Holdoff function allows the sweep to be triggered on every Nth event within a pulse train. The Trigger-On-Next/Trigger-On-Previous function allows the user to move forward and backward through the pulse train in order to select the desired triggering point within the pulse train. Thus, any pulse within the pulse train can be inspected in detail and easily compared to other events occurring within a circuit at the same time.

The Holdoff by Events function permits the main sweep to run immediately, or be armed for triggering by another signal source, after N events following a selected start event. This function, in effect, permits four-deep "stacking" of delaying events: a start event, followed by a selected number of holdoff events, followed by a main-sweep triggering event, followed by the running or triggering of one or both delayed sweeps.

Calibrated Fine Settings

A fine-settings mode provides calibrated sweep timing and vertical sensitivity to 1% increments between the conventional 1-2-5 settings. This permits the operator to take advantage of full scale, vertically or horizontally, for increased measurement accuracy.

Stored Front-Panel Setups

Up to 10 complete front-panel setups can be stored and recalled for immediate setup of all instrument controls for repetitive testing. Manual sequencing of the stored setups can be accomplished by means of the pushbutton at the probe tip. This allows the operator, probing from point to point within a circuit, to reset the entire oscilloscope for each test point without removing attention from the device being tested.

Reference Waveforms

On-board storage and display of two reference waveforms can provide templates for quick visual go/no-go comparison of complex waveforms. These reference waveforms can be created by a computer or captured by a waveform digitizer and downloaded to the oscilloscope's internal memory.

Direct Numeric Entry, with Arithmetic Operators

A touch-screen keypad permits immediate numeric entry of scale factors, holdoff events, offsets, counter/timer, cursor null references, etc.

CHARACTERISTICS

VERTICAL SYSTEM

System Bandwidth—Determined by main frame and plug-in. (See Maximum Bandwidth Matrix below at the right.)

Accuracy—Determined by mainframe and plug-in. See descriptions.

ΔDelay Between Channels—Adjustable ±500 ps.

Vertical-System Delay—At least 20 ns of the sweep is displayed ahead of the triggering event.

HORIZONTAL SYSTEM

Main-Sweep Timing Range—5 ns to 0.5 s/div in 1-2-5 steps, plus 1% increments between steps and to 1.0 s/div. X10 Mag extends maximum sweep rate to 500 ps/div.

Delayed-Sweep Timing Range—5 ns to 0.5 s/div, plus 1% increments between steps and to 1.0 s/div. X10 Mag extends maximum sweep rate to 500 ps/div.

ΔTime Accuracy Using Cursors—±(0.5% of time interval plus 0.03 div).

ΔTime Accuracy Using Delayed Sweep—±(0.03% of time interval plus 0.01 div).

X-Y Operation—From Center Plug-In: Horizontal bandwidth is dc to 3 MHz; phase difference between X and Y with normal bandwidth is 1° or less from dc to 1 MHz, 3° or less from 1 to 2 MHz.

TRIGGERING

Minimum p-p signal required for stable triggering from A and B external inputs. Triggering sensitivity can be adjusted to reject unwanted noise components on noisy signals.

DC Coupled—0.35 div from dc to 50 MHz; increasing to 1.0 div at system bandwidth.

AC Coupled—0.35 div from 50 Hz to 50 MHz, increasing to 1.0 div at system bandwidth.

HF Reject Coupled—0.5 div from dc to 30 kHz.

LF Reject Coupled—0.5 div from 80 kHz to 50 MHz, increasing to 1.0 div at system bandwidth.

TV Trigger—Triggers from TV line or TV field sources; 0.5 div or less required for stable composite TV triggers.

DC Coupled—20 mV from dc to 50 MHz, increasing to 150 mV at system bandwidth.

AC Coupled—20 mV from 50 Hz to 50 MHz, increasing to 150 mV at system bandwidth.

HF Reject Coupled—28 mV from dc to 30 kHz.

LF Reject Coupled—28 mV from 80 kHz to 50 MHz, increasing to 150 mV at system bandwidth.

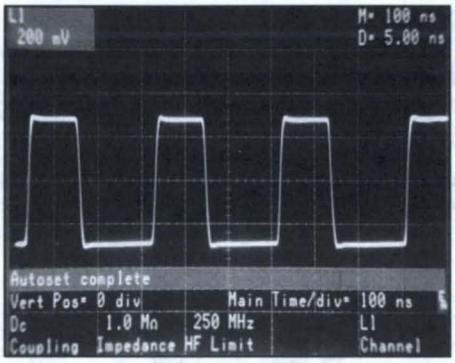
HOLDOFF

Holdoff By Time—Range: At least 20 times the inherent minimum reset time of the sweep (function of time/div).

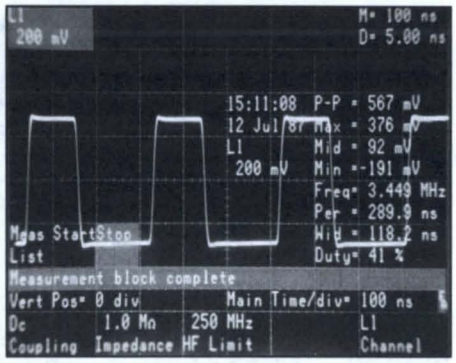
Holdoff By 2-ns Step—Settable in 2-ns increments from minimum inherent period of the sweep (function of Time/div) to 966 msec.

Countdown Holdoff—Settable from 2 to >500 million events. Maximum event frequency is 100 MHz.

Holdoff By Events—Settable from 2 to >500 million events. Maximum event frequency is 500 MHz. (One Start mode limits event frequency to 100 MHz.)



A press of a button at the probe tip or on the front panel automatically sets up the controls of the 11300A oscilloscopes for a triggered on-screen display of the selected signal.



The 11300A oscilloscopes make up to eight measurements, automatically, on the selected signal.

11000-SERIES MAXIMUM BANDWIDTH MATRIX

Plug-In	11302A	11301A
11A71 Single Channel, 10 mV/div, 50 Ω	500 MHz	400 MHz
11A52 Dual Channel, 1 mV/div, 50 Ω	400 MHz	350 MHz
11A32 Dual Channel, 1 mV/div, 1 MΩ/50 Ω	350 MHz	300 MHz
11A34 Four Channel, 1 mV/div, 1 MΩ/50 Ω	250 MHz	250 MHz
11A33 Differential Comparator, 1 mV/div, 50 Ω/1 MΩ/1 GΩ	150 MHz	150 MHz

BUILT-IN COUNTER/TIMER

Modes—Frequency, Period, Width, Ratio, Time A→B, Totalize.

Number of Digits—Up to 7; up to 10 with optional high-stability time base (Option 1T). (System computes and displays proper number of valid digits for specific measurement.)

Averaging—Selectable in two-decade steps (1, 10^2, 10^4, 10^6, etc.) up to 10^{10} for frequency, period, width, ratio, and time A→B measurements. Auto Average provides maximum resolution achievable with a 3 readings/s update rate.

Gating—Via External B input or internal delayed sweep gate, or open on External A and close on External B. Minimum external gate width: <25 ns.

Counter View—Shaped 1-div p-p display of any one or more of the following signals: Counter In, Gate, Sync Gate, A External Input, B External Input.

Sensitivity—Via Plug-In Inputs: 2X sweep-triggering sensitivities. Via External A and B Inputs: <100 mV p-p dc to 100 MHz, increasing to 500 mV p-p at 500 MHz.

Counter Ref Clock In/Out—Connector on rear panel allows application of 0-dBm 10-MHz external clock.

Trigger-Level Range—Plug-Ins: ±10×size/div setting. External A and B Inputs: ÷1, ±500 mV; ÷5, ±2.5 V.

Trigger-Level Accuracy—Internal: Add ±2% to plug-in unit's ΔV DC term (where ΔV is the Level Readout minus Amplifier Offset) divided by V/div, add 0.3 div to DC Balance term, and add peak noise in divisions. (Peak noise is 5×RMS.)

External A and B Inputs (for signals with 10% to 90% transition time >10 ns)—
÷1 (max signal, ±1V): ±[3% of setting +4% of p-p signal+10 mV +(0.5 mV times probe attenuation factor)].

÷5 (max signal, ±5 V): ±[3% of setting +4% of p-p signal+50 mV+(0.5 mV times probe attenuation factor)].

FREQUENCY

Range—<1 MHz to 750 MHz.

LSD—Greater of $\frac{1.8\ \text{ns}\times F^2}{N}$ rounded to the next higher decimal digit, or 1 count.

Resolution—Greater of LSD ±1.4 (TJE)F^2/N.

Accuracy—Resolution ±F (TBE).

PERIOD

Range—2 ns to 1250 hrs.

LSD—1.8 ns/N

Resolution—LSD±1.4 (TJE)/N.

Accuracy—Resolution±TBE (P).

WIDTH

Range—2 ns to 1250 hrs.

Maximum Repetition Rate—200 MHz.

LSD—2 ns (for N=1);
10 ns/$\sqrt{N}$ (for N>1).

Resolution—(LSD±1.4 (TJE_L)±1.4 (TJE_T))/$\sqrt{N}$±2 ps.

Accuracy (Gated and Nongated)—Resolution±Width (TBE)
±Hysteresis error
±TLE/($Slew_E - Slew_S$)±1 ns.

TOTAL

Range—0 to 10^{15} counts (engineering notation used above 10 digits).

Repetition Rate—>0 to 500 MHz.

LSD, Resolution, and Accuracy—1 up to 10^{11}–1,

Elapsed Time Range—25 ns to 1250 hrs.

RATIO

Range—10^{-11} to 10^{11}.
Frequency Range—1 Hz to 400 MHz.
LSD—Ratio/10^{10}.
Resolution—LSD ± 1.4 (TJE_D)$N_D \pm 1.4$ (TJE_M/N_M)$\pm F_D^2 \pm F_M F_D$) where N refers to trigger events.
Accuracy—Same as resolution.

TIME INTERVAL
(Main and Delay Trigger Sources)

Range—2 ns to 1250 hrs.
LSD—2 ns (for N=1);
10 ns/$\sqrt{N}$ (for N>1).
Resolution—$\pm$LSD $\pm(1.4(TJE_M)+TJE_D)/\sqrt{N}+2$ ps.
Accuracy—$\pm$(TBE)(Time Interval)$\pm$Resolution
$\pm$Plug-In Delay Mismatch
$\pm TLE_M$/Slew
$-TLE_D$/Slew
$\pm$200 ps.
Maximum Repetition Rate—200 MHz.
Channel Delay Mismatch—Not more than $\pm$500 ps (without null).

STANDARD TIME BASE

Frequency at Calibration—10 MHz $\pm$1 Hz.
Temperature Stability—$\pm$50 Hz, 0 to 50°C (5 ppm).
Aging—<10 Hz/year (1 ppm).
Adjustment Resolution—0.5 Hz.

HIGH STABILITY TIME BASE (OPTION 1T)

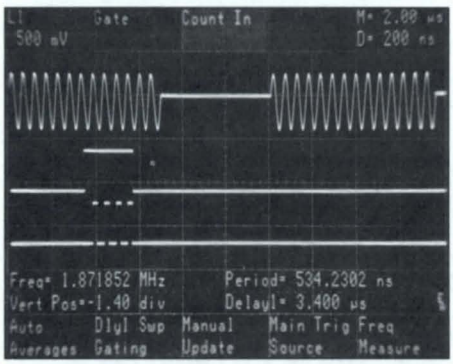
Frequency at Calibration—10 MHz $\pm$ 0.2 Hz.
Temperature Stability—$\pm$2 Hz, 0 to 50°C.
Warm-Up Time—10 minutes at 25°C to within 0.2 ppm of final frequency.
Aging—$<1\times10^{-8}$/day at time of shipping. $<4\times10^{-8}$/week after 30 days continuous operation. $<1\times10^{-6}$/year after 60 days continuous operation.
Short-Term Stability—$<1\times10^{-9}$ RMS based on 60 consecutive 1-s measurements.
Adjustment Resolution—0.2 Hz.
Adjustment Range—Sufficient for 8 years of aging.

DEFINITION OF TERMS

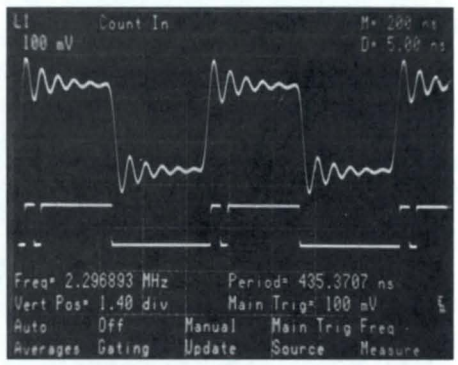
LSD = The smallest amount that the display can change.
N = Number of events in a measurement interval.
P = The period of the signal being measured.
RESOLUTION = The amount an input signal must change to be assured of a change on the display.
TBE = Time-base error.
TJE = Trigger-jitter error (in seconds RMS) =

$$\frac{\sqrt{(e_nS)^2+(e_nP)^2+(e_nM)^2}}{\text{input-signal slew rate}}$$

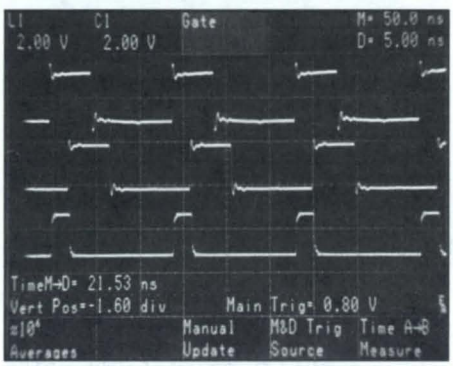
where e_nS = Input-signal RMS noise voltage
e_nP = RMS noise voltage contributed by plug-in (see plug-in characteristics).
e_nM = 0.05 div when using plug-in; 5 mV when using Ext. A or B input.
TLE = Trigger-level error; error resulting from the actual trigger point being different from the set trigger point.



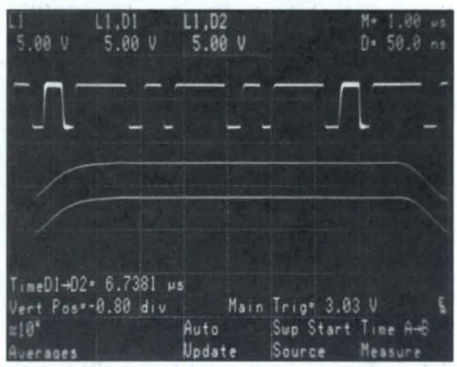
The 11300A oscilloscope delayed sweep supplies the gating signal (middle trace) for burst measurements. The Count In trace (bottom trace) shows the events being counted during the gate interval.



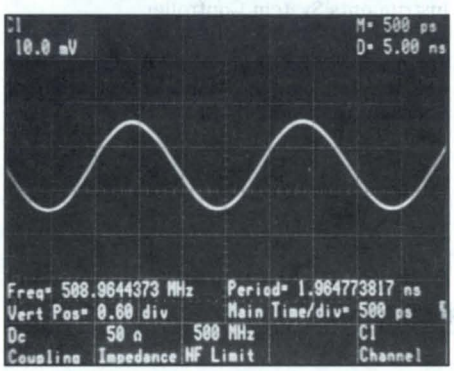
The Count In trace (lower trace) shows clearly that the counter/timer is miscounting because of the ripple on the top of the signal.



Here the 11300A universal counter/timer measures 21.53 nanoseconds of propagation delay between the leading edge of signal L1 (left plug-in, channel 1) and the leading edge of signal C1 (center plug-in, channel 1). Gate trace (bottom trace) clearly shows the time interval being measured.



Very accurate pulse-to-pulse timing measurements within a complex pulse train are made simple with the 11300A universal counter-timer and dual delayed sweeps.



The 500-MHz combination of 11302A mainframe and 11A71 single-trace amplifier allows accurate frequency measurements of small signals to 750 MHz or more with 11300A's built-in universal counter/timer.

EXTERNAL CONNECTORS

Camera Power—3-pin connector next to CRT is compatible with Tektronix C-50 Series cameras.

Calibrator Output—Front-panel female BNC connector. Square-Wave Mode: 5.0 V or 500 mV square wave into open circuit; 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz; 450-Ω output impedance. Fast-Rise Mode: 0.5 V into open circuit, 2-ns transition time into 50 Ω; 50-Ω output impedance; same frequencies as Square-Wave Mode plus 1 MHz.

A and B External Trigger and Counter Inputs—Front-panel female BNC connectors. Input impedance: 1 MΩ.

Trigger Ready Output—Rear-panel female BNC connector. TTL compatible; high state indicates Trigger-Ready condition.

Trigger Reset Input—Rear-panel female BNC connector. TTL compatible; high-to-low transition resets counter and/or single sweep.

Sweep Gate Output—Rear-panel female BNC connector. TTL compatible; high state indicates gate running. Main or delayed gate out selectable through UTILITY menu.

Left Vertical Out—Rear-panel female BNC connector. Output-signal amplitude = 100 mV/div ±10% of displayed signal. Bandwidth = dc to 100 MHz. Output impedance = 50 Ω ±10%.

Counter Ref Clock In/Out—Rear-panel BNC connector. See Counter/Timer description.

Main-Sweep Output—Rear-panel female BNC connector. Positive-going ramp, 0 to 5 V, coincident with main sweep: Output impedance: 950 Ω.

Z-Axis Input—Rear-panel female BNC connector. Positive voltage decreases intensity; +3 V blanks a maximum-intensity trace.

RS-232-C—25-pin "D" female connector configured as DCE.

IEEE-488—24-pin female connector for connecting instrument to GPIB.

CRT AND DISPLAY FEATURES

Standard CRT—11301A: 8×10 div (1.22 cm/div); P31 phosphor. 11302A: 8×10 div (1.0 cm/div); P31 phosphor. 11302A Writing Speed: 10 div/ns single-shot visual writing speed in 20 fC ambient illumination.

POWER REQUIREMENTS

Line Voltage—90 to 132 V ac, and 180 to 250 V ac.

Line Frequency—48 to 440 Hz.

Maximum Power Consumption—240 W.

ENVIRONMENTAL AND SAFETY

Temperature—Operating: 0 to +50 °C. Nonoperating: −45 to +75 °C.

Humidity—Operating and Nonoperating: Up to 95% relative humidity, up to 50 °C.

Altitude, Vibration, Shock, and Bench Handling—Meets MIL-T-28800C, Type III, Class 5.

Electromagnetic Compatibility—Meets MIL-T-28800C; MIL-STD-461B; FCC Part 15, Subpart J, Class B; VDE 0871/6.78 Class B; CE-01 Part 4, with exceptions; CE-03 Part 4, Curve 1; CE-03 Part 4, Curve 4, Navy, NB, BB (with exceptions); CS-01 Part 7; CS-02 Part 4 (with exceptions); CS-06 Part 5; RE-01 Part 4 (with exceptions); RE-02 Part 4; RS-01 Part 4; RS-03 Part 7 (limited to 1 GHz).

Safety—Listed UL 1244; CSA Bulletin 556B, September 1973; Tektronix self-certification to comply with IEC 348 recommendations.

ORDERING INFORMATION

11301A 400-MHz Programmable Counter/Timer Analog Oscilloscope **$8,550**
Includes: Operator manual (070-7174-00); User Reference Guide (070-7175-00); User Pocket Reference (070-7176-00).

11302A 500-MHz Programmable Counter/Timer Analog Oscilloscope With Microchannel-Plate CRT **$12,950**
Includes: Same as 11301A.

OPTIONS

Option 1C—Adds four additional rear-to-front feedthroughs to the existing standard four; total of eight. **+$150**

Option 1R—Rackmount **+$250**
Includes: Hardware, tooling, and instructions for converting bench model to rackmount configuration.

Option 1T—High stability Counter/Timer. **+$325**

Option 25—Adds PEP301 Instruments/System Controller and S47P103 utilities software. **+$7,870**

For more information on utility and application software, see the Test and Measurement Software Section.

CONVERSION KITS

Rackmount Adapter—To convert standard 11301A or 11302A to Option 1R. Order 040-1214-01 **$250**

High-Stability Counter/Timer—To convert standard 11301A or 11302A to Option 1T. Order 040-1232-00 **$325**

Four-Cable Feedthrough—To convert standard 11301A or 11302A to Option 1C. Order 040-1233-00 **$175**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

OPTIONAL ACCESSORIES

11301A Service Manual—Order 070-7178-50 **$175**

11302A Service Manual—Order 070-7179-50 **$175**

Cables—
(GPIB) 2 m. Order 012-0991-00 **$160**
(RS-232) 10 ft. Order 012-0911-00 **$100**

Blank Panel—For filling empty plug-in compartments. Order 016-0829-00 **$95**

DIGITIZING CAMERA SYSTEM

DCS01—Digitizes waveforms or single-shot signals to the full oscilloscope bandwidth to allow analysis with a personal computer. **$6,500**

See page 453 for complete ordering information.

RECOMMENDED ACCESSORIES

Cameras—See Camera and Mounting Adapter Selection Guide in the Instrumentation Documentation Devices section.

Probes—See recommended probes on page 282.

Cart—K217. See Instrument/Cart compatibility chart in the Cart Section. **$510**

TECHNICAL ASSISTANCE SERVICES

When you need technical assistance to supplement your own resources, Tektronix can arrange the services of an application engineer skilled in meeting your needs. For more information, see the Total Solution Section, page 35.

TRAINING

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. Information is in the Customer Training Section. For further information, or to enroll, call us at 1-800-835-9433 ext. 430. In Oregon call collect 1-629-1017.

PHYSICAL CHARACTERISTICS

Instrument	11301A		11302A		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**
Width, with handle	447	17.6	447	17.6	482	19.0
Height, with feet	239	9.4	239	9.4	222	8.8
Depth	581	22.9	581	22.9	548	21.6
Weight ≈	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
Net	18.1	40.0	20.0	44.0		
Shipping	21.8	48.0	23.6	52.0		

7000-SERIES ANALOG OSCILLOSCOPES

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Superior Performance

The 7000-Series plug-in laboratory scopes embody more state-of-the-art performance features than any other oscilloscope-based measurement system. The 7104 and R7103 Oscilloscopes feature a 1-GHz bandwidth combined with the fastest rise time and highest photographic writing speed available today.

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.

Maximum Flexibility

A choice of over 30 plug-ins and 7 mainframes gives you the flexibility to configure the scope package to meet your individual needs. When you needs change, your present package can be reconfigured with minimum additional equipment and effort.

Choose from a variety of features, including bandwidth, photographic writing speed, dual beam, alphanumeric displays, rackmounting, and three or four plug-in flexibility.

Expandability

Expandability ensures that the instrument you buy today will adapt to changing measurement needs, and that it won't become obsolete soon after you buy it.

BENEFITS

- **Intuitive and consistent interface which leads to a short learning process**
- **Ability to make accurate, differential measurements with a large dc offset**
- **High-bandwidth real-time measurement with effective sampling rates of 10 Gs/s**
- **High-bandwidth CRT storage with an effective sampling rate of 5 Gs/s**
- **High writing-rate CRT's which allow for viewing and photographing fast transients under lighting conditions**
- **Δ time and delayed time measurements**
- **Wide selection of plus-ins available to solve specific measurement problems**

7000-SERIES NONSTORAGE SELECTION GUIDE

Features	7104/R7103	7904A/R7903	R7844	7603/R7603
Bandwidth*1	1 GHz	500 MHz	400 MHz	100 MHz
Minimum Deflection Factor	10 mV/div at BW	10 mV/div at BW 10μV/div 1 mA/div	20 mV/div at BW 10 μV/div 1 mA/div	5 mV/div at BW 10 μV/div 1 mA/div
Maximum Sweep Rate	200 ps/div	500 ps/div	1 ns/div	5 ns/div
Four Traces	✓	✓	✓Dual Beam	✓
Delayed Sweep	✓	✓	✓	✓
Prices begin at *2	$26,695/$27,275	$11,530/$10,980	$18,335	$3,995/$4,910

*1 *Bandwidths are real time. Sampling plug-ins that extend bandwidths to 14 GHz are available for most mainframes.*
*2 *Price does not include plug-ins.*

7000 SERIES PLUG-IN VERTICAL AMP SPECIFICATIONS

Plug-in		7A13	7A18A	7A19	7A22	7A24	7A26	7A29	7A42	7F10A
Features		Differential dc offset, high-freq CMRR amplifier	Dual-channel amplifier	Wide band-width 50-Ω input amplifier	DC-coupled high-gain differential amplifier	Dual-channel 50-Ω amplifier	Dual-channel amplifier	Widest bandwidth single channel	Four-channel logic triggered	Optical/ Electrical converter w/built-in amplifier
Minimum Deflection Factor		1 mV/div	5 mV/div	10 mV/div	10 μV/div	5 mV/div	5 mV/div	10 mV/div	20 mV/div	2 μW/div
Accuracy*1 Without Probe		1.5%	2%	2%	3%	2%	2%	2%	3%	—
7104 R7103 0 to 35°C	BW	105 MHz	75 MHz	600 MHz	1 MHz ±10%	400 MHz	200 MHz	1000 MHz	350 MHz	750 MHz
	T_r	3.4 ns	4.7 ns	0.6 ns	350 ns ±9%	0.9 ns	1.8 ns	0.35 ns	1.0 ns	
7904A R7903	BW	105 MHz	75 MHz	500 MHz	1 MHz ±10%	350 MHz	200 MHz	500 MHz	300 MHz	400 MHz
	T_r	3.4 ns	4.7 ns	0.8 ns	350 ns ±9%	1.0 ns	1.8 ns	0.7 ns*5	1.2 ns	
	SIG OUT	100 MHz	90 MHz	300 MHz	1 MHz ±9%	140 MHz	140 MHz	300 MHz	NA	300 MHz
R7844 0 to 35°C	BW	100 MHz	75 MHz	400 MHz*2	1 MHz ±10%	300 MHz	180 MHz	400 MHz	275 MHz	300 MHz
	T_r	3.5 ns	4.7 ns	0.9 ns	350 ns ±9%	1.2 ns	1.9 ns	0.9 ns	1.3 ns	
7603/R	BW	75 MHz	75 MHz	100 MHz	1 MHz ±10%	100 MHz	100 MHz	100 MHz	100 MHz	100 MHz
	T_r	4.8 ns	4.7 ns	3.5 ns	350 ns ±9%	3.5 ns	3.5 ns	3.5 ns	3.5 ns	
0 to 50°C	SIG OUT	55 MHz	50 MHz	65 MHz	1 MHz ±10%	60 MHz	60 MHz	65 MHz	NA	65 MHz
Price		$3,655	$1,620	$3,010	$2,040	$2,760	$2,470	$3,540	$5,950	*4

*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 *Bandwidth is 325 MHz at 10 mV/div.*

*3 *R7903 with 7A29 T_r is 0.8 ns.*

*4 *Contact your local sales office.*

7000-SERIES MAINFRAME/TIME BASE/CAMERA SELECTION GUIDE

	Time Bases							Cameras					
Plug-In	7B50A	7B53A	7B80	7B85	7B92A	7B10	7B15	C-51	C-53	C-59	C-5C	C-7	C-4 Opt 02
Features*1	Single Time Base	Dual Time Base with Mixed Sweep	Single Time Base	Single Time Base with Delaying Δ Delay	Dual Time Base with Display Switching	Single Time Base	Single Time Base with Delaying Δ Delay	High Writing Rate	General Purpose	General Purpose	Low Cost	Low Cost	Low Cost
7104					✓	✓	✓		✓		✓	✓	✓
7904A			✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
R7844			✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
7603	✓	✓								✓	✓	✓	✓
Prices begin at	$1,320	$2,290	$1,885	$2,140	$3,870	$2,800	$3,000	$2,510	$2,090	$1,475	$495	$610	$410

*1 *Camera/time base recommendation is the same for rack mount version of scope.*

7000 SERIES ANALOG SCOPES DIMENSIONS AND WEIGHTS

Dimensions		7104	R7103	7904A	R7903	R7844	7603	R7603
Width	mm	305	483	305	483	483	221	483
	in.	12.0	19.0	12.0	19.0	19.0	8.7	19.0
Height	mm	345	178	345	135	178	290	133
	in.	13.6	7.0	13.6	5.3	7.0	11.4	5.3
Depth	mm	592	704	577	579	630	610	627
	in.	23.3	27.7	22.7	22.8	24.8	24.0	24.7
Weights ≈								
Net	kg	19.8	20.0	16.9	12.3	15.0	13.6	13.6
	lb	45.0	44.0	37.2	27.0	33.0	30.0	30.0
Shipping	kg	25.4	30.9	21.4	23.6	28.5	20.8	19.0
	lb	56.0	68.0	47.0	52.0	63.0	46.0	42.0

7000 SERIES OSCILLOSCOPE SYSTEMS/PROBE SELECTION GUIDE*1

(All bandwidths given in MHz.)

This selection guide lists the most popular combinations for optimum performance, but is not all inclusive. Current probes and other compatible probes are listed in the Probes section.

		Passive 1-MΩ Input								Passive 50-Ω Input		Active 50-Ω/1-MΩ Inputs			
Probe		P6101A 1 m	P6105A 2 m	P6130 1.5 m P6106A 1 m	P6131 1.3 m	P6055*2 3.5 ft	P6062B*5 6 ft	P6009 9 ft	P6015 10 ft	P6056 1.5 m	P6057 6 ft	P6201*4 6 ft	P6202A*4 2 m	P6230*4 1.5 m	P6046 6 ft
7100 Family	7A19	NC	NC	NC	NC	NC	NC	NC	NC	500	480	430	300	480	100
	7A24	NC	NC	NC	NC	NC	NC	NC	NC	350	350	310	300	350	100
	7A26	34	100	175	NC			125	75			195	185	200	90
	7A29	NC	NC	NC	NC	NC	NC	NC	NC	950	800	660	450	800	100
	7A42	34	100	250	300			130	80	350	350	300	280	350	100
7900 Family	7A13	34	75	105	NC	65		85		65		105	105	105	70
	7A18A	34	75	75	NC		75	70	60		75	75	75	75	60
	7A19	NC	NC	NC	NC	NC	NC	NC	NC	500	480	430	300	480	95
	7A22	1	NC	NC	NC	1	1								
	7A24	NC	NC	NC	NC	NC	NC	NC	NC	350	350	310	290	350	90
	7A26	34	100	175	NC			125	75			185	185	290	85
	7A42	34	100	250	300			130	80	300	300	300	300	300	90
7800 Family	7A13	34	100	100	NC	65		85	60			100	100	100	70
	7A18A	34	85	85	NC		85	80	60			90	75	90	65
	7A19	NC	NC	NC	NC	NC	NC	NC	NC	400	400	360	320	400	95
	7A22	1	1	NC	NC	1	1	1	1						
	7A24	NC	NC	NC	NC	NC	NC	NC	NC	300	300	280	270	300	90
	7A26	34	100	145	NC			105	75			155	150	180	85
	7A42	34	100	200	275			110	75	275	275	260	260	275	90
7600 Family	7A13	34	70	75	NC	55	70	60	55			75	75	75	55
	7A18A	34	70	70	NC		70	65	55			75	75	75	55
	7A22	1	1	NC	NC	1	1								
	7A26	34	95	95	NC		95	85	65			100	100	100	70
	7A42	34	95	95	100		95	85	65			100	100	100	70

*1 *The values in the above table represent the approximate useful frequency response for the measurement systems at the probe tip.*

*2 *Matched pair recommended.*

*3 *Option 09 Mainframe. Requires 1101/1101A Power Supply or other external source of power when used with 7854, 7603, 7633, or 7623.*

*4 *Bandwidths given for 10X switch position. NC = Not Compatible. If there is no bandwidth specified, the probe/plug-in combination is compatible but not recommended.*

PROBE FEATURES

Passive Voltage 1-MΩ Compatible
P6101A and P6105A—Miniature, 1X
P6130 and P6106A—Miniature, fast rise time, 10X
P6131—Subminiature, fast rise time, 10X
P6055—Adjustable attenuation, 10X High CMRR
P6062B—Selectable 1X, 10X attenuation
P6009—100X, 1.5 kV
P6015—1000X, 40-kV peak

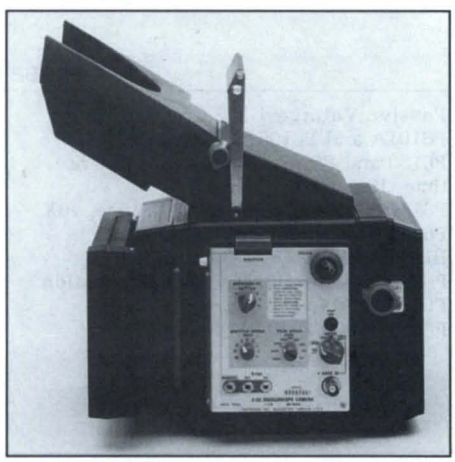
Passive Voltage 50-Ω Input Compatible
P6056—Fastest 10X passive probe
P6057—Fastest 100X passive probe

Active 50-Ω/1-MΩ Input Compatible
P6201—Low capacitive loading, AC coupling, DC offset
P6202A—10-MΩ input impedance, DC offset
P6230—ECL bias/offset 10X
P6046—Differential, high CMRR

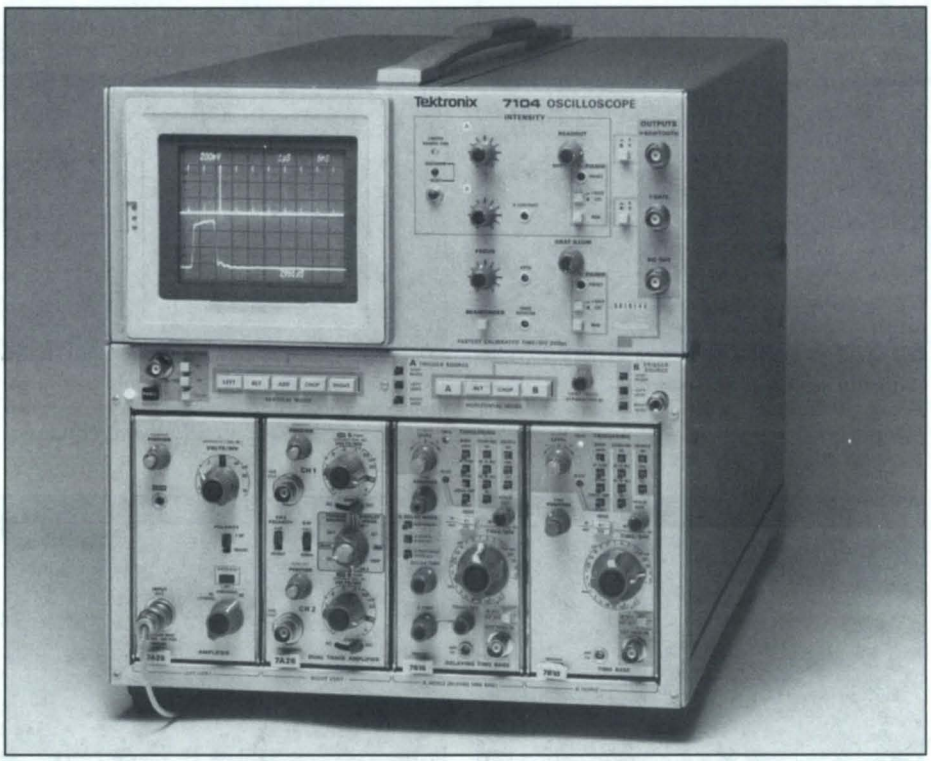
APPLICATION NOTES FOR 7000 SERIES

Title	Description	Order
Pulse Echo Measurements with digital accuracy	7603/7A22/7D15/7B53A timing measurements Pulse Echo Measurements between nonadjacent pulses.Ultrasonic transducers	42-W-3681-1
7A42 Logic Triggered Amplifier	Checking logic levels	42-W-5629
7A42 Bus Contention	Microprocessor Bus Contention measurements	42-W-5630
7A42 Advanced Trigger Application	7A42 measures complex signals easily	42-W-5588
X-Y Displays with Interval Timing for Measuring SOA	7D15/7A18/7A22 X-Y power dissipation measurements	42-AX-3957
Measuring time interval between nonadjacent digital word train pulses or multiecho radar pulses	7D15 demonstrates ability to measure the time between adjacent pulses with digital counter accuracy	42-W-2680-3
The 7D20 Programmable Digitizer: Performing a Wide Range of Measurement Tasks Easier, Faster, and more Accurately	7D20 application examples including ultrasonic testing, monitoring nerve activity, measuring pulse jitter, and SOA analysis of power devices	42-W-5085
Measuring memory core I/O signals with digital accuracy	7000 Series digital plug-ins demonstrate how to make accurate pulse parameter measurements both of amplitude and pulse timing	42-AX-2686-1
Measuring disc drive time and access voltages with Tektronix 7000 Series Digital Plug-ins	7000 Series digital plug-ins use a single CRT display to perform both digital and analog analysis of complex waveforms	42-W-2687-2
Pulse and digital timing measurements—a better technique	7B80/7B85 general operation overview	42-AX-3379-1
Using storage to find troublesome logic glitches	7633 shows how to capture/evaluate glitches	42-AX-3085
Variable persistence storage applications	7613/5441 various applications for variable persistence storage oscilloscopes	42-AX-3198
Tektronix Storage Oscilloscopes	Describes various applications	42-AX-3199
Increased measurement accuracy using a 7D15 in any 7000 Series scope	Introduction demonstrating variety of counting and timing measurements	42-W-5017-1
7D20 Programmable Digitizer: Digitizing Performance and versatility in a power plug-in	In-depth discussion of the features, functions and capabilities	42-W-5079-1
Sampling for High Speed Measurements	Describes how sampling works, TDR measurements, probes and sampling systems	42-W-5195
Measurement Techniques with Differential Amplifiers	Outlines what they are, functions and benefits	42-W-5325
Applying Photographic Writing Rate to High Speed Signal Measurements	Describes how scope/camera systems photograph fast moving traces	42-W-5335-1
Sampling Primer	Basic sampling principles in signal acquisition for scope measurements	42-W-5969

K213 Lab Instrument Cart
The K213 Lab Instrument 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. A drawer for the 7854 keyboard and a plug-in storage cabinet are available as Options 10 and 12 respectively, or Option 22 for both. For full details, see Scope-Mobile Carts in the Accessories section.



TEK C-53 Camera
The full line of cameras designed for 7000-Series oscilloscopes is summarized on the preceding page. For full details, see the Camera part of the Accessories section.



7104/R7103

TYPICAL APPLICATIONS

- **High-Speed Semiconductor Design**
- **Laser and High-Energy Research**
- **Digital Communications**

BENEFITS

- **Plug-in Versatility**
- **View Fast Transients in Normal Light**
- **Ability to View Low Rep Rate Signals Under Normal Lighting**

FEATURES

- **1-GHz at 10 mV/Div**
- **350-ps Rise Time**
- **200-ps/Div Fastest Calibrated Sweep Rate**
- **Horizontal Bandwidth 350 MHz**
- **Ultra-High Photographic Writing Speed—at Least 20 cm/ns**
- **CRT Readout**
- **7-Inch Rackmount (R7103 Only)**
- **Phase Compensation Option—Phase Matching to 250 MHz (7104 Only)**

See the 7000-Series Reference section for available Application Notes.

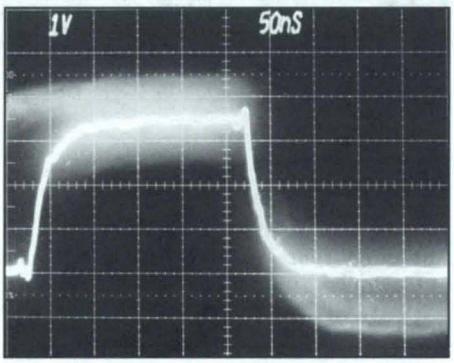
The capabilities of the 7104 and of the seven-inch rackmount R7103 are of substantial value in numerous high-technology environments. The 7104/R7103 have both the highest writing speed and highest bandwidth available in a general-purpose oscilloscope today.

The 7104/R7103's outstanding writing speed means unsurpassed single-shot capability, with trace brightness about one-thousand times that of conventional oscilloscopes. Any single-shot signal within the 1-GHz bandwidth can be seen directly on the CRT in average room light. Also, single-shot photography is now simple and straightforward, using standard oscillographic cameras and film without high-speed enhancement techniques.

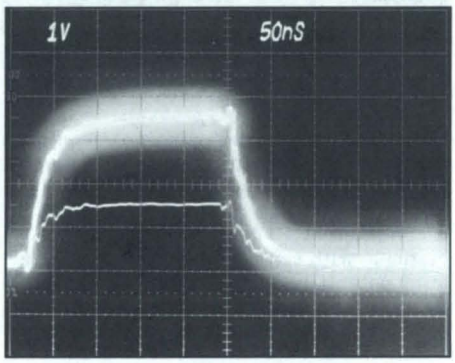
It is by no means unusual to see 250-MHz data rates and 900-MHz analog frequencies outside the lab and on the production line. In digital design, too, anomalies such as ringing and overshoot can only be dealt with by evaluating the signal's analog characteristics.

You can capture the fastest transients without expensive high-speed film or other time-consuming and complex techniques like fogging or reducing the scan. In fact, you can see those signals on the CRT, and eliminate costly time-consuming photographs.

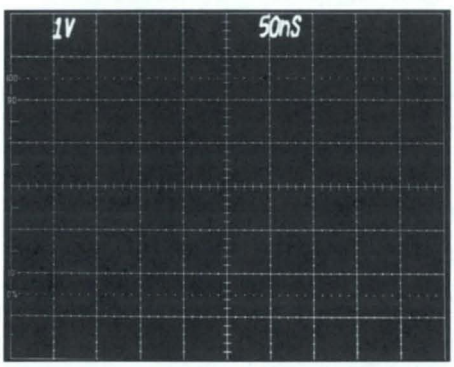
Horizontal bandwidth of 350 MHz, with the X-Y phase-compensation Option 02 (7104), gives accurate X-Y displays to 250 MHz. Designers can now directly obtain V-I curves for high-speed switching-power-supply evaluation or monitor performance of digital-communication systems using phase-constellation displays.



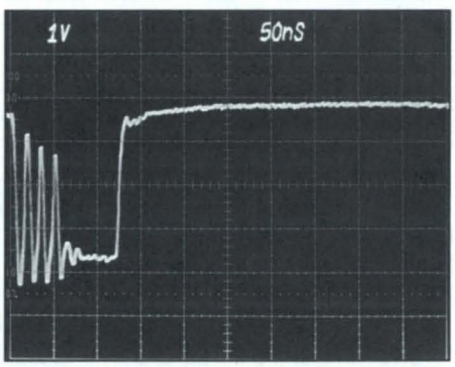
Before—A pulse train on a TEK 7904A doesn't reveal the low-level glitch occurring every ten-thousandth pulse. (The TEK 7904A was previously the world's fastest writing-rate scope.)



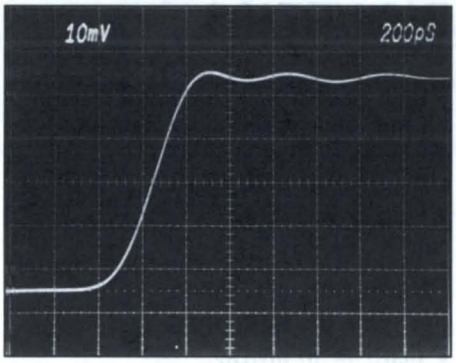
After—The same pulse train viewed directly on the 7104/R7103, with one-thousand times the brightness of conventional scopes. The researcher can now analyze the pulse with the naked eye and take pictures with ease.



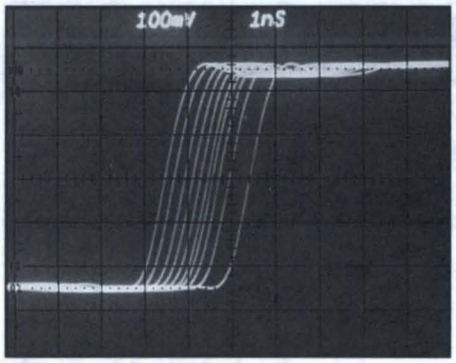
Before—Low-repetition-rate pulse is invisible on a conventional oscilloscope.



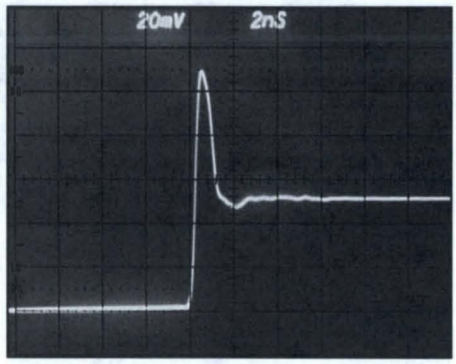
After—The same pulse as seen on the 7104/R7103 readily indicates that the problem is input-signal bounce.



With its sweep speed of 200 ps/div, the 7104/R7103 clearly shows a single-shot, 350-ps step, five divisions in amplitude.



A digital circuit that shows no jitter on a conventional oscilloscope is found to have a 2.0-ns jitter when viewed with the distinct image-viewing capability of the 7104/R7103.



Circuit faults such as high-frequency pulse overshoot and ringing can easily be observed with the 7104/R7103's 1-GHz bandwidth.

CHARACTERISTICS

The following characteristics are common to the 7104 and the R7103, except those noted under the R7103.

VERTICAL SYSTEM

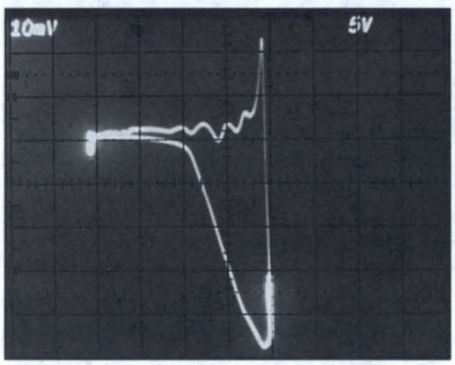
Channels—Two left-hand plug-in compartments. Compatible with all 7000-Series plug-ins (except 7D01, 7D02, and 7D20).
Bandwidth—Determined by mainframe and plug-in unit. See the 7000-Series Reference section.
Rise Time—Determined by mainframe and plug-in unit. See the 7000-Series Reference section.
Deflection Factor—Determined by plug-in unit. See the 7000-Series Reference section.
Display Modes—Left, Alt, Add, Chop, Right. Chopped-mode repetition rate is ≈1 MHz.
Trace Separation—(7104 only) In dual-sweep modes, positions B trace at least four divisions above and below A trace.
Delay Line—Permits viewing leading edge of displayed waveform.

HORIZONTAL SYSTEM

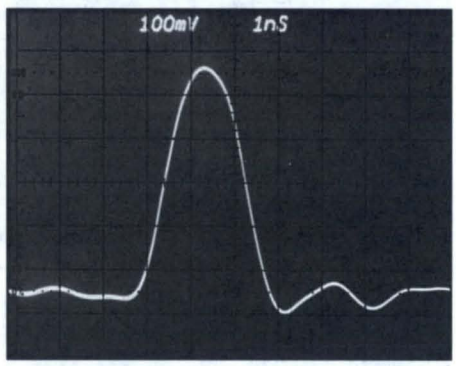
Channels—Two right-hand plug-in compartments. Compatible with the 7B10 Series, 7B80 Series, 7B50A, 7B92A, 7000-Series vertical amplifiers and specialized plug-ins (7B92, 7D01, 7D02, and 7D20 not recommended).
Bandwidth—DC to 350 MHz.
Display Modes—(7104 only) A, Alt, Chop, B. Chopped-mode repetition rate is ≈200 kHz.
Fastest Calibrated Sweep Rate—200 ps/div with the 7B10 or 7B15.
X-Y Mode—With Option 02, X-Y Phase Compensation (7104 only, using 7A19s or 7A29s with at least one having Variable Delay Option, B horizontal compartment only): Phase shift is 2° from dc to 50 MHz (after adjusting variable delay for balance at 35 MHz). Phase balance can be obtained at any frequency up to 250 MHz. Without Option 02, X-Y Phase Compensation: Phase shift is 2° from dc to 50 kHz.

CRT AND DISPLAY FEATURES

For CRT phosphor data see Oscilloscope Reference section.



The transient load line of a fast switching transistor in a power-supply prototype (switching time = 10 ns) is easily measured for compliance with safe operating area (Horizontal = Voltage; Vertical = Current).



View of a single clocking pulse 0.8-ns rise and 2-ns pulse width.

CRT—Internal 8×10-division (0.85 cm/div) graticule with variable illumination. Accelerating potential is 12.5 kV. GH (P31) phosphor.
Readout and Graticule Modes—Continuous or pulsed. Pulse source front-panel selectable: +Gate, External, Manual. Pulsed graticule is on for ≈0.5 s.

Typical Photographic Writing Speed*1

CRT	Camera	Lens	Writing Speed (cm/ns)
Standard 8×10 cm	C-53	f/1.9 1:0.85	20

*1 *Using the standard GH (P31) phosphor and Polaroid Type 107, 3,000 ASA film without film fogging.*

Autofocus—Reduces the need for additional manual focusing with changes in intensity after focus control has been set.
Beam Finder—Aids in locating offscreen signal.
External Z-Axis Input—2 V p-p for full intensity range. A positive signal blanks the trace. Maximum input voltage is 15 V (dc + peak ac) and p-p ac. Input is dc coupled.

CALIBRATOR

Voltage Output—Square wave positive going from ground.
Voltage Ranges—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 0.25%.
Current Output—40 mA rectangular waveshape with optional current loop accessory (012-0341-00) connected to calibrator output. Output R is 450 Ω.

OUTPUTS/INPUTS

+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.
+Gate—Positive-going rectangular waveform. 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 ≈950 Ω.
Vertical Signal Out—Output voltage is 25 mV/div into 50 Ω, 0.5 V into 1 MΩ. Output R is ≈950 Ω. Bandwidth depends upon vertical plug-in. See the 7000-Series Vertical-System Specifications in the 7000-Series Reference section.
Camera Power—Three-prong connector to the left of the CRT provides power, ground, and remote single-sweep reset access for C-50 Series camera.

The R7103 requires only seven inches of rack height in a standard 19-inch rack. It is fan-cooled and comes complete with slideout chassis.

Probe Power—Two rear-panel connectors for active probes (i.e., P6201, P6202A, P6230).
External Single-Sweep Reset—Ground closure, rear-panel BNC, input to reset sweep.
Single-Sweep Ready Indicator—Rear-panel BNC provides 5 V out to indicate single-sweep ready condition.
Graticule/Readout, Single Shot—Ground closure, rear-panel BNC input initiates one frame of CRT readout. Graticule is illuminated for ≈0.5 s.

POWER REQUIREMENTS

Line-Voltage Ranges—90 to 132 V ac and 180 to 250 V ac.
Line Frequency—48 to 440 Hz.
Maximum Power Consumption—215 W, 3.3 A at 90-V line, 60 Hz.

ENVIRONMENTAL AND SAFETY

Ambient Temperature—Operating: 0 to +50°C. Nonoperating: −55 to +75°C.
Altitude—Operating: 5000 m (15,000 ft). Nonoperating: 15 000 m (50,000 ft).
Vibration—Operating: 15 minutes along each of the three major axes. 4 mm (0.015 in.) p-p displacement 10 to 50 to 10 Hz in one-minute cycles. Held for three minutes at 50 Hz.
Humidity—Operating and Nonoperating: 95%, five cycles (120 hours), referenced to MIL-E-16400F.
Shock—Nonoperating: 30 g's, ½ sine, 11-ms duration in each direction along each major axis. Total of six shocks.
EMC Capability—(R7103, 7104 Option 03) Meets MIL-STD-461B requirements when tested in accordance with certain test methods of MIL STD-462. Contact your Tektronix representative for more information.
Safety—UL listed (UL 1244) and CSA certified (CSA 556B).

The 7D01, 7D02 Logic Analyzers and 7D20 Digitizer are not recommended for use in the 7104/R7103 mainframe. Such use will void the 7104/R7103 warranty.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	305	12.0	483	19.0
Height	345	13.6	178	7.0
Depth	592	23.3	704	27.7
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	20.4	45.0	20.0	44.0
Shipping	25.4	56.0	30.9	68.0

CHARACTERISTICS (R7103)

The following characteristics for the R7103 are in addition to or in lieu of those listed previously.

HORIZONTAL SYSTEM

Single Channel—Right-hand plug-in compartment compatible with time bases of the 7B10 and 7B80 Series and the 7B50A and 7B92A. The 7B50 Series (except 7B50A), the 7B70 Series, and the 7B92 (non-A) are not recommended. 7000-Series vertical amplifiers and specialized plug-ins (except 7D01, 7D02, and 7D20) may also be used.
Bandwidth—DC to 350 MHz.
X-Y Mode—Phase shift is 2° from dc to 50 kHz.

OUTPUTS/INPUTS

Vertical Signal Out—Output voltage is 25 mV/div within 25% into 50 Ω, 0.5 V into 1 MΩ. Output R is ≈950 Ω. Bandwidth depends upon vertical plug-in. See the 7000-Series Vertical-System Specifications in the 7000-Series Reference section.

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

7104 Oscilloscope **$26,695**
Includes: Power cord (161-0066-00); instruction manual (070-2314-00).
R7103 Rackmount Oscilloscope **$27,275**
Includes: Power cord (161-0066-00); mask frame (426-0514-00); CRT filter (378-0625-00); drawer slide (351-0375-01); right spacer (361-0806-00); left spacer (361-0807-00); hardware kit (016-0099-00); instruction manual (070-5039-00).

OPTIONS (7104)

Option 02—X-Y Horizontal Compensation. **+$315**
Option 03—EMC Capability. **+$395**

CONVERSION KIT (7104)

EMC Modification—Order 040-0965-00 **$605**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz
Option A2—UK 240 V, 50 Hz
Option A3—Australian 240 V, 50 Hz
Option A4—North American 240 V, 60 Hz
Option A5—Switzerland 220 V, 50 Hz

RECOMMENDED PLUG-INS

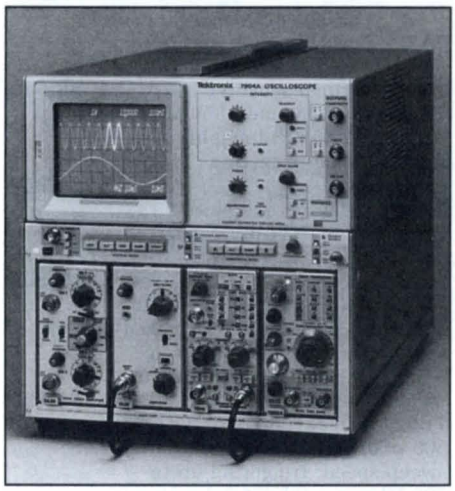
7A29—Vertical amplifier, 50-Ω input, dc to 1 GHz; 10-mV/div to 1-V/div vertical sensitivity. **$3,540**
7A42—Four-channel, 350-MHz bandwidth vertical amplifier with Boolean logic triggering capabilities. **$5,950**
7B10—Delayed time base with 200-ps/div to 0.2-s/div calibrated sweep speed; triggering up to 1 GHz. **$2,800**
7B15—Delaying time base with 200-ps/div to 0.2-s/div calibrated sweep speed; triggering up to 1 GHz; capable of Δ time measurements in conjunction with 7B10. **$3,000**
7B92A—Dual time base with 500-ps/div to 0.2-s/div calibrated sweep speed; triggering up to 500 MHz; capable of delay-time measurements. **$3,870**

OPTIONAL ACCESSORIES

Recommended Cameras—See Camera Selection Guide in the Instrumentation Documentation Devices section.

The DCS01 Digitizing Camera System combines CCD technology with an IBM PC, XT, AT, or compatible to acquire and digitize repetitive and transient waveforms displayed on oscilloscopes, spectrum analyzers, and other displays. Used with scopes having the microchannel-plate CRT, such as the 7104 and 2467, the DCS01 can acquire repetitive and transient signals at the full bandwidth of the scope. With other scopes, the DCS01 will acquire repetitive events at the full scope bandwidth and transient events according to the photographic writing rate of the oscilloscope.

Recommended Probes—See the 7000-Series Oscilloscope Systems/Probe Selection Guide on pages 200–201.
Recommended Carts—
See the Instrument/Cart Compatibility chart in the Cart section.
K213 Option 12—(7104) **$765**
K217—(R7103) **$510**



7904A/R7903

TYPICAL APPLICATIONS

- **Digital Design**
- **Radar**
- **Laser Research**

BENEFITS

- **Over 30 Compatible Plug-ins**
- **Good Cost/Perform Ratio**
- **Real Time Signal Analysis**
- **Ability to Make High CMRR Differential Measurements**

FEATURES

- **500 MHz at 10 mV/Div**
- **700-ps Rise Time (7904A)**
- **500-ps/Div Fastest Calibrated Sweep Rate**
- **Greater Than 7-cm/ns Writing Speed With Optional CRT (Option 13) and WSEN**
- **CRT Readout**
- **900-MHz FET Probe Available**

See the 7000-Series Reference section for available Application Notes.

The 7904A and 5.25-inch rackmount R7903 are high-bandwidth, general-purpose oscilloscopes. The 7A29 Amplifier/7904A mainframe attains 500 MHz at 10 mV/div. A 7A29 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 7A29/7904A, it provides a system bandwidth of 450 MHz at 10 mV/div.

The CRT, the major contributor to the performance of the 7904A and R7903, has good visual brightness and an 8×10-cm display area.

CHARACTERISTICS

The following characteristics are common to the 7904A and R7903, except those noted under the R7903.

VERTICAL SYSTEM

Channels—Two left-hand plug-in compartments. Compatible with all 7000-Series plug-ins.

Bandwidth, Rise Time, and Deflection Factor—Determined by plug-in unit. See 7000-Series Vertical-System specifications in the 7000-Series Reference Section.

Display Modes—Left, Alt, Add, Chop, Right. Chopped-mode repetition rate is ≈1 MHz.

Trace-Separation Range—(7904A only) In dual-sweep modes, positions B trace at least four divisions above and below A trace.

Delay Line—Permits viewing leading edge of displayed waveform when using 7B80- and 7B90-Series time bases. 7B50-Series not recommended.

HORIZONTAL SYSTEM

Channels—7904A: Two right-hand plug-in compartments. R7903: One right-hand plug-in compartment. 7904A and R7903: Compatible with 7B80- and 7B90-Series time bases, 7000-Series vertical amplifiers and specialized plug-ins.

Bandwidth—DC to at least 1 MHz.

Display Modes—A, Alt, Chop, B. Chopped-mode repetition rate is ≈200 kHz.

Fastest Calibrated Sweep Rate—500 ps/div with the 7B92A.

X-Y Mode—With Delay Compensation: Phase shift is within 2° from dc to 1 MHz. Without Delay Compensation: Phase shift is within 2° from dc to 35 kHz.

CRT AND DISPLAY FEATURES

For CRT phosphor data see Comparative CRT-Phosphor Data chart in the Oscilloscope Reference section.

CRT—Internal 8×10-division (0.85 cm/div) graticule with variable illumination. Accelerating potential is 24 kV. GH (P31) phosphor is standard.

Option 78, BE (P11) Phosphor—Replaces standard GH (P31) phosphor. Contact your local sales representative for details.

Typical Photographic Writing Speed*[1]

CRT	Camera	Lens	Writing Speed cm/ns
Opt 04 4×5 cm	C-51P	f/1.2 1:0.5	2
Opt 13 4×5 cm			7
Opt 78 8×10 cm			2.5

*[1] *Using Polaroid Type 612 20,000 ASA Film without film fogging.*

In typical applications, GH (P31) phosphor has approximately one-half the writing speed of BE (P11) phosphor. The writing speed can be increased by using controlled film fogging with a writing speed enhancer (camera accessory).

Autofocus—Reduces the need for additional manual focusing with changes in intensity after focus control has been set.

Beam Finder—Aids in locating offscreen signal.

External Z-Axis Input—2 V p-p for full intensity range. A positive signal blanks the trace. Maximum input voltage is 15 V (dc + peak ac) and p-p ac. Input is dc coupled.

CALIBRATOR

Output Waveshape—Rectangular positive going from ground.

Voltage Ranges—40 mV, 0.4 V, 4 V into an open circuit. 4 mV, 40 mV, 0.4 V into 50 Ω. Amplitude accuracy is within 1%. Repetition rate is 1 kHz within 0.25%.

Current Output—40 mA with optional current-loop accessory (012-0341-00) connected to calibrator output. Output R is 450 Ω.

OUTPUTS/INPUTS

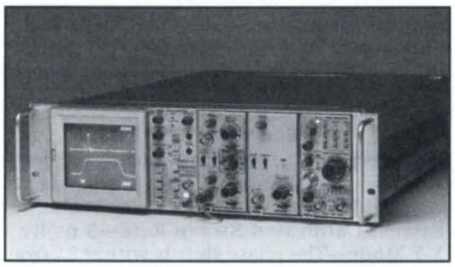
+Sawtooth—Sawtooth starts 1 V or less from ground into 1 MΩ. Front-panel selectable from A or B horizontal. Output voltage is 50 mV/div (±15%) into 50 Ω, 1 V/div (±10%) into 1 MΩ. Output R is ≈950 Ω.

+Gate—Positive-going rectangular waveform derived from A, B, or Delayed Gate, front-panel 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.

Vertical Signal Out—Selected by B Trigger Source switch. Output voltage is 25 mV/div into 50 Ω, 0.5 V/div into 1 MΩ. Output R is ≈950 Ω. Bandwidth depends upon vertical plug-in. See 7000-Series Vertical-System Specifications in the 7000-Series Reference section.

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 for two active probes.



The R7903 requires only 5.25 inches of rack height in a standard 19-inch rack. It is fan-cooled and comes complete with slideout chassis tracks.

POWER REQUIREMENTS

Line-Voltage Ranges—90 to 132 V ac and 180 to 250 V ac.
Line Frequency—48 to 440 Hz.
Maximum Power Consumption—210 W, 3.5 A at 90-V line, 60 Hz.

ENVIRONMENTAL AND SAFETY

Ambient Temperature—Operating: 0 to +50°C. Nonoperating: −55 to +75°C.
Altitude—Operating: 5000 m (15,000 ft). Nonoperating: 15 000 m (50,000 ft).
Vibration—Operating: 15 minutes along each of the three major axes. 0.04 cm (0.015 in) p-p displacement 10 to 55 to 10 Hz in one minute cycles. Held for three minutes at 50 Hz.
Humidity—Operating and Nonoperating: 95%, five cycles (120 hours), referenced to MIL-E-16400F.
Shock—Nonoperating: 30 g's, ½ sine, 11-ms duration in each direction along each major axis. Total of six shocks.
EMC Capability—(Option 03) Meets MIL-STD-461B requirements when tested in accordance with certain test methods of MIL-STD-462. Contact your Tektronix representative for more information.
Safety—UL listed (UL 1244) and CSA certified (CSA 556B) 7904A only.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	305	12.0	483	19.0
Height	345	13.6	135	5.3
Depth	577	22.7	579	22.8
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	16.9	37.2	12.3	27.0
Shipping	21.4	47.0	23.6	52.0

CHARACTERISTICS (R7903)

The following characteristics for the R7903 are in addition to or in lieu of those listed previously.

HORIZONTAL SYSTEM

Channel—Single right-hand plug-in compartment. Compatible with 7B80 Series, 7B90 Series, 7000-Series vertical amplifiers and specialized plug-ins.
Fastest Calibrated Sweep Rate—500 ps/div with the 7B92A.

CRT AND DISPLAY FEATURES

Option 10, Pulsed Graticule—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.

CALIBRATOR (NOT AVAILABLE WITH OPTION 10)

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.
Current Output—40 mA rectangular waveshape with optional current loop accessory (012-0341-00) connected to calibrator output. Output R is 450 Ω.

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 ≈950 Ω.
+Gate—Positive-going rectangular waveform derived from Main or Auxiliary Gate. Output voltage is 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 ≈950 Ω.
Vertical Signal Out—Selected by Trigger Source switches. Output voltage is 25 mV/div into 50 Ω, 0.5 V/div into 1 MΩ. Output R is ≈950 Ω. Bandwidth depends upon vertical plug-in. See 7000-Series Vertical-System Specifications in the 7000-Series Reference section.
External Single-Sweep Reset—Ground closure, rear-panel input to reset sweep.
Single-Sweep Ready Output—Rear-panel BNC provides 5 V out to indicate single-sweep-ready condition.
Probe Power—Two front-panel connectors for two active probes. Not available for Option 10.
CRT Readout—Inhibit: Ground closure, rear-panel BNC input locks out CRT readout. Not available with Option 10. 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.

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 pulsed graticule.

POWER REQUIREMENTS

Line-Voltage Ranges—90 to 132 V ac and 180 to 264 V ac.
Maximum Power Consumption—160 W, 2 A at 115-V line, 60 Hz.

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

Ordering information is common to the 7904A and R7903 unless otherwise noted.

7904A Oscilloscope **$11,530**
Includes: Power cord (161-0066-00); instruction manual (070-4593-00).

R7903 Oscilloscope **$10,980**
Includes: Power cord (161-0066-00); test adaptor (012-0092-00); two 18-in. test leads (012-0087-00); slide guide (351-0314-01); hardware kit (016-0099-00); instruction manual (070-1464-00).

OPTIONS

Option 02—(7904A only) X-Y Horizontal Compensation. Adds X-Y delay compensation network to equalize the signal delay between the vertical and the B horizontal compartments. **+$260**
Option 03—EMC Capability. Adds special shielding for protection to the instrument when operated in severe EMC environments. **+$395**
Option 10—(R7903 only) Pulsed Graticule. **+$260**
Option 78—BE (P11) Phosphor. **+$100**

CONVERSION KITS

X-Y Horizontal Compensation—(7904A only) Order 040-0606-00 **$470**
EMC Capability—(7904A)*[1]
(R7903) Order 040-0647-00 **$375**
CRT Readout—(R7903 only) Order 040-0605-08*[1]

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

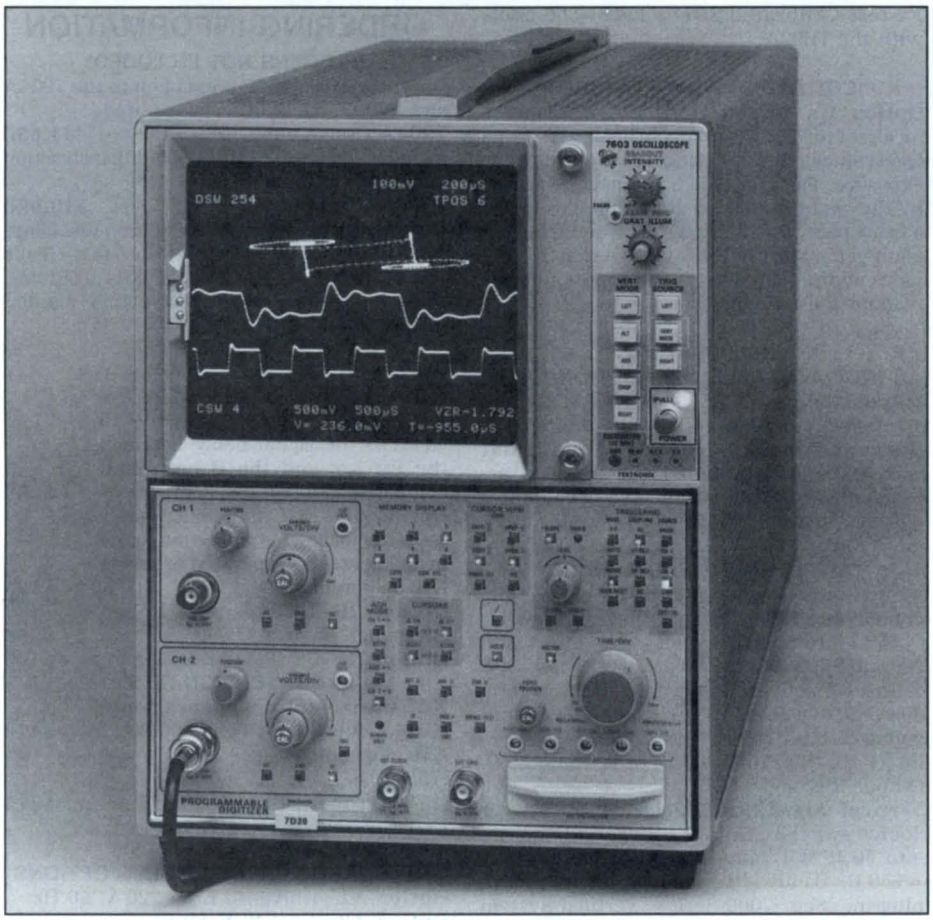
*[1]*Contact your local sales representative.*

OPTIONAL ACCESSORIES

Recommended Plug-Ins—See 7000-Series Vertical-System Specifications on pages 200–201.
Recommended Probes—See 7000-Series Oscilloscope Systems/Probe-Selection Guide on pages 200–201.
Recommended Cameras—See 7000-Series Mainframe/Time Base/Camera Selection Guide on pages 200–201.
Recommended Carts—See Instrument/Cart Compatibility Guide in the Cart section.
K213 Option 12—(7904A) **+$765**
K217—(7903) **$510**

TRAINING

Tektronix offers service training classes on the 7904A General-Purpose Oscilloscope. For further training information, contact your local Sales/Service Office and request a copy of the Customer Service Training Catalog.



7603/R7603

TYPICAL APPLICATIONS

- Digital Design and Testing
- Communications
- Spectrum Analysis

BENEFITS

- Familiar Lab Scope Operation
- Good Price/Performance Ratio
- Large Display
- Versatile Array of Plug-ins

FEATURES

- DC to 100-MHz Bandwidth
- 3.5-ns Rise Time
- 5-ns/Div Fastest Calib Sweep Rate
- Greater Than 260-cm/µs Writing Speed With Optional CRT (Opt 13)
- 6.5-Inch CRT
- CRT Readout
- 5.25-Inch Rackmount

See 7000-Series Reference section for available Application Notes.

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—8×10 divisions (1.22 cm/div)—and features an internal graticule with variable illumination and 15-kV accelerating potential. An optional high-brightness CRT with a smaller 8×10-cm display and 18-kV potential gives you greater visual brightness and higher photographic-writing speed. See Oscilloscope Reference section for writing-speed specifications.

CHARACTERISTICS

VERTICAL SYSTEM

Channels—Two left-hand plug-in compartments. Compatible with all 7000-Series plug-ins.
Bandwidth, Rise Time, and Deflection Factor—Determined by mainframe/plug-in. See 7000-Series Vertical-System Specifications.
Display Modes—Left, Alt, Add, Chop, Right. Chopped-mode repetition rate is ≈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.
Bandwidth—DC to 2 MHz.
Fastest Calibrated Sweep Rate—5 ns/div.
X-Y Mode—The phase shift is within 2° from dc to 35 kHz.

CRT AND DISPLAY FEATURES

CRT—Internal 8×10-division (1.22 cm/div) graticule with variable illumination. Accelerating potential is 15 kV. GH (P31) phosphor is standard.
Option 04, High-Brightness CRT With Reduced Area—Internal 8×10-cm graticule with variable illumination. Accelerating potential is 18 kV. GH (P31) phosphor.
Option 06, Spectrum-Analyzer Graticule—Provides internal spectrum-analyzer graticule.
Autofocus—Reduces the need for additional manual focusing with changes in intensity after focus control has been set.
Beam Finder—Aids in locating an offscreen signal.
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. Maximum input voltage is 10 V (dc + peak ac) and p-p ac.

CALIBRATOR

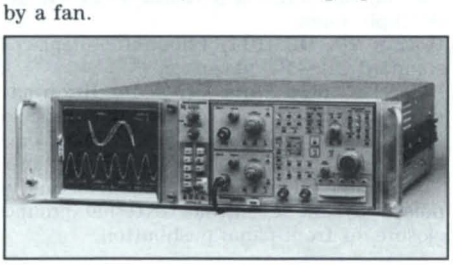
Voltage Output—Rectangular waveshape, positive going from ground (dc voltage available when selected by internal jumper).
Voltage Ranges—40 mV, 0.4 V, 4 V into 1 MΩ; 20 mV, 0.2 V, 0.4 V into 50 Ω. Amplitude accuracy is within 1% (+15 to +35°C); within 2% (0 to +50°C). Repetition rate is ≈1 kHz.
Current 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 ground pin jacks. Output R is 950 Ω.

OUTPUTS/INPUTS

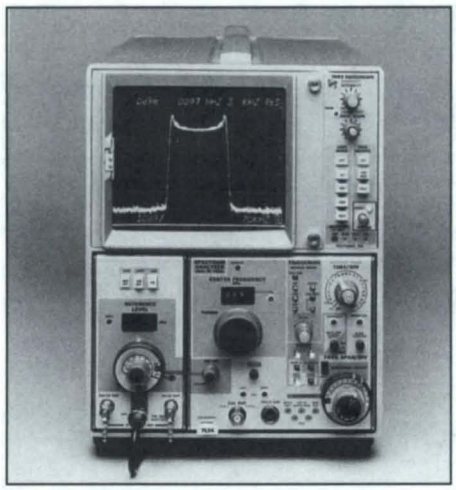
+Sawtooth Out (Rear Panel)—Sawtooth starts 1 V or less from ground (into 1 MΩ). Output voltage is 1 V/div (±10%) into 1 MΩ, 50 mV/div (±15%) into 50 Ω. Output R is 950 Ω.
+Gate Out (Rear Panel)—Positive gate of the same duration and coincident with sweep. Selectable from Main, Delay, or Auxiliary Gate. 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. Output R is 950 Ω.
Vertical Signal Out (Rear Panel)—Selected by Trigger Source switch. Output voltage is 0.5 V/div into 1 MΩ, 25 mV/div into 50 Ω. Output R is 950 Ω. Bandwidth determined by vertical plug-in. See 7000-Series Reference section.
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.
External Single-Sweep Reset—Ground closure, rear-panel BNC provides input to reset sweep.
Single-Sweep Ready Output—Rear-panel BNC provides 5 V out to indicate single-sweep ready condition.

POWER REQUIREMENTS

Line-Voltage Ranges—100, 110, 120, 200, 220, and 240 V ac ±10%; internally selectable with quick-change jumpers.
Line Frequency—50 to 60 Hz.
Option 05, Line-Frequency Change (50 to 400 Hz)—Converts the R7603 and 7603 from 50 to 400 Hz operation.
Maximum Power Consumption—180 W, 2.0 A at 115-V line, 60 Hz. Cooling is provided by a fan.



The R7603 requires only 5.25 inches of rack height in a standard 19-inch rack. It is fan-cooled and comes complete with slideout chassis tracks.



The 7L14 converts the 7603 Oscilloscope to a 1.8-GHz Spectrum Analyzer.

ENVIRONMENTAL AND SAFETY

Ambient Temperature—Operating: 0 to +50°C. Nonoperating: −55 to +75°C.
Altitude—Operating: 5000 m (15,000 ft). Nonoperating: 15 000 m (50,000 ft).
Vibration—Operating: 15 minutes along each of the three major axes. 0.04 cm (0.015 in) p-p displacement, 0 to 55 to 9 Hz in one-minute cycles. Held for three minutes at 55 Hz.
Humidity—Operating and Nonoperating: 95%, five cycles (120 hours), referenced to MIL-E-16400F.
Shock—Nonoperating: 30 g's, ½ sine, 11-ms duration in each direction along each major axis. Total of six shocks.
EMC Capability—(Option 03) Meets MIL-STD-1-A-6181B. Contact your Tektronix representative for more information.
Safety—UL listed (UL1244) and CSA certified (CSA 556B).

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	221	8.7	483	19.0
Height	290	11.4	127	5.2
Depth	610	24.0	627	24.7
Weights ≈	**kg**	**lb**	**kg**	**lb**
Net	13.6	30.0	13.6	30.0
Shipping	20.8	46.0	19.1	42.0

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

Ordering information is common to the 7603 and R7603 unless otherwise noted.
7603 Oscilloscope **$3,995**
Includes: Clear CRT filter (337-1700-04); blue CRT filter (337-1700-01); 20-in. two-pin-to-BNC cable (175-1178-00); instruction manual (070-1310-00).
R7603 Rackmount Oscilloscope **$4,910**
Includes: In addition to the above, a rack-mounting hardware kit (016-0099-00).

OPTIONS

Option 03—EMC Capability. Adds special shielding for protection to the instrument when operated in severe EMC environments. **+$395**
Option 04—High-Brightness 8×10-cm CRT Display. GH (P31) Phosphor. **+$500**
Option 05—Line-Frequency Change (50 to 400 Hz). **+$315**
Option 06—With Internal Spectrum Analyzer Graticule. **+$50**
Option 08 (7603)—Protective Panel Cover. **+$115**
Option 20—(R7603) IEEE Standard 488 Interface for the 7D20 only. (Deletes rear panel + sawtooth out, + gate out, and vert sig out.) **+$105**
Option 78—BE (P11) Phosphor. **+$100**

CONVERSION KITS

CRT Readout—
(7603) Order 040-0654-07. **$900**
(R7603) Order 040-0674-07.*1
EMC Capability—
(7603) Order 040-1000-00. **$395**
(R7603) Order 040-0955-00. **$315**
Power Supply—To Light Plug-in Pushbuttons. Order 040-0686-01. **$90**
X-Y Horizontal Comp—
Order 040-0718-00. **$425**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

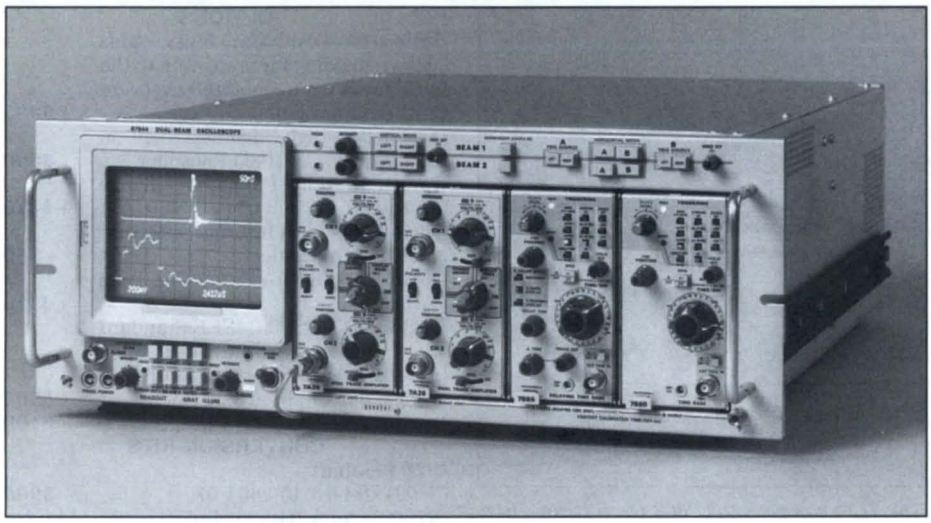
1 Contact your local Sales Representative.

FIELD-INSTALLED KITS

Field-Installable Option 20—(R7603 only) Intended for use with a previously purchased R7603. This kit provides parts to connect the 7D20's IEEE Standard 488 Interface to the R7603 mainframe.
Order 040-1093-01. **$500**
International Power Plug Options—Five field installed kits are available. Contact your local Tektronix Sales Office for information.
A1—Universal Euro. Order 040-1094-01
A2—UK. Order 040-1095-01
A3—Australian. Order 040-1096-01
A4—North American. Order 040-1097-01
A5—Switzerland. Order 040-1098-01

OPTIONAL ACCESSORIES

Recommended Plug-Ins, Probes, and Cameras—See 7000-Series Reference section, pages 200–202.
Recommended Carts—See Instrument/Cart Compatibility chart in Cart section.
K213 Option 12—(7603) **$765**
K217—(R7603) **$510**



R7844

TYPICAL APPLICATIONS

- Radar/Lidar
- Destructive Testing
- SCR Switching

BENEFITS

- View Two Simultaneous Events at Two Different Time Bases
- View the Same Event at Two Time Bases
- Plug-in Versatility

FEATURES

- 400-MHz Bandwidth
- 900-ps Rise Time
- 1 ns/Div Fastest Calibrated Sweep Rate
- Greater Than 1.5-cm/ns Writing Speed
- 8×10-cm Display
- CRT Readout
- True Dual Beam (Dual-Gun)
- Full Vertical Crossover Switching

See 7000-Series Reference section for available Application Notes.

The seven-inch rackmount R7844 is a wide-bandwidth, dual-beam oscilloscope 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. See Oscilloscope Reference section for photographic writing-speed specifications.

CHARACTERISTICS

VERTICAL SYSTEM

Channels—Two left-hand plug-in compartments. Compatible with all 7000-Series plug-ins.

Bandwidth, Rise Time, and Deflection Factor—Determined by mainframe/plug-in. See 7000-Series Vertical-System Specifications.

Display Logic

	Beam 1	Beam 2
Vertical Compartment Controlling Beam	Left	Left
	Left	Right
	Right	Left
	Right	Right

Crossover—Permits viewing the same signal on two time bases.

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 7B80 and 7B90 Series time bases. Not compatible with 7B50 Series.

HORIZONTAL SYSTEM

Channels—Two right-hand plug-in compartments. Compatible with 7B80 Series, 7B90 Series, 7000-Series vertical amplifiers, and specialized plug-ins.

Bandwidth—DC to at least 1 MHz.

Fastest Calibrated Sweep Rate—1 ns/div.

X-Y Mode—Phase shift is within 2° from dc to 50 kHz.

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. 8×10-cm graticule with variable illumination. CRT readout intensity is adjustable with front-panel control. Accelerating potential is 24 kV. GH (P31) phosphor.

Option 78, BE (P11) Phosphor—Replaces standard GH (P31) phosphor.

Pulsed Readout and Graticule Illumination—Provides a means of pulsing the graticule lights and CRT readout at a preset level, coincident with a single-shot event in one exposure. The graticule lights and CRT readout can be pulsed by the event, an external ground closure, or front-panel pushbutton.

Typical Photographic Writing Speed*1

CRT	Camera	Lens	Writing Speed cm/ns
Standard 8×10 cm	C-51	f/1.2	0.75
Opt 78 8×10 cm		1:0.5	1.5

*1 *Using Polaroid Type 107 3,000 ASA film without film fogging.*

The photographic writing-speed enhancer, Option 22, provides a preset automatic method of film fogging for the R7844. Option 22 is recommended for writing-speed enhancement when a camera with a writing-speed enhancer is not available.

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)—Aids in locating off-screen signal.

External Z-Axis Input (Beam 1 and Beam 2)—2 V p-p for full intensity range. A positive signal blanks the trace. Maximum input voltage is 15 V (dc + peak ac), p-p ac, dc coupled.

CALIBRATOR

Voltage Output—Rectangular waveform positive going 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. Optional current-loop adaptor (012-0341-00) required for R7844. Output R is 450 Ω.

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 ≈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 ≈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 connectors provide correct operating voltages for two active probes.

External Single-Sweep Reset—Ground closure, rear-panel BNC, provides input to reset sweeps.

Single-Sweep Ready Output—+5 V, rear-panel BNC output, for single-sweep ready indication.

POWER REQUIREMENTS

Line Voltage Ranges—Selectable 115 V nominal (90 to 132 V), 230 V nominal (180 to 264 V).

Line Frequency—48 to 440 Hz.

Maximum Power Consumption—235 W, 2.9 A at 60-Hz 115-V line.

ENVIRONMENTAL AND SAFETY

Ambient Temperature—Operating: 0 to +50°C. Nonoperating: −55 to +75°C.

Altitude—Operating: 5000 m (15,000 ft). Nonoperating: 15 000 m (50,000 ft).

Vibration—Operating: 15 minutes along each of the three major axes. 0.04 cm (0.015 in.) p-p displacement 10 to 50 to 10 Hz in one-minute cycles. Held for three minutes at 50 Hz.

Humidity—Operating and Nonoperating: 95%, five cycles (120 hours), referenced to MIL-E-16400F.

Shock—Nonoperating: 30 g's, ½ sine, 11-ms duration in each direction along each major axis. Total of six shocks.

EMC Capability—(Option 03) Meets MIL-STD-461B requirements when tested in accordance with certain test methods of MIL-STD-462. Contact your Tektronix representative for more information.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	483	19.0
Height	178	7.0
Depth	630	24.8
Weight ≈	**kg**	**lb**
Net	15.0	33.0
Shipping	28.6	63.0

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

R7844 Rackmount Oscilloscope **$18,335**
Includes: Power cord (161-0066-00); instruction manual (070-1676-02); hardware rackmount kit (016-0099-00); slide guide (351-0314-01).

OPTIONS

Option 03—EMC capability. Adds special shielding for protection to the instrument when operated in severe EMC environments. **+$395**

Option 22—Writing-Speed Enhancer. **+$400**

Option 78—BE (P11) Phosphor. **+$100**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.

Option A2—UK 240 V, 50 Hz.

Option A3—Australian 240 V, 50 Hz.

Option A4—North American 240 V, 60 Hz.

Option A5—Switzerland 220 V, 50 Hz.

OPTIONAL ACCESSORIES

Recommended Plug-Ins, Probes, and Cameras—See 7000-Series Reference section on pages 200–202.

Recommended Carts—K217 **$510**
See Instrument/Cart Compatibility chart in the Cart section.

5000-SERIES ANALOG OSCILLOSCOPES

CONTENTS

5110/R5110 215
5440/R5440 216
Oscilloscope Plug-ins 277

BENEFITS

- **Wide Choice of Plug-ins**
- **Low cost**

FEATURES

- **2-MHz, or 50-MHz Bandwidth**
- **10-μV/Div Sensitivity**
- **One- to Eight-Channel Capability**
- **Large 6.5-Inch CRT (8×10 Div)**
- **CRT Readout (5400 Series)**
- **Delayed-Sweep Time Bases**
- **Y-T or X-Y Operation**
- **Bench-to-Rack Convertibility**

The 5000-Series plug-in oscilloscope family is designed to provide maximum versatility and performance at the lowest possible price.

5100 Series mainframes provide real-time bandwidth to 2 MHz, sensitivity to 10 microvolts per division, dual-sweep operation, and more.

The 5440 single-beam, nonstorage mainframe features CRT readout of plug-in scale factors, three plug-in compartments, and benchmount-to-rackmount convertibility.

With its 50 MHz bandwidth the 5400 Series offers a satisfying wide range of measurement needs. Readout of plug-in scale factors on the CRT (except with plug-ins having a suffice N: 5A22N, 5B10N, etc), previously available only on more sophisticated oscilloscopes, allows you to make measurements more quickly and conveniently. The CRT readout can also be externally accessed (Option 03).

5000-SERIES ANALOG OSCILLOSCOPE SELECTION GUIDE

PRODUCT	BANDWIDTH	MINIMUM DEFLECTION FACTOR	NUMBER OF CHANNELS	MAXIMUM SWEEP RATE	PRICE
5440/R5440	50 MHz	5 mV/div at BW 10 μV/div; 0.5 mA/div	up to 8	5 ns/div	$4,220/$4,300
5110/R5110	2 MHz	1 mV/div at BW 10 μV/div; 0.5 mA/div	up to 8	100 ns/div	$2,305/$2,405

Each 5000-Series mainframe houses up to three plug-in units. For conventional Y-T operation, the left and middle plug-ins are amplifier units and the right plug-in is a time-base unit. An amplifier unit may be used in the right plug-in compartment to provide X-Y operation to the full sensitivity of the amplifier unit used. A dual-trace amplifier unit in the right compartment can provide fully independent, dual X-Y displays.

The 5110 single-beam nonstorage mainframe features 2-MHz vertical systems with large 6½-inch CRTs.

The 5440 single-beam, nonstorage features CRT readout of plug-in scale factors, three plug-in compartments, and benchmount-to-rackmount convertibility.

The 5400 Series offers 50-MHz bandwidth and satisfies a wide range of measurement needs. Readout of plug-in scale factors on the CRT (except with plug-ins having a suffix N: 5A22N, 5B10N, etc.), allows you to make measurements more quickly and conveniently. The CRT readout can also be externally accessed (Option 03).

A wide choice of plug-ins is available. Compatibilities of 5000-Series mainframes and plug-ins are shown in the chart below.

5000-SERIES MAINFRAME/PLUG-IN COMPATIBILITY

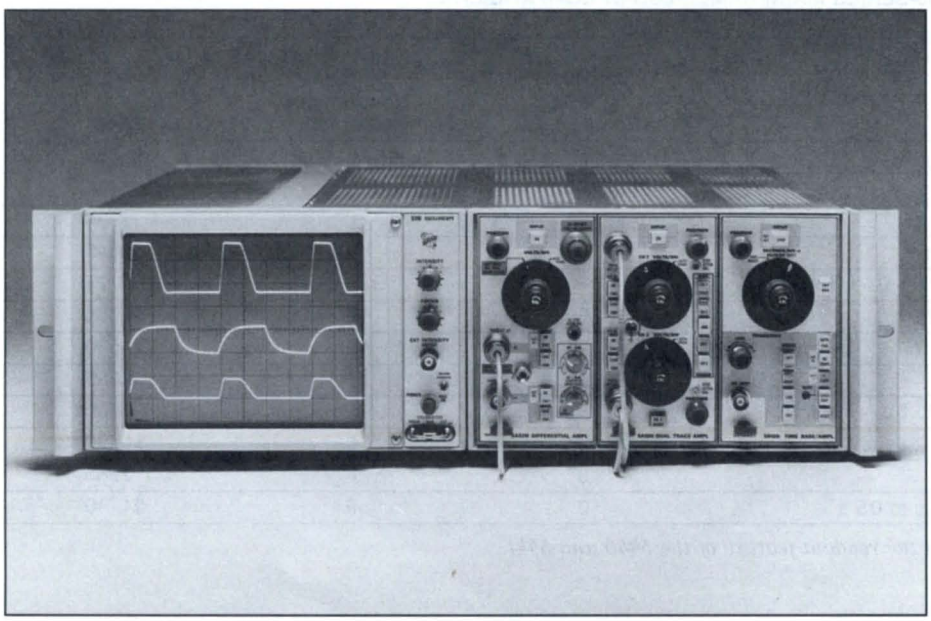
F=Full compatibility L=Limited compatibility 0=No compatibility

Plug-Ins	5110 2 MHz Nonstorage	5440 50 MHz Nonstorage W/Readout	Price
5A14N Four Channel, 1 MHz, 1 mV/div	F	L	$1,855
5A15N Single Channel, 2 MHz, 1 mV/div	F	L	$445
5A18N Dual Channel, 2 MHz, 1 mV/div	F	L	$930
5A19N Single-Channel Differential, 2 MHz, 1 mV/div	F	L	$545
5A21N Single-Channel Differential, 1 MHz, 50 μV/div, 0.5 mA/div	F	L	$725
5A22N Single-Channel Differential, 1 MHz, 10 μV/div	F	L	$1,365
5A26 Dual-Channel Differential, 1 MHz, 50 μV/div	F	F	$1,530
5A48 Dual Channel, 50 MHz, 1 mV/div	0	F	$1,385
5B10N Single-Channel Time Base/Amplifier, 1 μs to 5 s	F	L	$705
5B12N Dual-Channel Time Base, A-1 μs to 5 s, B-2 μs to 0.5 s	F	L	$1,490
5B40 Single-Channel Time Base, 0.1 μs to 5 s	0	F	$985
5B42 Delaying Time Base, A-0.1 μs to 5 s, B-0.1 μs to 0.5 s	0	F	$1,740

Plug-ins with an "N" suffix do not implement the readout feature of the 5440 and 5441.

APPLICATION NOTES FOR 5000 SERIES

Title	Description	Order
Biophysical Data Retrieval, The Digitizing Approach	5223/5B25N/5A18N Roll mode, chart recorder output.	52-W-4462-1
Interpreting Mechanical Measurements With the Plug-In Oscilloscope	5111/5A22N/5A18N Transducer measurements and storage.	52-A-3533-1
Simultaneous Display of Two Independent X-Y Signal Pairs	5111/5A15/5A15N/5A18N. Dual X-Y techniques, engine analysis.	52-AX-4114
Simultaneous X-Y, Y-T Displays	5111/5A15/5A15N/5B12N. X-Y, Y-T techniques. Biomedical application.	52-AX-4113
Custom Plug-In Ideas for 5000 Series Scopes	Recommended starter note for customers considering custom plug-in project.	52-AX-3758
A High Resolution 60 Hz Notch Filter	Construction project using a commercial module in our plug-in kit. Preconditions signals by removing 60 Hz hum.	52-AX-4031
A True RMS Converter	Construction project using thermal true RMS converter module in our blank plug-in kit. Measures true RMS up to 200 V RMS.	52-AX-4112



5000-Series rackmount oscilloscopes and cabinet-to-rackmount kits include complete slideout tracks and mounting hardware for interface with standard 19-inch racks.

5000 SERIES PLUG-IN/PROBE COMPATIBILITY

Plug-In	Probe	Attenuation	Features
5A14N	P6101A	1X	Full bandwidth
5A15N	P6102A	10X	Full bandwidth
5A18N	P6062B	1X–10X	Switchable attenuation, ground-reference button
5A21N	P6101A	1X	Full bandwidth
5A22N	P6102A	10X	Full bandwidth
5A26	P6062B	1X–10X	Switchable attenuation, ground-reference button
	P6055	10X	Variable attenuation for high CMRR in differential operation
5A48	P6101A	1X	Reduced bandwidth
	P6105A	10X	Full bandwidth
	P6062B	1X–10X	Switchable attenuation, ground-reference button, reduced bandwidth at 1X

See Probe Section for complete descriptions.

OPTIONAL ACCESSORIES

CART

K213 Lab Instrument Cart—For cabinet models. Plug-in storage available as Option 12. See Cart section for more information. **$625**

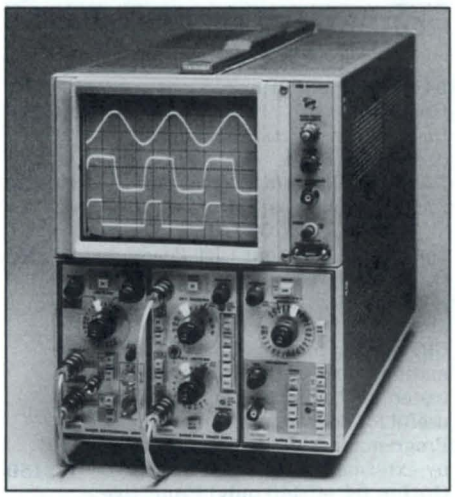
CAMERAS

C-7, C-5C or C-4 Option 02—For all 5100 Series. Suitable for repetitive or stored traces.
C-59A (G or P)—General Purpose. For 5100 Series storage scopes and 5400 Series.

For full details, see Instrumentation Documentation Devices section.

Blank Plug-In Kit—
Order 040-0818-03 **$140**
Blank Panel—Order 016-0452-00 **$27**
Viewing Hoods—
Order 016-0154-00 **$43**
(Folding) Order 016-0260-00 **$27**
Protective Cover—
Order 016-0544-00 **$19.25**

For full details, see Other Accessories section.



5110/R5110

Oscilloscopes

TYPICAL APPLICATIONS

- **Biomedical Research**
- **Electromechanical Design/Test**

BENEFITS

- **Wide Choice of Plug-ins**

FEATURES

- **Lowest Cost Single-Beam Analog Scope with Plug-in Configurability**
- **DC to 2 MHz**
- **8 Channels at 1 mV/Div, 4 Channels at 50 μV/Div, 2 Channels at 10 μV/Div, With Appropriate Amplifiers**
- **Rear-Panel Signal Outputs (Optional)**

The 5110 is a single-beam nonstorage oscilloscope featuring a large 6½-inch diagonal (1.27 cm/div) CRT. Choose from single-channel or dual-channel basic amplifiers and time-base plug-ins to suit the special needs of education and industry.

CHARACTERISTICS

Characteristics are the same for the 5110/R5110 unless otherwise indicated.

VERTICAL SYSTEM

Channels—Left and center plug-in compartments. Compatible with all 5000-Series plug-ins. See 5000-Series Reference section.
Deflection Factor and Bandwidth—Determined by plug-in. See 5000-Series Reference section.
Chopped Mode—(5110/R5110) The mainframe vertical amplifier will chop between left and center plug-in compartments, and/or between two or more amplifier channels. The total time segment per channel is ≈5 μs, consisting of ≈4 μs displayed, ≈1 μs blanked. Chop or alternate mode is selected at the time-base unit.
Alternate Mode—Each amplifier plug-in is swept twice before switching to the next. Single-trace amplifiers are swept twice. Each channel of a dual-trace amplifier is swept once before switching to the second amplifier.

HORIZONTAL SYSTEM

Channel—Right plug-in compartment. Compatible with all 5100-Series plug-ins. See 5000-Series Reference section.
Fastest Calibrated Sweep Rate—0.1 μs/div (X10 mag) with 5B10N or 5B12N.
X-Y Mode—Phase shift is within 1° from dc to 100 kHz.

CRT AND DISPLAY FEATURES

CRT—Internal 8 x 10 div (1.27 cm/div) parallax-free, nonilluminated graticule. Illuminated graticule available at extra cost.
Accelerating Potential—3.5 kV.
Standard Phosphor—GH (P31).
Optional Phosphors (Specify)—GM (P7) or BE (P11).
Beam Finder—Aids in locating an off-screen signal.

CALIBRATOR

Voltage Output—Square wave, positive going from ground.
Voltage Range—400 mV within 1%.
Current Output—4 mA with current loop. Frequency is two times the line frequency.

OUTPUTS/INPUTS

External Intensity Input—+5 V turns beam on from off condition. −5 V turns beam off from on condition. Frequency range is dc to 1 MHz. Input R and C is ≈10 kΩ paralleled by ≈40 pF. Maximum input is ±50 V (dc + peak ac).

POWER REQUIREMENTS

Line-Voltage Ranges—100, 110, 120, 200, 220, and 240 V ac ±10% (except that maximum input should not exceed 250 V ac). Internally selected with quick-change jumpers.
Line Frequency—48 to 440 Hz.
Maximum Power Consumption—110 W.

ENVIRONMENTAL

Ambient Temperature—Operating, 0 to +50°C; nonoperating, −40 to +70°C.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	213	8.4	483	19.0
Height	302	11.9	135	5.3
Depth	518	20.4	483	19.0
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	10.4	23.0	10.9	24.0
Shipping	14.5	32.0	19.5	43.0

OPTION 07

Rear-Panel Signal Outputs

CHARACTERISTICS

Left and Center Compartments—Two BNC connectors provide access to the CRT-related signals from the left and center plug-in amplifiers. Sensitivity: 0.5 V/CRT division. Output impedance: 1 kΩ.
Right Compartment—Sweep: One BNC connector provides access to the CRT-related sweep waveform. Sensitivity is 0.5 V/CRT division; positive going sawtooth, ≥ 5 V. Output Impedance is 1 kΩ. Gate: One BNC connector provides access to TTL-compatible gate. Positive going, coincident with displayed sweep.
X-Y Mode—CRT-related X-Y signals are available at the appropriate rear-panel connectors when amplifier plug-ins are used in either the left or center compartment and the right compartment to display X-Y information. Sensitivity (X-Y): 0.5 V/CRT division.

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

Ordering information is common to all units unless otherwise noted.
5110 Oscilloscope **$2,305**
Includes: Instruction manual (070-2134-01).
R5110 Oscilloscope **$2,405**
Includes: Same as 5110.

OPTIONS

Option 02—(5110) Protective Panel Cover. The cover protects the front panel and knobs during transportation and storage. **+$40**
Option 07—Add Rear-Panel Signals Out. **+$130**
Option 76—GM (P7) Phosphor. **+$50**
Option 78—BE (P11) Phosphor. **+$50**

CONVERSION KITS

Cabinet-to-Rackmount Conversion Kit—Order 040-0583-03 **$250**
Rackmount-to-Cabinet Conversion Kit—Order 040-0584-04 **$225**
Protective Panel Cover Kit—Order 040-0620-00 **$45**
Rear Panel Signal Outputs—Order 040-0915-02 **$400**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

OPTIONAL ACCESSORIES

Recommended Plug-Ins and Probes—See Signal Acquisition section.
Recommended Cart—K213
Option 12. See Cart section. **$765**

RECOMMENDED CAMERAS

(See Instrumentation Documentation Devices section.)

C-5C—Low cost. **$495**
C-59AP—General purpose for 5100 Series. **$1,475**
C-7—AutoFilm Eject. **$610**

5440/R5440

General Purpose Oscilloscopes

TYPICAL APPLICATIONS

- **Electrical Engineering**
- **Component Testing**
- **Ultrasonics**

FEATURES

- **DC to 50 MHz**
- **CRT Readout**
- **Three Plug-In Flexibility**
- **Wide Choice of Plug-Ins**
- **Bench-to-Rack Convertibility**
- **Low Cost**

The 5440 combines versatility and low cost in a 50-MHz general-purpose, plug-in oscilloscope.

Plug-in scale factors are displayed on the CRT, so measurement time and operator errors are reduced. The CRT readout can also be accessed externally to allow the display of dates, times, test numbers, etc., along with displayed waveforms. (Order Option 03, User Addressable CRT Readout.)

The wide variety of plug-ins allows an oscilloscope/plug-in configuration to meet your current and future needs. All the plug-ins in the 5000 Series are compatible with the 5440.*[1]

*[1] *Plug-ins with a suffix N (5B12N, etc.) do not provide CRT readout. The 5B10N and 5B12N Time Bases do not permit viewing the leading edge of a triggered waveform when used in the 5400 Series.*

CHARACTERISTICS

VERTICAL SYSTEM

Channels—Left and center plug-in compartments. Compatible with all 5000-Series plug-ins. CRT readout is not available with plug-ins having a suffix N (5A18N, etc.).
Bandwidth—Up to 50 MHz, determined by plug-in unit. See 5000-Series Reference section.
Deflection Factor—Determined by plug-in unit. See 5000-Series Reference section.
Chopped Mode—The oscilloscope will chop between channels at ≈ 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-channel amplifier is swept twice and each channel of a dual-channel amplifier is swept once before switching to the second amplifier.

HORIZONTAL SYSTEM

Channel—Right plug-in compartment. Compatible with all 5000-Series plug-ins. CRT readout is not available for plug-ins with a Suffix N (5B10N, etc.).
Internal Trigger Mode—Left vertical, right vertical.
Fastest Calibrated Sweep Rate—10 ns/div, determined by plug-in.
X-Y Mode—Phase shift is within 2° from dc to 20 kHz.

CRT AND DISPLAY FEATURES

CRT—Internal parallax-free 8×10 div (1.22 cm/div) illuminated graticule. Accelerating potential is 15 kV with GH (P31) phosphor standard.
Autofocus—Reduces the need for manual focusing with changes in intensity after focus control has been set.
External Intensity Input—+5 V turns beam on from off condition. −5 V turns beam off from on condition. Frequency range is dc to 2 MHz. Input R and C is ≈10 kΩ paralleled by ≈40 pF. Maximum input is ±50 V (dc + peak ac).
Beam Finder—Brings offscreen trace into graticule area.
Minimum Photographic Writing Speed—Using Polaroid film 20,000 ASA without film fogging. Writing speed can be increased with the Tektronix Writing Speed Enhancer. (See Accessories section for more information.)
Optional Phosphors (Specify)—GM (P7) or BE (P11).

CALIBRATOR

Voltage—400 mV within 1%.
Current Output—4 mA within 1%. Frequency is two times the power-line frequency.

POWER REQUIREMENTS

Line-Voltage Ranges—100, 110, 120, 200, 220, and 240 V ac ±10% (except that maximum input should not exceed 250 V ac), internally selected with quick-change jumpers.
Line Frequency—48 to 440 Hz.
Maximum Power Consumption—100 W at 120 V ac, 60 Hz.

ENVIRONMENTAL

Ambient Temperature—Operating: 0 to +50°C. Nonoperating: −40 to +70°C.
Altitude—Operating: 5000 m (15,000 ft). Nonoperating: 15 000 m (50,000 ft).

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

5440 General-Purpose Oscilloscope **$4,220**
Includes: Instruction manual (070-2139-01).
R5440 Rackmount Oscilloscope **$4,300**
Includes: Same as 5440.

OPTIONS

Option 01—Without CRT Readout. **NC**
Option 03—User-Addressable CRT Readout. Up to 20 user-selected characters may be displayed in the CRT readout for additional test information such as time, date, device tested, test number, etc. Especially useful for documenting photographs. Programming of characters is done by external resistors and switches. **+$150**
Option 04—(5440 only) Protective Panel Cover. **+$40**
Option 76—GM (P7) Phosphor. **+$50**
Option 78—BE (P11) Phosphor. **+$50**

CONVERSION KITS

CRT Readout—Order 040-0691-02 **$580**
Cabinet-to-Rackmount—Order 040-0583-03 **$250**
Rackmount-to-Cabinet—Order 040-0584-04 **$225**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.

OPTIONAL ACCESSORIES

Recommended Plug-Ins—See Oscilloscope Plug-Ins section, page 277.
Recommended Probes—See Signal Acquisition section.
Recommended Cameras—See 5000-Series Reference section (pages 213-214) and Instrumentation Documentation Devices section.
Recommended Cart—K213 Option 12. See 5000-Series Reference section (pages 213-214) and Cart section.

Writing Speed cm/μs				Camera	Lens
GH (P31) Phosphor		BE (P11) Phosphor			
20,000 ASA	3000 ASA	20,000 ASA	3000 ASA		
180	90	245	125	C-59P	f/2.8 0.67 mag
330	160	450	230	C-50P*[1]	f/2.8 0.7 mag

*[1] *Slight cropping of the graticule corners. Requires optional battery pack (016-0270-02) for operation with the 5440.*

DIGITAL STORAGE OSCILLOSCOPES

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Tek is always improving digitizing oscilloscope performance. Call your local sales representative for the latest offerings.

DIGITAL OSCILLOSCOPE AND WAVEFORM DIGITIZER SELECTION GUIDE

Type	Analog Digitizing BW	Maximum Digitizing Rate	Vertical Resolution	Data Words per Waveform	Maximum Stored Waveforms	Useful*1 Storage BW (SS)	Equiv*2 Storage BW (rep)
11201	400MHz	20 MS/s	10 bits*3	Up to 10,240	100K pts	2MHz	400 MHz
11401	500 MHz	20 MS/s	10 bits*3	Up to 10,240	100K pts	2 MHz	1 GHz
11402	1 GHz	20 MS/s	10 bits*3	Up to 10,240	100K pts	2 MHz	1 GHz
11801	20 GHz*4	200 KS/s	8 bits	Up to 5,120	500K pts	N/A	20 GHz
11802	20 GHz*4*5	200 KS/s	8 bits	Up to 5,120	500K pts	N/A	20 GHz*5
336A	50 MHz	1 MS/s	8 bits	1024 each channel	2 (16 with option)	100 kHz	50 MHz
2220	60 MHz	20 MS/s	8 bits	2048 dual channel 4096	2	2 MHz	60 MHz
2221	60 MHz	20 MS/s	8 bits	single channel	2	2 MHz	60 MHz
2230	100 MHz	20 MS/s	8 bits	2048 dual channel 4096 single channel	8 (+52 with option)	2 MHz	100 MHz
7854	400 MHz*6	500-kHz Ext Clock	10 bits	Up to 1024	Up to 40	50 kHz	400 MHz
7D20	70 MHz	40 MHz	8 bits	Up to 1024	6	10 MHz	70 MHz
2430A	150 MHz	100 MS/s	8 bits	1024	6	40 MHz	150 MHz
2432A	300 MHz	250 MS/s	8 bits	1024	6	40 MHz	300 MHz
2440	300 MHz	500 MS/s	8 bits	1024	6	200MHz	300MHz
DCS01/ 7104	1 GHz	250 GHz 9-bits sing.	12-bits rep.	512	26	1 GHz	1 GHz

*1 *Useful Storage Bandwidth is a measure of the highest frequency sine wave that can be stored in a single sweep and displayed in a visually useful manner. This is dependent on both the maximum digitizing rate as well as the display reconstruction technique used.*

*2 *Equivalent Storage Bandwidth indicates the highest frequency repetitive signal that can be stored and displayed with less than 3 dB loss of signal amplitude using equivalent-time digitizing techniques.*

*3 *14 bits with averaging.*

*4 *With SD24 or SD26 sampling head. The analog bandwidth is a function only of the sampling head.*

*5 *5 GHz if delay lines are used.*

*6 *14 GHz with sampling.*

PORTABLE DIGITAL STORAGE OSCILLOSCOPES

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Now Tektronix gives you many choices in portable digital-storage oscilloscopes. They build on the high value, high performance standards that Tektronix is famous for. They also set some standards of their own—in performance, price and ease of use.

PORTABLE STORAGE OSCILLOSCOPE SELECTION GUIDE

Product	Bandwidth (MHz)	Sensitivity (mV/div)	Dual Trace	Delayed Sweep	Fastest Sweep (ns/div)	Features	Size mm (in.) H×W×D	Weight kg (lb)	Power Requirements	Prices Begin at
2440 2440M	300	2	✓	✓	2	Digital Storage, 500 MS/s with 8-bit vertical resolution and simultaneous dual-channel acquisition	190×330×479 (7.5×13×18.8)	11.1 (24.4)	Line (90-132/180-250 V ac, 48-440 Hz)	$11,500 $21,000
2432A 2432M	300	2	✓	✓	2	Digital Storage 250 MS/s with 8-bit vertical resolution and simultaneous dual-channel acquisition	190×330×479 (7.5×13×18.8)	11.1 (24.4)	Line (90-132/180-250 V ac, 48-440 Hz)	*1 $19,000
2430A/ 2430M	150	2	✓	✓	5	Digital Storage, 100 MS/s with 8-bit vertical resolution and simultaneous dual-channel acquisition	190×330×479 (7.5×13×18.8)	11.1 (24.4)	Line (90-132/180-250 V ac, 48-440 Hz)	$7,950 $17,450
2230	100	2	✓	✓	5	Digital Storage 20 MS/s at 5μs/div and faster	137×237×440 (5.4×9.3×17.3)	8.3 (18.0)	Line (90-250 V ac, 48-440 Hz)	$4,995
2220	60	2	✓		5	Digital Storage 20 MS/s at 5μs/div and faster	137×237×440 (5.4×9.3×17.3)	8.3 (18.0)	Line (90-250 V ac, 48-440 Hz)	$2,995
2221										3,995
2210	50	5	✓		50	Digital Storage, 20 MS/s; 4K record length	137×380×438 (5.4×15.0×17.2)	7.6 (16.8)	Line (95-250 V ac, 48-440 Hz)	$2,395
336A	50	5	✓	✓	100	Digital Storage 1 MS/s Microprocessor control and menu driven	112×237×482 (4.4×9.3×14.6)	5.1 (11.3)	Line (90-132/180-250 V ac, 48-440 Hz)	*1
2201	20	5	✓		100	Digital Storage 10 MS/s, 2K record length	137×380×438 (5.4×15.0×17.2)	7.6 (16.8)	Line (95-250 V ac, 48-440 Hz)	$1,495

*1 *Contact your local sales office.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

PORTABLE SCOPE PRODUCT LITERATURE AND APPLICATION NOTES

Tektronix product literature is readily available from your local Tektronix Sales Office.

For data sheets and product brochures, just ask for literature on the specific instrument. Additional related publications also available are listed below.

Title	Description	Order
Using the 2430A to Develop Fault Detection Equipment for Power Transmission	Application Note	37W-6655
Making Accurate Timing Measurements in Digital Circuits Using the 2430A	Application Note	37W-6692
Using the 2430's Time and Events Delay for Accurate Data Acquisition	Application Note	37W-6807
Using the 2430 for Rapid Data Acquisition and Nonvolatile Storage	Application Note	37W-6801
Using 2430A X/Y Mode Tests For Easier Modem Design	Application Note	37W-6693
Quick and Easy Digitizing of Fast, Transient Events, Using the 2440	Application Note	37W-7015
Using the Portable 2432 to Verify T-Carrier Signal Quality—Quickly and Accurately	Application Note	37W-6989
Using the 2430 for Rapid Data Acquisition and Nonvolatile Storage	Application Note	37W-6801
Increasing Throughput in Production Testing, Using the 2430A's Waveform Parameter Extraction	Application Note	37W-6379-1
Using the 2430 for Limit Testing Automation	Application Note	37W-6379
Combining the Tektronix 2430 and IBM PC for Flexible Automated Board Testing	Application Note	37W-6653
Using the 2430 for High Throughput Production Testing	Application Note	37W-6691
Using 2400 Series Digital Oscilloscopes to Cut Cost Per Test and Time Per Test	Application Note Handbook	37W-6935
Using the 2430A for TV Waveform Measurements	Engineering Brief	37W-6772
2400 Series DSO Concepts	Engineering Briefs	37W-6136-1
Using 2400 Series Digital Oscilloscopes to Automatic Complex Timing Measurements	Engineering Brief	37W-6525
Portable Oscilloscope Selection Guide	A helpful aid for choosing the right portable scope for your needs.	38W-5158-2
2000 Series Warranty Brochure	Describes Tek's 3-year warranty on 2000 Series scopes and 5-year *Warranty-Plus* Service	81W-5258
Quick and Easy Phase Measurement	Application Note	38W-5223-1
Chip CRT and Assembly	Article Reprint	38W-5312
336 Brochure	Describes 336	53W-5426-1
VITS Analysis for TV Servicing	Application Note	41AX-4047-1 46W-5207
Integrating a Scope	Article Reprint	46W-5337

Title	Description	Order
Portable Storage	Selection Guide	41W-5546
Your Direct Line to the World's Best Instruments and Technical Expertise	Find out about the Tektronix National Marketing Center and Tek's Service Offices	60A-4873-1
2225 Instructor's Aid	Supplement to Primer	46W-6466
2225 Workbook	Supplement to Primer	46W-6465
2225 Poster	Supplement to Primer	46W-6430
2215A Primer	Concepts	46AX-4758-2
2215A Poster	Supplement to Primer	46TT-528
ABCs of Probes	Primer on signal acquisition probes, applications, specs and selections	60-W-6053
DSO Primer	Concepts	41W-6051
Waveform Storage using the 2230	Concepts	41W-6392
Peak Detect Feature of the 2230	Concepts	41W-6393
Capture of Transient Events with the 2230	Concepts	41W-6398
Signal Averaging Using the 2230	Concepts	41W-6570
Scan & Roll Modes for Capturing Slow Events	Concepts	41W-6570
Single Fiber Muscle Research Using the 2230	Application Note	41W-6395
2230 Data Acquisition for Process Control	Application Note	41W-6024
Muscle Fatigue Research Using the 2230	Application Note	41W-6396
Computer Disk Drive Repair with the 2230	Application Note	41W-6397
Using the 2230 to Design Zero Defects into the Manufacturing Process	Application Note	41W-6504
G.E. Medical Diagnostic Instrument Service	Application Note	41W-6571
DSOs: Take a New Look	Article Report	41W-6484
New DSO Techniques for Capturing Elusive Glitches	Article Reprint	41W-6480
Use a DSO to get More and Better Data	Article Reprint	37W-6251
GPIB Utility Software for 4041	Software Data Sheet	41W-6486
GPIB Waveform Analysis Software for 4041	Software Data Sheet	41W-6496
GPIB Utility Software for the IBM PC	Software Data Sheet	41W-6485
RS-232C Utility Software for IBM PC	Software Data Sheet	41W-6503
Think-Jet Printer	System Applications	41W-6497
EPSON Printer	System Applications	41W-6499
HP-GL Plotter	System Applications	41W-6501
X-Y Plotter	System Applications	41W-6489
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2220/2221/2230	Data Sheet	41W-6657

PORTABLE SCOPE/ACCESSORIES COMPATIBILITY GUIDE

	PROBES*4			CAMERAS			CARTS	MISCELLANEOUS ACCESSORIES
	Passive	**Active**	**Current**	**Single Shot or Low Rep Rate**	**Stored/Stable or Repetitive**	**Low Cost**		
2440 **2440M** **2432A** **2430A** **2430M** **2432M**	P6101A, P6009 P6015, **P6133, P6136 (2430A)** **P6137**	P6201 P6202A P6230	P6021/P6022 A6302/AM 503 A6303/AM 503	C-31B Opt 01 016-0269-03 adapter*1	C-30B Opt 01 016-0269-03 adapter*1	C-5C Opt 02 016-0359-01 adapter*1 C-4 122-0894-01	K212	Folding Polarized Viewing Hood 016-0180-00; Collapsible Viewing Hood (Binocular) 016-0566-00; 1105 Power Supply; 1106 Battery Pack; 1107 Dc Inverter Power Supply; Protective Cover 016-0720-00.
2220 **2221** **2230** **2210** **2201**	P6101A P6009 P6130 P6015 P6062B P6230 P6122 P6121 (2230) **P6109** **P6103**	P6201 P6202A	P6021 P6022 A6302/AM 503 A6303/AM 503	C-31B Opt 01 016-0269-03 adapter	C-31B Opt 01 016-0269-03 adapter	C-5C Opt 04 016-0359-01 adapter*1*3 (with flash) C-4 Option 02 C-7 Opt 02*4, Opt 03 C-5C Opt 02	K212	Clear CRT Light Filter 337-2775-01; CRT TV Graticule Custom Mod; Accessories Pouch 016-0677-02; Front Cover 200-2520-00; RM Kit: 016-0466-00 for 2235; 016-0819-00 for 2225; 016-0833-00 for 2235 Opt 01; 016-0015-00 for 2236; RM Kit: F2240R for 2245/2246; P6602 Temperature Probe
336A	P6101A **P6149A** **P6148A (336A)**		P6021, P6022 A6302/AM 503 A6303/AM 503	C-31B Opt 01 016-0327-01 adapter*2	C-30B Opt 01 016-0327-01 adapter*2		NA	Viewing Hood 016-0297-00; Mesh Filter 378-0063-00; 1105 Battery Power Supply; Rain Cover (314, 335) 016-0612-00.

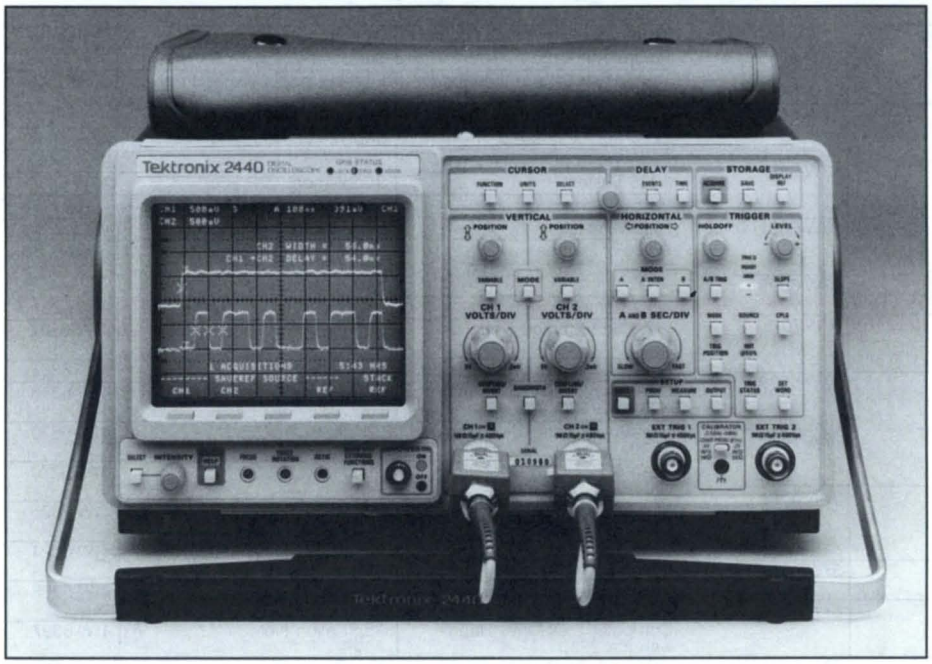
*1 *Mounting adapter comes with camera/option listed, others are optional.*

*2 *Mounting adapter must be ordered in addition to the camera/option listed.*

*3 *2235 Opt 01 Order C-5C Opt 02 or C7 Opt 03.*

*4 *Highlighted probes are preferred for typical general purpose use and/or are shipped as included accessory to the instrument.*

2400 SERIES PORTABLE DIGITAL STORAGE OSCILLOSCOPES



2440

NEW 2440
NEW 2432A
2430A

GPIB IEEE-488

The 2400 Series of digital scopes complies with IEEE Standard 488.1-1987, RS-232C, and Tektronix *Standard Codes and Formats.*

TYPICAL APPLICATIONS

- **Analog and Digital Design**
- **Applied Research**
- **Manufacturing Test**
- **Telecommunications**

BENEFITS

- **Better Repeatability from Built-in Automation**
- **Faster Results from Automated Measurements**
- **Less Drudgery from Push-Button Selections**
- **Better Accuracy from Reduced Operator Error**

FEATURES

- **500 MS/s Digitizing (250 MS/s for the 2432A and 100 MS/s for the 2430A)**
- **300 MHz Bandwidth (150 MHz for the 2430A)**
- **2 ns Glitch Capture**
- **Autoprobe Function with P6137 Probe (2440 and 2432A)**
- **300 MHz X-Y Bandwidth (150 MHz for 2430A) at Probe Tip**
- **Automatic Measurements**
- **Extensive Triggering Capabilities**
- **Printer/Plotter Output**
- **On-Screen HELP Text Describing Every Front-Panel Control**

Versatile Scopes

Tektronix adds timesaving innovations to high standards of technical performance. the results are powerful and versatile scopes that speed measurements, simplify setups and automate test procedures—all from the front panel. Their portable, compact design easily serves benchtop as well as rack needs.

Fully Programmable, Proven Scopes

With the 2440's 500 MS/s digitizing rate—on two channels simultaneously—you can digitize, view and store wide bandwidth, complex signals. You have 8-bit vertical resolution, 1K record length per channel and a 0.0015% crystal-controlled time base for accurate voltage and time measurements.

No other portables let you:

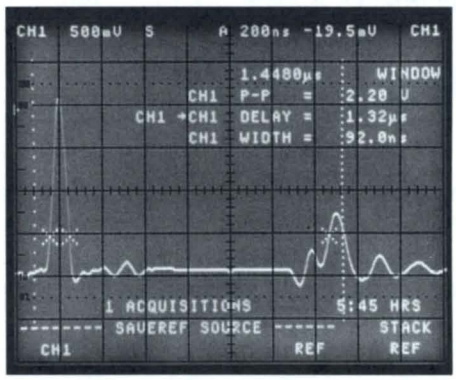
- Capture glitches as narrow as 2 ns.
- Automatically catch intermittent failures in babysitting applications, using the patented auto pass/fail testing feature.
- See waveform changes virtually *as they happen* thanks to Tektronix' fast update rate.

Unmatched Ease of Use

The 2440, 2432A, and 2430A operate like analog scopes and save time with new automated capabilities. You will immediately recognize the familiar grouping of front panel controls. You will appreciate the simple, single-level menus for standard functions.

2400 Series with MATE/CIIL Capabilities

The 2440M, 2432M, and 2430M Digital Oscilloscopes offer Control Intermediate Interface Language (CIIL) capability that is essential for operation in Modular Automatic Test Equipment (MATE) used in testing military avionics and weapons systems.



Tektronix 2400 Series Digital Oscilloscopes easily capture single-event pulses—as in nondestructive, ultrasound testing—and store them in scope memory. Here the scope measures the time from a reflected pulse using the automatic delay measurement feature.

Contact your local Sales representative for more detailed information.

2400 SERIES DIGITAL OSCILLOSCOPES

	Sampling Rate	Bandwidth	Glitch Capture	Automation Time Savers	Auto Probe	Warranty
2440*1	500 MS/s	300 MHz	2 ns	Yes	Yes	3 years*2
2432A*1	250 MS/s	300 MHz	2 ns	Yes	Yes	3 years *2
2430A*1	100 MS/s	150 MHz	2 ns	Yes	No	3 years *2

*1 *2440M, 2432M and 2430M also.*
*2 *Five years optional.*

CHARACTERISTICS

AUTOMATION FEATURES

Auto Sequencing
Saves and recalls typically 50 to 200 front-panel setups, user prompts, test procedures and associated control and I/O actions in up to 40 named test sequences.

Auto Setup
Automatically configures controls to display the selected channel in the selected mode. In View and Measurement mode, auto setup is user-selectable on: Period, Pulse, or Edge.

Pressing the button on the autoprobe selects the auto setup function on the 2440 and 2432A.

In the View mode, the auto setup capability displays one channel with ground at screen center. Displays two channels with ground ±2 divisions. Horizontally scales for three to six cycles.

Auto Pass/Fail Testing
This unique Save on Delta feature compares incoming waveforms to a user-definable waveform envelope and saves the waveforms that are outside reference limits. For easy examination, saved events (events that caused a Save on Delta trigger) are horizontally positioned at center screen.

Auto Measure
Provides two operating modes:

- Simultaneously measures up to four parameters on one or more displayed waveforms. Parameter readouts are updated at 3 Hz intervals.
- Displays a Snapshot of 20 waveform parameters on a single waveform target.

Waveform parameters measured—Frequency, period, width, rise time, fall time, propagation delay, duty cycle overshoot, RMS, area, minimum, maximum, mid, peak-to-peak, mean, base, top, proximal, mesial, and distal.
Thresholds—Settable in percentage or voltage.
Determining 0% and 100% levels—Three methods available.
Threshold crossing locations indication—Visual.
Windowing capability—Measurement windows defined by cursors.
Indications—Extensive warning and error-condition indication capabilities.

VERTICAL SYSTEM

Channels—Two, with simultaneous acquisition.
Bandwidth Limit—20 MHz or 100 MHz (50 MHz for 2432A and 2430A), selectable; reduces −3 dB point between 13-24 and 90-110 MHz.
Vertical Accuracy—±2% +1 digitizing level (25 digitizing levels per CRT division).

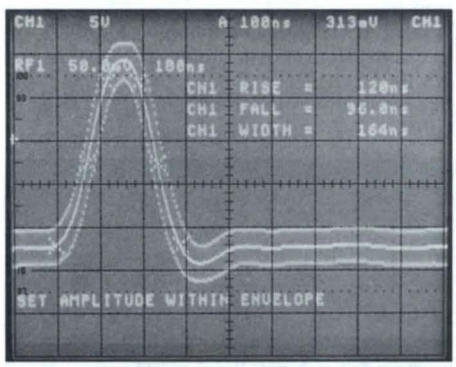
Bandwidth*1 Versus Temperature—

	−15 to +30°C	30 to 55°C
2440	<10 Hz to 300 MHz for ac coupling	Reduce upper BW limit 2.5 MHz for each °C, above 30°C*2
2432A	DC to 300 MHz for dc coupling	
2430A	<10 Hz to 150 MHz for ac; dc to 150 MHz for dc input coupling	

*1 *Measured at −3 dB in Normal, Average, or Envelope with Repet mode on.*
*2 *Measured with standard accessory probe or internal 50 Ω termination.*

Deflection Factor—2 mV/div to 5 v/div in 1-2-5 sequence, continuously variable between ranges.
Vertical Position Range—±10 div (+0.4 div, −0.7 div).
Auto Scale Factor—On-screen readout indicates probe tip deflection factors for 1X, 10X, 100X and 1000X probes.
Delay Matching—CH1 to CH2 ±150 ps for 2440, 2432A; ±250 ps for 2430A. Delay between CH1 to CH2 is nulled in progagation delay measurement readout (for 2432A and 2440).
Maximum Input Voltage—For 1 MΩ input with DC, AC, and GND coupled selections: 400 V (dc +peak ac), 800 V p-p ac at 10 kHz or less.

For 50 Ω input: 5 V RMS; 0.5 W for any 1 s interval for instantaneous voltages from 5 to 50 V.
Input R and C—
For 1 MΩ input, ±0.5% paralleled by 15 pF ±2 pF.
For 50 Ω input, ±1%.



Perform high-speed testing of disk-drive test applications. Using a reference memory template waveform, compare live read pulses for full automatic testing.

HORIZONTAL SYSTEM

Display Modes—A, A Intensified, and B.
A and B Delayed Sweep Range—
For 2440 and 2432A: 2 ns/div to 5 s/div in 1-2-5 sequence.

For 2430A: 5 ns/div to 5 s/div in 1-2-5 sequence.

External Clock Repetition Rate—
1 MHz min, 100 MHz max.
Delay by Events—Delays the A or B sweep by a user-selected number of B trigger events after the normal A trigger occurs. (Maximum events: 65,536.)

ACQUISITION SYSTEM

Maximum Single-Event Useful Storage Bandwidth—200 MHz (2440), 100 MHz (2432A), 40 MHz (2430A) using internal Modified (Sine X)/X Interpolator (Repet mode off).
Maximum Sample Rate—500 MS/s (2440); 250 MS/s (2432A), and 100 MS/s (2430A) on two channels simultaneously.
Vertical Resolution—8 bits (256 levels over 10.24 vertical div).
Record Length—1024 points per channel.
Dynamic Range (2440 and 2432A only)—

Sweep Speed	Digitizing Levels
100 μs or slower	0 to 255 (−128 to +127)
50 μs to 500 ns	4 to 251 (−124 to +123
200 ns	7 to 248 (−121 to +120
100 ns*1	15 to 240 (−113 to +112)
50 ns to 2 ns*2, Repetitive mode off	15 to 240 (−113 to +112)
50 ns to 2 ns*2, Repetitive mode on	7 to 248 (−121 to +120)

*1 *Applies to 2440 only.*
*2 *100 ns 2432A.*

Normal Acquisition Mode Sweep Speeds—

Model	Real Time Sampling	Equivalent Time Sampling	Interpolated Real Time Sampling
2440 **2440M**	5 s/div to 100 ns/div	50 ns/div to 2 ns/div	50 ns/div to 2 ns/div
2432A **2432M**	5 s/div to 200 ns/div	100 ns/div to 2 ns/div	100 ns/div to 2 ns/div
2430A **2430M**	5 s/div to 500 ns/div	200 ns/div to 5 ns/div	200 ns/div to 5 ns/div

Acquisition Modes

Normal Mode—Normal, real-time sampling of input signals.

Envelope Mode—Uses internal analog peak detectors to record and display minimum and maximum waveform values over one or more sweeps. Number of waveforms recorded before reset is user-selectable in binary sequence from 1 to 256 or continuous.

Envelope Mode Pulse Response (Glitch Capture)—The following pulse capture capabilities apply for sweep speeds from 5 s/div to 500 ns/div.

Pulse Duration	% of Amplitude Capture	Confidence Level
2 ns	>50%	>85%
4 ns	>50%	100%
8 ns	>80%	100%

Envelope Mode Software Function—Operates at sweep speeds from 2 to 50 ns/div (2440); 2 to 100 ns/div (2432A); from 5 to 200 ns/div for the 2430A (repetitive mode on).

Average Mode—Averages continuously for a number of acquisitions from 2 to 256 in binary sequence. Averaging of 128 or 256 acquisitions effectively increases vertical resolution to 11 bits and vertical sensitivity to 200 μV/div (for signals containing sufficient noise component).

MEMORY

Nonvolatile Memory—Memory containing calibration data, readout data, an initial front-panel setting, power-down front-panel setup and action storage. Nonvolatile memory retention time: ≥3 years; lithium battery back-up.

DISPLAY

Display Modes—CH1, CH2, Invert, Add, Multiply, X-Y (CH1 vs CH2, Ref1 vs Ref2) reference displays 1 through 4.

Waveform Expansion—10X vertical expansion of SAVEd waveforms, in 1-2-5 sequence. 100X horizontal expansion of SAVEd waveforms, in 1-2-5 sequence. (Expanded waveforms can be positioned vertically and horizontally to examine any area of interest.)

Display Update Rate—With 50 kHz trigger, and one channel selected and 100 μs/div sweep speed, fastest update rate possible: 100 Hz. Average: 60 Hz (typical performance).

ON-SCREEN CURSORS

Functions—Volts, Time, Volts at Time, 1/Time, Slope. Settings selectable for either data or absolute time/volts (referenced to trigger point/ground).

Units	Selectable as
Volts	Volts, %, dB
Volts at Time	Volts, %, dB
Time	Seconds, %, degrees
1/Time	Hz, %, degrees

FUNCTIONS

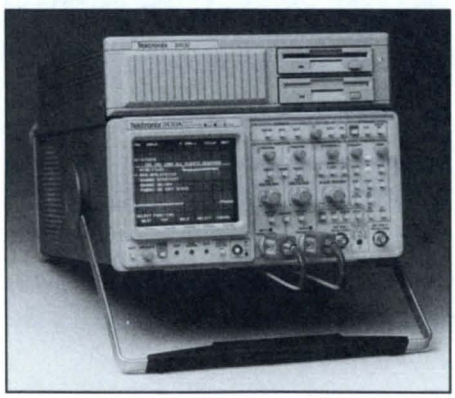
A Mode—Auto Level, Auto/Roll, Normal, and Single Sequence.

B Mode—Triggerable After Delay, Runs After Delay.

A and B Source—Vertical, CH1, CH2, Line (A only), Ext 1, Ext 2, A*B (A sweep only), Word (17-bit Word Recognizer Probe optional accessory).

A and B Coupling—AC, DC, Noise Reject, HF Reject, LF Reject, TV,f A mode only with option 05.

A and B Trigger Position—1/8 to 7/8 of acquisition record, user selectable in 1/8-1/4-1/2-3/4-7/8 sequence. User selectable in 32 sample intervals (from 1/32 to 30/32) using GPIB.



Ext 1 and Ext 2 Inputs—Resistance: 1 MΩ ±1%.
Capacitance: 15 pF ±3 pF.
Maximum Input Voltage: 400 V (dc + peak ac), 800 V p-p ac at 10 kHz or less.
Trigger Level Control Range—CH1 and CH2 Source: ±18 div ×V/div.
Ext 1 and Ext 2 Source Gain ÷1: ±0.9 V.
Ext 1 and Ext 2 Source Gain ÷5: ±4.5 V.

REAR PANEL OUTPUTS AND INPUTS

Channel 2 Output Voltage—
- 20 mV/div ±10% into 1 MΩ
- 10 mV/div ±10% into 50 Ω
- −3 dB bandwidth: dc to >50 MHz.

A Trigger, Record Trigger, Word Recognizer Output—Logic Polarity: negative-true trigger occurence indicated by HI to LO transition.
Output Voltage HI: ≤400 μA load is 2.5 V to 3.5 V 50 Ω load to ground is ≤0.45 V.
Output Voltage LO: ≤4 mA load is ≤0.5 V. 50Ω load to ground is ≥0.15 V.
Direct Hardcopy Output—Sends waveform data and parameters, cursor measurements, and instrument configuration over GPIB to an HP 7400 Series plotter, Tek HC 100 Color Pen Plotter, or HP ThinkJet™.

POWER REQUIREMENTS

Line Voltage Ranges—115 V: 90 to 132 V; 230 V: 80 to 250 V.
Line Frequency—48 to 440 Hz.
Power Consumption—Typical (standard instruments): 160 W (250 VA). Maximum (fully optioned instruments): 200 W (300 VA).

GPIB PROGRAMMABILITY

GPIB compatibility includes: Full talk-listen modes, control of all front-panel settings, transmitting and receiving waveform data.
Data Transfer Rate—36–45 KB/s (depending on sweep speed.)
Debug Mode—Helps streamline GPIB program development; permits user to monitor general bus traffic or traffic to and from scope.

ENVIRONMENTAL AND SAFETY

Environmental Requirements—
- Meets requirements of MIL-T-28800C for Type III, class 3 Style D equipment.
- Meets humidity and temperature requirements defined in paragraphs 3.9.2.2, 2.8.2.3, and 3.8.2.4.

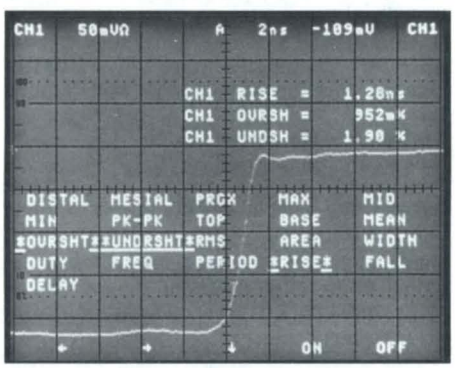
Electromagnetic Interference (EMI)—
- Meets MIL-T-28800C.
- Meets MIL-STD-461B, Part 4 (CE-03 and CS-02), Part 5 (CS-06 and RS-02), and Part 7 (CS-01, RE-02, and RS-03—limited to 1 GHz.
- Meets VDE 0871, Category B, Part 15 of FCC rules and regulations, Subpart J, Class A.
- Meets Tektronix Standard 062-2866-00.

Ambient Temperature—−15 to +55 °C, operating; −62 to +85 °C, nonoperating.
Humidity—Operating and nonoperating: stored at 95% relative humidity for five cycles (120 hours), at +30 to +60 °C, with operational performance checks at +30 °C and +55 °C.

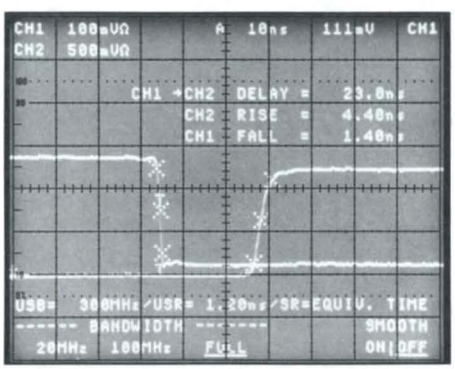
Drip Proof— Front cover meets MIL-T-28800C, paragraph 4.5.5.5.3.
Safety—Certified by CSA, Electronic Bulletin No. 556B, and UL 1244. Complies with IEC 348.

PHYSICAL CHARACTERISTICS

Dimensions	Cabinet mm	Cabinet in.	Rackmount mm	Rackmount in.
Width (with handle)	330	13.0	483	19.0
Height (with feet and pouch)	190	7.5		
Height (without feet and pouch)	160	6.3		
Depth (with front cover)	479	18.9	419	16.5
Depth (with handle extended)	550	21.7		
Weights	**kg**	**lb**	**kg**	**lb**
Net (with accessories and pouch)	12.8	28.1	4.0	8.8
Net (without accessories and pouch)	10.9	23.9		
Shipping	16.4	36.0		



The auto measure feature provides a menu of the 21 measurements that you can select. Here the user selected rise time, undershoot, and overshoot measurements of the waveform on channel 1.



Here, a 2440 user has set markers and selected propagation delay, rise time and fall time measurements—all by simply pressing a few front panel buttons.

ORDERING INFORMATION

When ordering a 2440, 2432A, or 2430A, please use the exact nomenclature given here:

2440 Digital Oscilloscope **$11,500**
Includes: Two 10X, 1.3 m P6137 probes w/accessories; snap accessory pouch (016-0692-00); ziploc accessory pouch (016-0537-00); 5A, 250 V, AGC/3AG fuse (159-0014-00); blue plastic CRT filter (378-0199-03); clear plastic CRT filter (378-0208-00); front cover (200-3199-01); operator's manual (070-6599-00); Programmer's Reference Guide (070-6601-00); GPIB Pocket Guide (070-6602-00); User's Reference Guide (070-6600-00).
2440M Digital Oscilloscope **$21,000**
2432M Digital Oscilloscope **$19,000**
2432A Digital Oscilloscope*[1]
Includes: Same as above except operator's manual (070-7272-00); Programmer's Reference Guide (070-7271-00); GPIB Pocket guide (070-7270-00); User's Reference Guide (070-7269-00).
2430M Digital Oscilloscope **$17,450**
2430A Digital Oscilloscope **$7,950**
Includes: Same as above except operator's manual (070-6286-01); Programmer's Reference Guide (070-6338-00); GPIB Picket Guide (070-6604-00); User's Reference Guide (070-6339-00).

2400 SERIES INSTRUMENT OPTIONS

Option 1R—Configuration for rack mounting. **+$320**
Option 1T—Transit case. **+$185**
Option 2F—(US Power) Quickstart Operator's Training Package. **+$199**
Option 3F—(European Power) Quickstart Operator's Package. **+$199**
Option 2C—Feedthrough Cable Kit. **+$210**
Option 4D—Dutch HELP Text. **NC**
Option 4F—French HELP Text. **NC**
Option 4G—German HELP Text. **NC**
Option 4H—Italian HELP Text. **NC**
Option 4S—Spanish HELP Text. **NC**
Option 03—Word Recognizer Probe Pod (P6407). **+$455**
Option 05—Video Waveform Measurement System. **+$1,150**
Option 10—Power Strip.*[1]
Option 11—Probe power. **+$195**
Option 12—Extra Tray.*[1]
Option 22—Two additional P6133 (2430A), P6137 (2432A), P6137 (2440) probes. **+$320**
Option 25—PEP 301 System Controller (US Power). **+$7,995**
Option 26—EZ Test test program generator software. **+$1,495**
Option 1P—HC100 Four Color Plotter. **+$965**
Option 2P—(European power) HC100 Four color plotter. **+$965**
*[1] *Contact your local sales office.*

RECOMMENDED SOFTWARE

For more information on utility and application software, see the Test and Measurement Software Section or consult your local sales or applications engineer.

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

WARRANTY-PLUS SERVICE PLANS

Warranty-Plus service plans are available at the time of purchase.
Option M1—Calibration in second and third year.
(2440/2440M/2432M/2432A) **+$214**
(2430M/2430A) **+$259**
Option M2—Remedial coverage in fourth and fifth years.
(2440/2440M/2432M/2432A) **+$266**
(2430M/2430A) **+$385**
Option M3—Calibration in second and third years, calibration and remedial coverage in fourth and fifth years.
(2440/2440M/2432M/2432A) **+$695**
(2430M/2430A) **+$904**
Option M4—Calibration with certification in the first three years.
(2440/2440M/2432M/2432A) **+$511**
(2430M/2430A) **+$619**
Option M5—Calibration with certification in the first five years; remedial coverage in the fourth and fifth years.
(2440/2440M/2432M/2432A) **+$1,182**
(2430M/2430A) **+$1,493**

OPTIONAL ACCESSORIES

Service Manual—
(2440) 070-6603-00. **$50**
(2432A) 070-7273-00.*[1]
(2430A) 070-6330-00. **$50**
P6009 Probe—100X (100 MHz bandwidth) 010-0264-01. **$205**
P6230—10X FET Probe. **$420**
Oscilloscope Camera—C-5C Series **$495**
SCOPE-MOBILE® Cart—K212 **$350**
Carrying Strap—346-0199-00 **$17.50**
Carrying Case—016-0792-01 **$225**
Swivel Base—K501 **$75**
Optical Probes—
(P6701) **$1,900**
(P6702) **$2,095**

RACKMOUNTING ACCESSORIES

Rackmounting Conversion Kit—016-0825-01 **$395**
*[1] *Contact your local sales office.*

TECHNICAL ASSISTANCE SERVICES

When you need technical assistance to supplement your own resources, Tektronix can arrange the services of an application engineer skilled in meeting your needs. For more information, see the Tektronix Solutions/New Products Section (page 35) or consult your local sales engineer.

TRAINING

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. See Customer Training Section for information. For further information, or to enroll, call us at 1-800-835-9433 ext. 430.

NEW QUICKSTART

Operator's Training Package

TYPICAL APPLICATIONS

- **Basic Techniques for First-Time Digital Scope User**
- **Advanced Techniques for Experienced Users**
- **Refresher Training for Occasional Users**

BENEFITS

- **Saves Time Through Simplified Learning**
- **Cuts Training Costs Through a Reusable Package**
- **Improves Confidence Through Step-by-Step Practice**

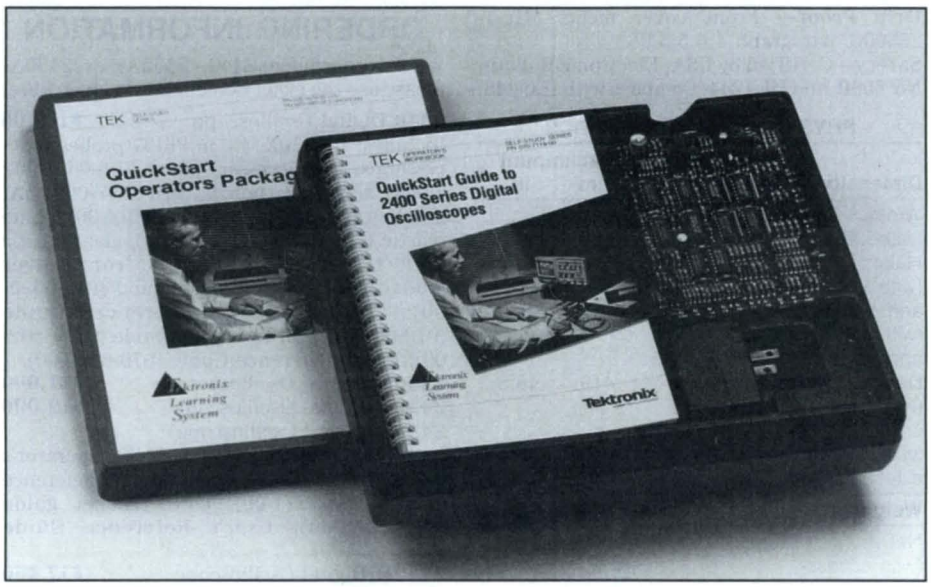
FEATURES

- **Thorough Self-study**
- **Sections for Novice, Intermediate, and Advanced Users**
- **Complete: Videotape, Workbook, and Circuit Board Lab**
- **Easy Reference**

All 2400 Series Digital Oscilloscopes have many features that save you time, eliminate drudgery, and improve measurement results. The QuickStart Operator's Training Package takes you through various scope functions, step by step.

Proceed at your own pace. If you are a novice digital scope user, you can begin at the front by quickly reading the workbook's digital scope concepts introduction and immediately start making the measurements shown in section 1.

Section 2 provides measurement exercises for intermediate digital scope users. Section 3 offers measurement exercises for advanced users. Section 4 describes procedures for running calibration and diagnostics routines.



QuickStart Operator's Training Package

The simple actions you need to take—selecting menu items and pushing front-panel buttons—are presented on one side of each page. On the other side are helpful comments that explain the reasons for each step and the results to expect. Scope photos show the correct displays for each procedure.

The QuickStart videotape previews the exercises and explains key points in the Workbook.

The QuickStart Lab circuit board contains all the signals you need to perform the exercises.

The whole package is complete and portable. One package can serve several users, even at different locations.

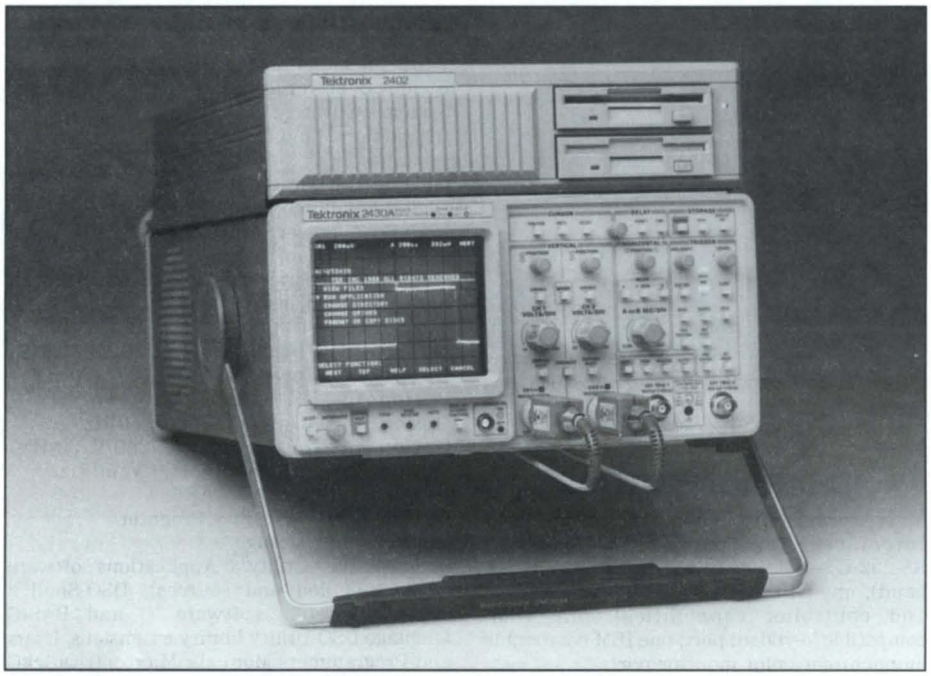
ORDERING INFORMATION

When ordering as an option for a 2400 Series Digital Oscilloscope, use the following nomenclature:

Option 2F—(U.S. Power) QuickStart Operator's Training Package. **+ $199**
Includes: Workbook, Videotape, and Training Lab.

Option 3F—(European Power) QuickStart Operator's Training Package. **+ $199**
Includes: Workbook, Videotape, and Training Lab.

For QuickStart package only (for use with existing 2400 Digital Oscilloscope) order: 020-1679-00 (U.S. Power) 020-1681-00 (European Power).



2402 and 2440 Digital Storage Oscilloscopes

The 2402 will be available in early 1989.

NEW 2402 TekMate

GPIB IEEE-488 The 2402 complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

TYPICAL APPLICATIONS

- **Mass Waveform Storage**
- **Complex Waveform Analysis**
- **Benchtop ATE**
- **Off-Site Servicing**
- **Pass/Fail Waveform Testing**
- **Date/Time Stamping**
- **Data Logging**

BENEFITS

- **Cost Savings from Automating Complex Test Procedures**
- **Time Savings from Easy to Use Menus**
- **Complete 2400 Series DSO Compatibility and Convenience from a Single-Vendor, Integrated Solution**

FEATURES

- **Stores Over 500 Waveforms**
- **Runs Test Procedures Unattended**
- **Data Logging with Date/Time Stamping**
- **Makes Pass/Fail Waveshape Comparisons**
- **Attaches Directly to Tek 2400 Series Digital Scopes**
- **Offers Rugged and Dependable Operation**
- **Provides Two Full or Three Half IBM-Compatible Expansion Slots**

In one compact unit that mounts directly to a Tektronix 2400 Series Digital Oscilloscope (DSO), the 2402 TekMate extends the capability of your digital scope to do more than ever before including:

- Store over 500 test waveforms for later analysis and comparison
- Characterize waveforms with complex waveform analysis capabilities including: Fast Fourier Transform, correlation, integration, division, multiplication, addition, and subtraction.
- Run executable test procedures in automated or semi-automated modes to improve efficiency and reduce test error.
- Monitor signals for failure events, saving failures to disk with time and date identification, all without an operator.
- Logs data and runs test procedures without an external controller.
- Conduct experiments and store waveform to disk automatically at user-specified time and date without the aid of an operator.
- Operates from the scope CRT and front panel. Runs like the 2400 Digital Oscilloscope you already know how to use.

Makes Your Tek 2400 Series DSO A *Smart Scope*

With the DSO Utility software package, the 2402 and your digital scope can:

- Store waveforms
- Perform complete waveform analysis including FFT
- Run tests unattended
- Stamp failures with date and time
- Test at user selected times

The 2402 does it all without time-comsuming programming.

A Truly Portable Test System

With your Tek 2400 Series DSO, the 2402 forms a self-contained test station, giving you all the advantages of computer-driven test systems. The 2402 is versatile. The following are just a few features the 2402 offers:

Benchtop Tester

The 2402 is an easy-to-use, low-cost solution to your test needs.

- Automate step-by-step test procedures
- Reconfigure between tests quickly
- Use many test and analysis programs that run under MS-DOS®
- Run procedures developed on your Tek PEP 301 Systems Controller

Unattended Monitoring Station

Take the 2402 to a remote monitoring site, leave it, and let it do the work.

- Run unattended tests
- Run tests repetitively until failures occur
- Monitor signals constantly and save results
- Date and time stamp failures

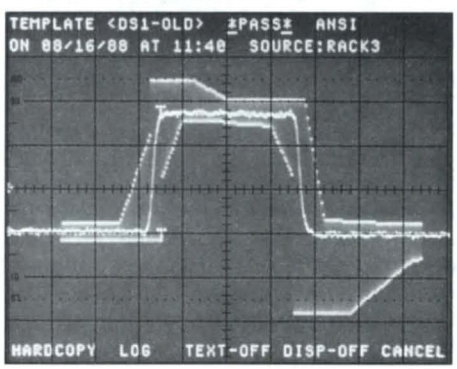
Troubleshooting Tool

Together, the 2402 and 2400 Series DSO are a portable, one-handle servicing tool.

- Run comprehensive test procedures
- Make permanent files of all test results
- Build a library of reference waveforms or failure-mode signatures

More Power for Your Digital Scope

The 2402 includes two 720K floppy disks, allowing you to store over 500 waveforms without changing disks.



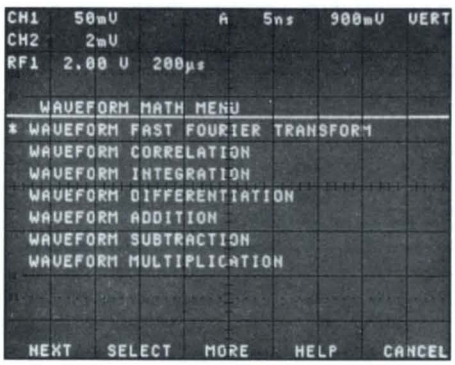
Create reference waveforms for pass/fail comparison testing.

Small and Rugged

Only 3.1 inches high and 12 inches wide, the 2402 attaches securely to all Tek 2400 Series digital scopes. Because it is designed for portable digital scopes, the 2402 is rugged and dependable.

DSO-Utility™ Feature Summary

- Store and retrieve waveforms on disks
- Generate reference waveforms for pass/fail comparison
- Log at selected date and time, end of test, or waveform comparison error
- Perform waveform math: add, subtract, multiply, divide, integrate, differentiate, Fast Fourier Transform, correlate



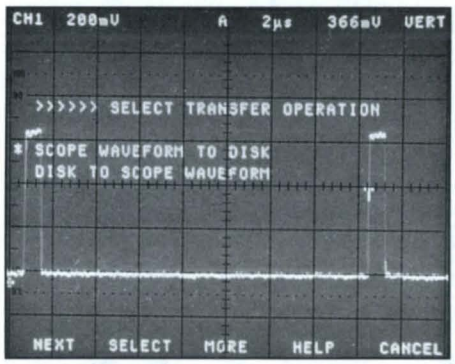
Perform complete waveform analysis with DSO-Utility software.

DSO-Shell™ Feature Summary

- List disk directories
- List files
- Print files
- Copy files
- Delete files
- Format floppy disks
- Change default drive
- Change default directory
- Set and display date and time
- Execute application programs

Reduce Custom Program Development Time and Cost

Use our library of subroutines to develop your custom programs in less time. The Program Development Package includes DSO, menu, waveform math, and GPIB library extensions to reduce program development time and make your task easier. The Development Package also includes MicroSoft Quick C and Quick Basic Programming languages.



Save over 500 waveforms on a single 3-½ inch floppy disk.

CHARACTERISTICS

Mass storage—Two 3.5 in., 720K floppy disks
Interfaces—One parallel printer port; RS-232-C serial port (programmable to 19.2K baud); one GPIB port (talker, listener, DMA, and controller capabilities); one IBM-compatible keyboard port; one IBM-compatible monochrome/color monitor port.
Display—Uses oscilloscope CRT: includes multi-function color/monochrome graphics display driver for IBM-compatible display.
Clock-Calendar—Built-in, with battery backup.
IBM Compatible Card Slots—Three expansion slots; (two full-size or three half-size, two with back-panel access).
Operating System Software—MS-DOS 3.3.
Applications Software—DSO-Utility Applications software.
Optional Program Development Software—DSO-Utility Program Development package, includes: DSO-Utility applications software, Microsoft® QuickC® and QuickBASIC® languages, C and BASIC DSO-Utility and GPIB Library Extensions, all manuals
Power Requirements—90 to 250 VAC, 48 to 440 Hz, 70 Watts.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	305	12.0
Height	79	3.1
Depth	381	15.0
Weight ≈	**kg**	**lb**
Net	4.6	10.0
Shipping	14.6	32.1

Environmental—5 to 50 °C, 8 to 80% relative humidity noncondensing, 29 °C max. wet bulb, 0 to 15,000 feet.

ORDERING INFORMATION

2402 TekMate*1
Includes: Power cord, MS-DOS® Operating System software; MS-DOS Users Manual; 2402 Instruction Manual; and diagnostic software.

OPTIONS

Option 01—(For 2400 Series Digital Oscilloscope compatibility).*1
Includes: Power cord; DSO Utility and DSO-Shell™ software; DSO-Utiity Users Manual, 2400 Series digital scope mounting kit with tools and instructions; 0.5 meter GPIB cable.

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland, 220 V, 50 Hz.

SOFTWARE

Option 41—DSO-Utility Program Development Package.*1
Includes: DSO-Utility™ Applications software (both compiled and sources), DSO-Shell™ Operating-System software, C and BASIC language DSO-Utility library extensions, Users and Programmers Manuals, Microsoft QuickC and QuickBASIC programming languages.

OPTIONAL ACCESSORIES

IBM-Compatible Keyboard.*1
118-7073-00—U.S. **$150**
118-7609-00—U.K.*1
118-7602-00—French **$150**
118-7607-00—Swedish*1
118-7603-00—German*1
118-7604-00—Italian*1
118-7606-00—Spanish*1
IBM-Compatible Color Monitor—Order 118-7444-03. **$1,195**
Mounting Kit—For 2400 Series Digital Oscilloscopes, provides mechanical compatibility only. Order 016-0978-00.*1
Mounting Kit—For 2400 Series Analog Oscilloscopes (except 2467), provides mechanical compatibility only.*1
Mounting Kit—For 2467 Analog Oscilloscope, provides mechanical compatibility only.*1
2402 Field Installation Guide.*1
2402 TekMate Instruction Manual.*1
1 Meter GPIB Cable.*1
Rain Jacket—Order 200-3685-00.*1
Carrying Case—Order 202-0302-00.*1

*1 *Contact your local sales representative for information.*

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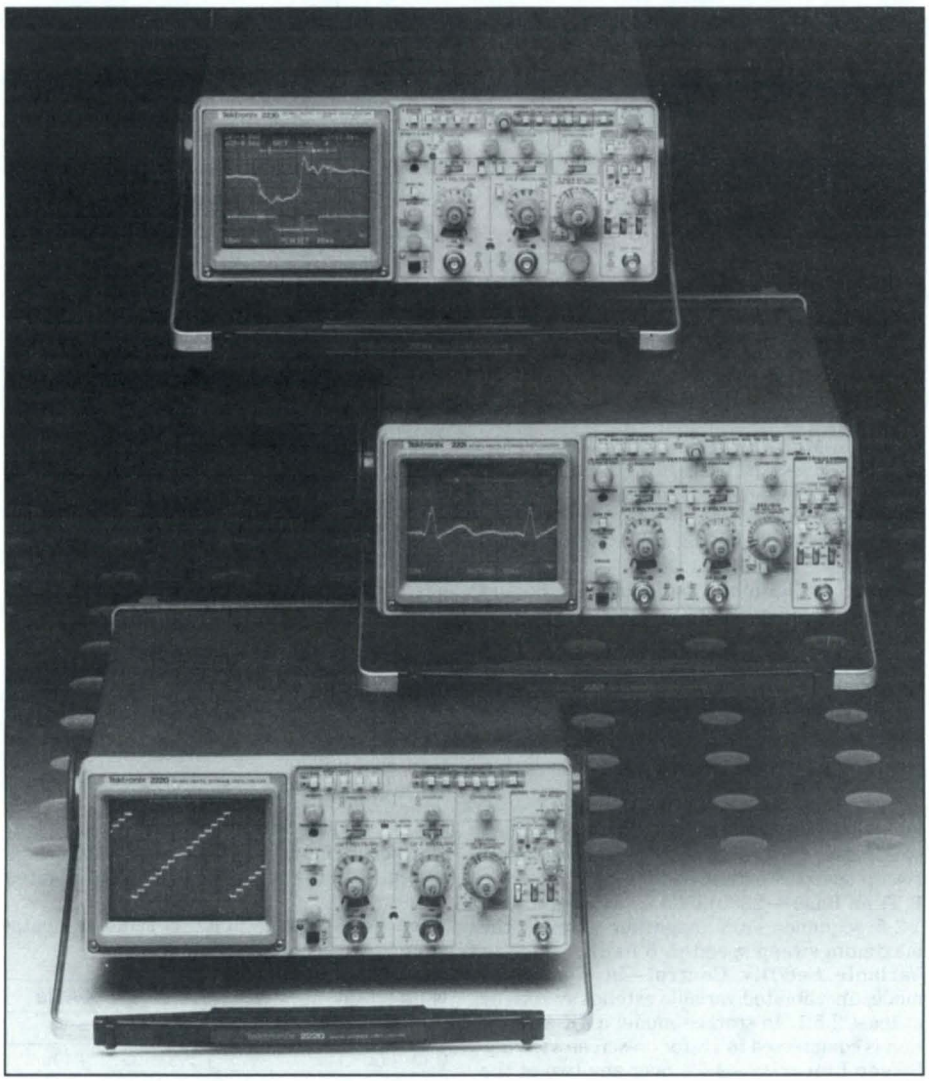
TRAINING

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. See Customer Training Section for information. For further information, or to enroll, call us at 1-800-835-9433 ext. 430.



2230/2221/2220

TYPICAL APPLICATIONS (2230/2221/2220)

- Teleservicing
- Medical Equipment Servicing
- Digital Design and Troubleshooting
- Power Supply Design and Troubleshooting

BENEFITS

- UL Listed, CSA and VDE Certified
- 3-Year Warranty, 5-Year Optional

FEATURES

- 100-MHz Analog/Digital Bandwidth (2230); 60 MHz (2221, 2220)
- 100 ns Glitch Capture at Any Speed
- 4K Record Length (1K/4K Selectable 2230)
- Pre/post Triggering (Point Selectable 2230)
- Cursors and Readout (2230, 2221)
- Signal Averaging (2230, 2221)
- Three Save Reference Memory Locations (2230), One location (2220, 2221)
- Expand, Compress, Reposition Stored Waveforms (2230)
- Dual Time Base (2230)
- GPIB or RS-232 Comm Options
- 26K Extended Waveform Storage (with 2230 Comm Options)

Analog and Digital Versatility

Now get the best of both worlds—analog and digital—with the 2200 series of digital storage oscilloscopes. In analog mode, the 2230, 2221, and 2220 operate as conventional oscilloscopes, with the ability to capture complex waveforms with the ease of use and familiarity you expect from Tektronix. Switch to digital operation, and powerful new capabilities are at your command.

Discover Digital Capabilities

With the push of a button, the 2200 series of digital storage oscilloscopes bring the power of digital to your measurement needs. Now you can capture and view events that are difficult or impossible to see on an analog oscilloscope, such as fast transients, single-shot events, elusive glitches, and low-speed phenomena. With pre-trigger capability, you can see what is occurring before a trigger event. And since waveforms can be stored, you can recall them later for analysis or comparison to newly acquired data. For easy documentation, waveforms can be sent to a printer or plotter, or transferred to a PC for subsequent analysis and data storage.

Capture and Display Narrow Glitches

The 2230/2221/2220 DSO's feature 20 MS/s sampling rates, with repetitive sampling to the full analog bandwidth of the oscilloscope. In addition, each offers Tek's proprietary peak-detect mode, for catching signal extremes or glitches that would otherwise be missed between sample points. Elusive glitches as narrow as 100 ns are always captured, even at the slowest sweep speeds.

Time-Saving Features

The 2230 and 2221 both offer additional features that save you time and ensure accuracy. Cursors and CRT readout provide for simultaneous voltage and timing measurements for fast, accurate waveform analysis. Weighted signal averaging can be used to remove unwanted noise from a signal. Accumulate Peak Detect mode allows you to capture extremes in signal variations or drift over time.

Flexibility and High Performance

The 2230 adds benefits that are normally found only on much more expensive products. Features like dual time-base operation, point-selectable trigger positioning, a choice of 1K and 4K record length, and adjustable sweep limits and average weighting. Waveforms can be saved in one of three reference-memory locations, then subsequently repositioned, expanded vertically, and horizontally magnified by a factor of ten. With either the GPIB or RS-232 option, you get an additional 26K of battery-backed memory for storing and retaining up to 26 additional waveform sets for up to three years.

These capabilities, and more, coupled with Tek's proven reliability and support, mean you are assured of outstanding value and long life from your oscilloscope investment.

CHARACTERISTICS

The following characteristics are common to the 2230, 2221, and 2220 except where indicated.

DIGITIZER AND MEMORY

Speed—Digitizing rates from 20 MS/s at 5 μs/div and faster to 20 samples/s at 5 s/div. CHOP/ALT modes effectively halve the digitizing rate/waveform. The effective sampling rate in Repetitive Storage mode is 2 GS/s.

Useful Storage Bandwidth—Single Shot: Useful storage bandwidth is the maximum sampling rate (20 MS/s) divided by the desired points/signal period. Repetitive Storage Mode: DC to 100 MHz (2230); DC to 60 MHz (2220, 2221).

Resolution—Vertical: 8 bits, 25 levels/div. Horizontal: 10 bits, 100 points/div.

Acquisition/Process Modes—Sample, Peak Detect, Average (2230, 2221) Accumulated Peak Detect.

Peak Detect (Enhanced Envelope) Mode—100-ns minimum pulse width for 100% probability of 50% signal amplitude capture. 10 MS/s sampling rate.

Average Mode—(2230) Normalized Average weight is selectable from $^1/_1$, $^1/_2$, $^1/_4$, $^1/_8$, $^1/_{16}$, $^1/_{32}$, $^1/_{64}$, $^1/_{128}$, $^1/_{256}$. Number of sweeps averaged adjustable from 1 to 998,000 or to an unlimited number. (2220, 2221). Normalized weight of average is $^1/_4$ for 2220, $^1/_{16}$ for 2221. (2220 Average mode used for 2 μs/div and faster sweep settings.)

Pre/Posttrigger—(2230) $^7/_8$ (Pretrig) or $^1/_8$ (Posttrig) of waveform acquisition is prior to the trigger event. Trigger position menu selectable over the entire record. (2220, 2221) $^7/_8$ (pretrig), $^1/_2$ (midtrig) or $^1/_8$ (posttrig) of waveform acquistion window prior to trigger event.

Record Length—(2230) 4K or 1K record length, selectable. (2220, 2221) 4K record length. Dual Channel: 2K per channel.

Save-Reference Memory—(2230) One 4K or three 1K acquisitions may be saved in reference memory. Options 10 and 12 offer 26K of battery backed reference memory, allowing 26 waveform sets to be saved. (2220, 2221) One 4K acquisition may be saved in reference memory.

Total Cursor Accuracy—Voltage: ±3% of delta voltage reading. Time difference: 5s to 5 μs/div. ±1 sample display interval (+1 if in Peak or ACC Peak); 2 μs to 0.05 μs/div ±2 sample display intervals (+2 if in ACC Peak).

X-Y Plotter Output—Standard on 2230, 2221, and 2220. The oscilloscopes plot all displayed waveform(s) and readout information in either Auto or Manual Plot mode. The plotting of the graticule is selectable on the 2230. Plotter pen lift is adjustable with a relative speed range of 1 to 10 div/s.

External Clock—Provides an input for Ext Clock signals, dc to 1 kHz, to the storage acquisition system.

VERTICAL SYSTEM (2 Identical Channels)

Bandwidth (−3 dB) and Rise Time (Nonstore)—(2230) 100 MHz and 3.5 ns, derated to 80 MHz and 4.4 ns at 2 mV/div and outside 0 to +35°C. (2220, 2221) 60 MHz and 5.8 ns, derated to 50 MHz and 7.0 ns at 2 mV/div and outside 0 to +35°C.

Bandwidth Limit—(2230) 20 MHz ±10%. (2220, 2221) 10 MHz ±15%.

Deflection Factor and Accuracy (Store/Nonstore)—2 mV to 5 V/div in 1-2-5 sequence. Accuracy: 15-35°C: 2%; 0-50°C: 3% Uncalibrated: Continuously variable between steps by at least 2.5:1.

Vertical System Operating Modes—CH 1, CH 2, CH 2 Invert, ADD, ALT, CHOP (500 kHz nonstore).

Common-Mode Rejection Ratio—For signals of 6 div or less, at least 10:1 (at 50 MHz).

Input R and C—1 MΩ, 20 pF.

Maximum Input Voltage (AC and DC Coupled)—400 V (dc + peak ac) or 800 V (p-p to 10 kHz).

Channel 1/Channel 2 Isolation—≥100:1 at 50 MHz.

AC-Coupled Lower Cutoff Frequency—10 Hz or less at −3 dB.

Automatic Scale Factor—(2230, 2221) Probe tip deflection factors for coded probes are automatically indicated in the CRT readout.

HORIZONTAL SYSTEM

A Time Base—0.05 μs to 0.5 s/div in 1-2-5 sequence. 10X magnifier extends the maximum sweep speed to 5 ns/div. In Store mode, lower sweep speed is extended to 5 s/div.

B Time Base—(2230) 0.05 μs to 50 ms/div in 1-2-5 sequence. 10X magnifier extends the maximum sweep speed to 5 ns/div.

Variable Sec/Div Control—In Nonstorage mode, uncalibrated variable extends sweeps by at least 2.5:1. In storage mode, a 4K acquisition is compressed to 1K for on-screen viewing.

Sweep Linearity—±5% over any two of the center eight divisions.

Time-Base Accuracy—Storage mode: 0.1% over full 10 cm (or div).

Nonstorage Mode	15 to 35°C	0 to +50°C
Unmagnified	±2%	±3%
Magnified	±3%*1	±4%*2

*1 *4% at 0.05 μs/div.*
*2 *6% at 0.05 μs/div.*

Horizontal Operating Modes—(2230) Nonstorage: A, Alternate with A intensified by B, and B; Storage: A, A intensified by B, and B.

DELAYED SWEEP (2230)

Delayed Sweep Delay Times—Continuously variable with 10-turn control from less than 0.5 div plus 300 ns to greater than 10 div.

Differential Delay Time Accuracy—±1% (+15 to +35°C); ±2% (0 to +50°C).

Delay Jitter—5,000:1 (0.02%), nonstore mode only.

TRIGGERING

'A' Trigger Sensitivity

2230	Internal	External
10 MHz	0.35 div	40 mV
100 MHz	1.5 div	200 mV
2220/2221	**Internal**	**External**
10 MHz	0.35 div	40 mV
60 MHz	1.0 div	120 mV

B Trigger (2230 Internal Only)—Sensitivity: 0.35 div at 10 MHz; 1.5 div at 100 MHz.

Trigger System Operating Modes—Normal, P-P Automatic, TV Line, TV Field, and Single Sweep. HF Rej triggering attenuates signals above 40 kHz. Lowest usable frequency for P-P Automatic is 20 Hz.

Trigger Coupling—Automatic coupling with internal signal sources: AC with P-P Automatic and TV Field; DC with Normal and Single Sweep.

Trigger Sources—A trigger: Internal, external, and line. B trigger (2230): Internal only.

External Trigger Input—Input Coupling: AC, dc, or dc divide by 10. Bandwidth: 100 MHz (2230), 60 MHz (2220, 2221); ac-coupled lower cutoff frequency is 10 Hz or less at −3 dB. Maximum safe input voltage same as scope's vertical channels.

Variable Hold-Off—(Non-Store) ≤1:10.

X-Y MEASUREMENTS

Deflection Factors—Same as scope's vertical system with the Volts/Div switch in calibrated detent.

Accuracy—Storage Mode is same as digital storage vertical-deflection system.

Nonstorage	Y-Axis	X-Axis
+15 to +35°C	±2%	±3%
0 to +50°C	±3%	±4%

Storage-Mode Bandwidth—(2230) dc to 100 MHz. (2220, 2221) dc to 60 MHz. Bandwidth changes proportionate to sweep speed.

Nonstorage Bandwidth—Y-axis same as scope's vertical system, X-axis: 2.5 MHz.

Nonstorage Phase Difference—Between X and Y amplifiers: ±3° from dc to 150 kHz.

Storage-Mode Phase Difference—Time difference between Y-axis and X axis is no more than 100 ns. The X-axis is sampled before the Y-axis. Between X and Y amplifiers: Less than ±2° referenced to a 10-division signal period.

Nonstorage Bandwidth—Y-axis same as scope's vertical system, X-axis: 2.5 MHz.

Nonstorage Phase Difference—Between X and Y amplifiers: ±3° from dc to 150 kHz.

Storage-Mode Phase Difference—Time difference between Y-axis and X-axis is no more than 100 ms. The X-axis is sampled before the Y-axis. Between X and Y amplifiers: Less than ±2° referenced to a 10-division signal period.

CRT AND DISPLAY FEATURES

CRT—8×10 cm display; internal graticule, nonilluminated, accelerating potential is 14 kV, GH (P31) phosphor standard.
Controls—Beam finder, focus, trace rotation. (2230). Storage/Readout intensity (2221). Separate A and B sweep intensity (2230).
Z-Axis—Sensitivity: 5 V causes noticeable modulation, positive voltage decreases intensity. Usable frequency range is dc to 20 MHz. Maximum safe input voltage is 30 V (dc + peak ac) or 10 V ac p-p at 1 kHz or less. Input resistance is approximately 10 kΩ.

OTHER CHARACTERISTICS

Probe Adjustment Signal—0.5 V ±5% square wave at 1 kHz ±20%.

POWER REQUIREMENTS

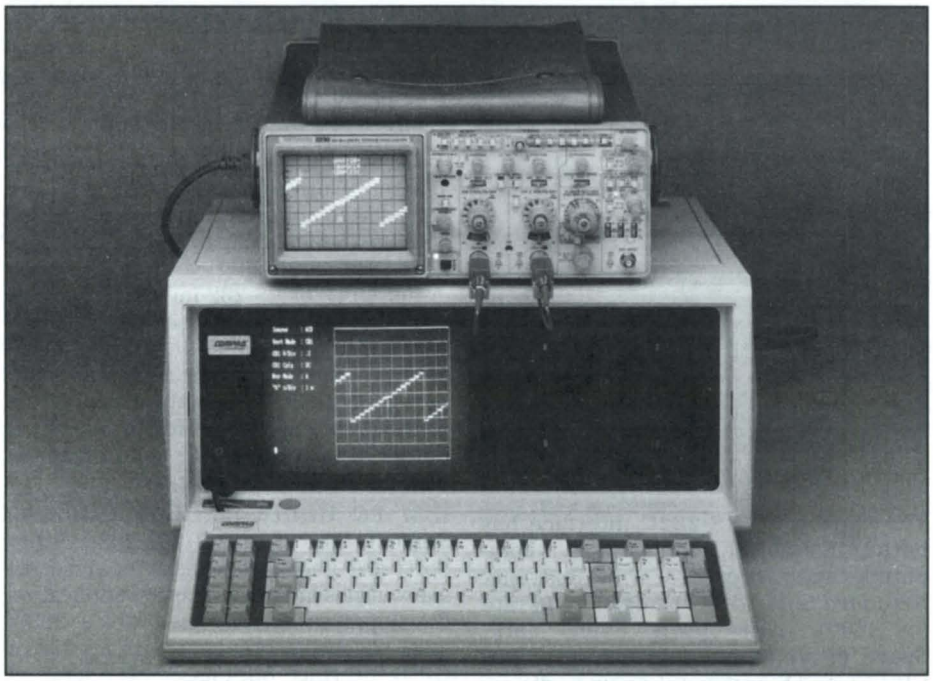
Line-Voltage Range—90 to 250 V ac.
Line Frequency—48 to 440 Hz.
Maximum Power Consumption—85 W, 2.0 A, at 250 V (slow blow line fuse).

ENVIRONMENTAL

Temperature—Operating: 0 to +50°C; Nonoperating: −55 to +75°C.
Altitude—Operating: to 4,500 meters (15,000 ft), maximum operating temperature decreased 1°C per 1,000 ft above 5,000 ft. Nonoperating: to 15 000 m (50,000 ft).
Humidity—Operating and Nonoperating: 5 cycles (120 hours) referenced to MIL-T-28800C, for Type III, Class 5 instruments.
Radiated and Conducted Emissions—Requirements per VDE-0871. Meets Class B.
Vibration—Operating: 15 minutes along each of three axes at a total displacement of 0.015-inch p-p (2.4 g's at 55 Hz) with frequency varied from 10 to 55 to 10 Hz in one-minute sweeps; hold for 10 minutes at 55 Hz in each axis; all major resonances must be above 55 Hz.
Shock—Operating and Nonoperating: 30 g's, half-sine, 11-ms duration, 3 shocks per axis for a total of 18 shocks.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width		
w/handle	360	14.2
w/o handle	328	12.9
Height, w/feet & handle	137	5.4
Depth		
w/front cover	445	17.5
w/o front cover	440	17.3
w/handle extended	511	20.1
Weight ≈	**kg**	**lb**
Net, w/cover access	9.4	20.7
Net, w/o cover, access/pouch	8.2	18.0



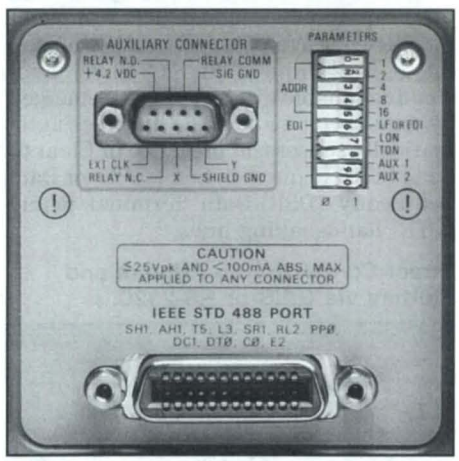
Option 10 GPIB Interface
Option 12 RS-232C Interface

GPIB IEEE-488

With Option 10, the 2230/2221/2220 comply with IEEE Standard 488.1-1987 and use Tektronix *Standard Codes and Formats*. With Option 12, the 2230/2221/2220 feature Standard RS-232C and use an extension of Tektronix *Standard Codes and Formats*.

GPIB (Option 10) and RS-232C (Option 12) interfaces are available for the 2230, 2221, and 2220. Either interface can transmit and receive waveform data. Most front-panel settings can be queried and many functions can be controlled via the interface; e.g., single-sweep reset.

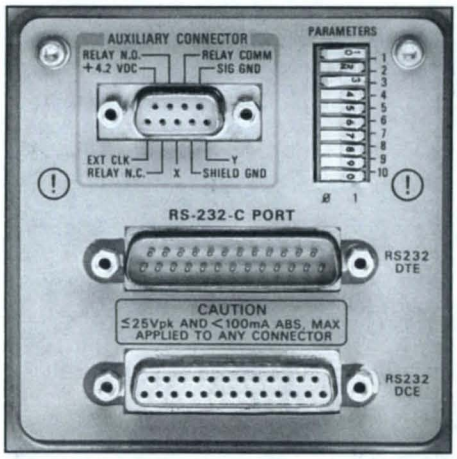
2230 and 2221 Option 10 or 12 interfaces also allow messages or computed results to be displayed on screen. Both options for the 2230 include a battery-backed reference memory (minimum lifetime 3 years) for storage of up to 26 additional waveform sets.



Option 10 GPIB Interface

The **Option 10 GPIB** interface conforms to IEEE Standard 488.1-1987. It is fully compatible with Tektronix *Standard Codes and Formats*. Primary address (0-30), message terminator (EOI or LF/EOI), and talk/listen mode are selected by a switch on the oscilloscope side panel. Maskable interrupts for RQS and OPC can be programmed.

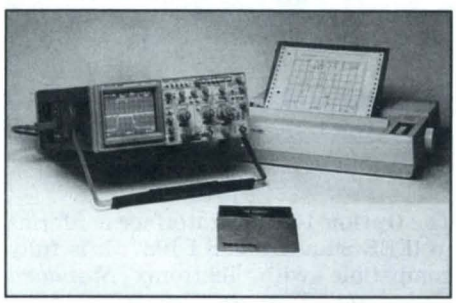
IEEE Standard 488.1-1987 Interface Function Subsets Implemented—SHI, AHI, T6, L3, SRI, RL2, PP0, DCI, DT0, C0.



Option 12 RS-232C Interface

The **Option 12 RS-232C** interface has both DCE and DTE connectors. It is compatible with an extension of Tektronix *Standard Codes and Formats*. Baud rate (50–4800), parity (Odd, Even, Mark, Space, or none), line termination (CR or CR-LF), and SRQ generation on parity error (ON or OFF) are selected by a switch on the oscilloscope side panel. Number of bits per character (7 or 8), number of stop bits (1 or 2), and CTRL-S/CTRL-Q handshaking (enable/disable) may be changed by remote commands. The interface automatically senses the presence of Clear to Send (CTS)/Request to Send (RTS) or Data Set Ready (DSR)/Data Terminal Ready (DTR) handshaking lines.

Direct Connection to Printers and Plotters via GPIB or RS-232C.



A 2230, 2221, or 2220 equipped with either Option 10 or Option 12 interface is fully compatible with any Digital X-Y plotter that uses Hewlett-Packard Graphics Language (HPGL), any Epson FX-Series format printer, or the HP Thinkjet 2225D printer. The GPIB interface is also compatible with the Tektronix HC100 Plotter. Plotter output is directed to the interface if its control switches are set for the appropriate plotter or printer. Otherwise, plotting is directed to the X-Y outputs. Plotting is in single color only.

SOFTWARE

- **RS-232-C Software Utilities**
- **GPIB Software Utilities**
- **Advanced Data Analysis and Controller**

Tektronix offers a variety of software packages to help you transform your 2200 DSO into a highly capable system component. By equipping your scope with either GPIB or RS-232 interface options, you can send and receive digitized waveform data to and from external devices such as controllers and computers. With RS-232, data can even be sent over phone lines, offerfing excellent potential for remote-site monitoring via modem and phone linkages.

IBM PC Utility Software (S49Z200 Series)—The S49Z201/202/203 Utility Software packages consist of a set of subroutines intended to speed application development for users of Tek's 2230, 2221, 2220 digital scopes with RS-232 or GPIB interface options.

This software is capable of being used directly for essential data handling functions, including transmitting and receiving waveforms, displaying waveforms using PC graphics, and storing and retrieving waveforms from disk storage. With these capabilities, you can create a library of reference waveforms, or maintain a record of previous acquisitions for later review or analysis.

The 2200 DSO's also support limited command sets for changing select front panel and menu settings, such as acquisition mode and single sweep trigger reset, thereby enabling remote *babysitting* applications.

In addition, you can utilize the subroutines for integrating essential data handling and instrument communication protocols into your own developed application programs. Applications such as automated data analysis, waveform comparison, or data logging can be created more easily with less development time.

S49Z121/122 Tek 4041 Software—These programs include subroutines written in 4041 BASIC to perform many necessary instrument control functions and data handling procedures with the Tek 4041 controller. S49Z122 further enables you to perform complex mathematical and statistical analysis on retrieved waveforms.

GURU II, SPD, and ASYST—There are several other advanced software packages offered by Tektronix that are easily integrated with the 2230. They include: GURU II (GPIB User's Resource Utility) Software, which provides subroutines written in BASIC to support application environment work; SPD (Signal Processing and Display) Software for performing complex waveform analysis on acquired waveforms; and ASYST Drivers, consisting of instrument control subroutines.

For more information on utility and application software, see the Test and Measurement Software Section or consult your local sales or applications engineer.

TECHNICAL ASSISTANCE SERVICES

When you need technical assistance to supplement your own resources, Tektronix can arrange the services of an application engineer skilled in meeting your needs. For more information, see Total Solution/New Product section, page 35 or consult your local sales engineer.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

ORDERING INFORMATION

2220—60 MHz Single Time-Base Digital Storage Oscilloscope. **$2,995**
Includes: Two P6109 10X Voltage Probes, front-panel cover (200-2520-00), Accessory Pouch (016-0677-02), Operator Manual (070-5301-01), Users Reference Card (070-5681-00).

2221—60 MHz Single Time-Base Digital Storage Oscilloscope **$3,995**
Includes: Two P6109 10X Voltage Probes, front-panel cover (200-2520-00), Accessory Pouch (016-0677-02), Operators Manual (070-6530-00), Users Reference Card (070-6532-00).

2230—100 MHz Dual Time-Base Digital Storage Oscilloscope **$4,995**
Includes: Two P6109 10X Voltage Probes, front-panel cover (200-2520-00), Accessory Pouch (016-0677-02), Operators Manual (070-4998-02), Users Reference Card (070-5370-00).

OPTIONS

Option 10—(2230) GPIB IEEE-488 Interface includes 26K battery backed memory **+$750**

Option 10—(2220/2221) GPIB IEEE-488 Interface **+$500**

Option 12—(2230) RS232C Interface includes 26K battery-backed memory **+$750**

Option 12—(2220/2221) RS232C Interface **+$500**

Option 1C—C-5C Option 04 Camera **+$495**

Option 1K—K212 Portable Instrument Cart **+$350**

Option 1T—Transit Case **+$215**

Option 1R—Rackmount*1

FIELD RETROFIT KITS

2230F10—Field Retrofit kit for Option 10 **$750**

2230F12—Field Retrofit kit for Option 12 **$750**

2221F10—Field Retrofit kit for Option 10 **$500**

2221F12—Field Retrofit Kit for Option 12 **$500**

2220F10—Field Retrofit Kit for Option 10 **$500**

2220F12—Field Retrofit Kit for Option 12 **$500**

*1 *Contact your local sales office.*

SOFTWARE

S49Z201—RS-232 Utility Software. **$50**
Includes: Software diskettes (5.25 inch); User's Manual. Required equipment and software: 2230, 2221, or 2220 Digital Oscilloscope with Option 12 (RS-232 Interface); IBM PC or fully compatible (384K bytes of RAM, 2 diskette drives, color monitor, color graphics card, DOS V2.1 or later); BASICA Interpreter (V3.0 or later) or Microsoft QuickBASIC Compiler (V2.0 or V3.0); and RS-232 Cable (straight-through).

S49Z202—GPIB/Turbo Pascal Utility Software. **$50**
Includes: Software diskettes (5.25 inch); User's Manual. Required equipment and software: 2230, 2221, or 2220 Digital Oscilloscope with Option 10 (GPIB Interface); IBM PC or fully compatible (512K bytes of RAM, 2 diskette drives, color monitor, color graphics card, DOS V2.1 or later); Borland's Turbo Pascal (V3.0 or above); National Instruments PC2/PC2A GPIB Card, or Tektronix GURU card (or equivalent); GPIB Cable.

S49Z203—GPIB/BASICA Utility Software. **$50**
Includes: Software diskettes (5.25 inch); User's Manual. Required equipment and software: 2230, 2221, or 2220 Digital Oscilloscope with Option 10 (GPIB Interface); IBM PC or fully compatible (256K bytes of RAM, 2 diskette drives, color monitor, color graphics card, DOS V2.1 or later); BASICA Interpreter or QuickBASIC Compiler; National Instruments PC2/PC2A GPIB Card, or Tektronix GURU card (or equivalent); GPIB Cable.

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz

Option A2—UK 240 V, 50 Hz

Option A3—Australian 240 V, 50 Hz

Option A4—North American 240 V, 60 Hz

Option A5—Switzerland 220 V, 50 Hz

WARRANTY-PLUS SERVICE PLANS

M1—(2230) 2 Calibrations **+$229**

M1—(2221) 2 Calibrations **+$229**

M1—(2220) 2 Calibrations **+$229**

M2—(2230) +2 Years Service **+$338**

M2—(2221) +2 Years Service **+$328**

M2—(2220) +2 Years Service **+$319**

M3—(2230) 4 Calibrations & 2 Years Service **+$796**

M3—(2221) 4 Calibrations & 2 Years Service **+$785**

M3—(2220) 4 Calibrations & 2 Years Service **+$776**

M4—(2230) 5 Calibrations **+$547**

M4—(2221) 5 Calibrations **+$547**

M4—(2220) 5 Calibrations **+$547**

M5—(2230) 9 Calibrations & 2 Years Service **+$1,318**

M5—(2221) 9 Calibrations & 2 Years Service **+$1,307**

M5—(2220) 9 Calibrations & 2 Years Service **+$1,298**

OPTIONAL ACCESSORIES 2200 SERIES DSOs

HC100—Color Pen Plotter. **$825**

Option 01—GPIB Cable **+$140**

Service Manuals—
(2230) Order 070-4999-00 **$25**
(2221) Order 070-6531-00 **$30**
(2220) Order 070-4999-00 **$25**
(2210) Order 070-7648-00*1
(2201) Order 070-7819-00*1

Rackmount Conversion Kit—
(2220/21/30) Order 016-1003-00 **$140**
(2210/2201) Order 016-0819-00 **$190**

Padded Suitcase—Order 016-0792-01 **$225**

Carrying Strap—Order 346-0199-00 **$17.50**

Rain Cover—Order 016-0848-00 **$16.25**

Viewing Hoods—
(Collapsible) 016-0592-00 **$15**
(Polarized) 016-0180-00 **$60**
(Binocular) 016-0566-00 **$21**

CRT Light Filter, Clear—Order 337-2775-01 **$1.95**

Portable Power Supply—1105. See page 315. **$2,090**

Battery Pack—1106. See page 315. **$1,580**

DC Inverter—1107. See page 316. **$1,175**

DC Inverter Mounting Kit—Order 016-0785-00. **$60**

Isolators—
(Ground Isolation Monitor) A6901. **$760**
(Isolation Amplifier) A6902B. **$1,980**

RECOMMENDED PROBES

Passive Voltage Probes

P6008—10X Probe **$260**

P6062B—Switchable 1X/10X **$175**

P6101A—Non Attenuating 1X **$53**

P6121—Modular 10X **$100**

P6122—Modular 10X **$58**

High Voltage Probes

P6009—1.5 kV 100X Probe **$205**

P6015—20 kV 1000X Probe **$725**

Active Voltage Probes

P6201—1X FET Probe **$1,280**

P6202A—10X FET Probe **$735**

P6230—10X Bias/Offset Probe **$420**

P6046—Differential Probe **$1,895**

Current Probes

P6021—AC Current Probe **$450**

P6022—AC Current Probe **$495**

A6302—DC/AC 20 A Current Probe (Requires TM500 Mainframe and AM503 Current Amplifier **$625**

A6303—DC/AC 100 A Current Probe (Requires TM500 Mainframe and AM503 Current Amplifier **$1,180**

CT-4—AC 1000 A Current Transformer **$1,320**

RECOMMENDED CARTS

K212—Portable Instrument Cart **$350**

RECOMMENDED CAMERAS

See Instrumentation Documentation Devices section.

C-5C—Option 04. **$495**

C-7—Option 02. **$610**

*1 *Contact your local sales office.*

TRAINING

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. See Customer Training Section for information. For further information, or to enroll, call us at 1-800-835-9433 ext. 430.

NEW 2210 Digital Oscilloscope

TYPICAL APPLICATIONS

- **Field Service**
- **Electromechanical Measurements**

BENEFITS

- **3-Year Warranty; 5-Year Optional**
- **U.L. Listed, CSA and VDE Certification**

FEATURES

- **50 MHz Bandwidth in Non-storage Mode**
- **20 MS/s per Channel Maximum Sample Rate**
- **2 MHz Single Shot Digital Bandwidth**
- **4 k per Channel Record Length**
- **50 s/div to 20 μs/div Storage Time Base Range; 0.05 μs/div Non-Storage**
- **2 P6103 10X Voltage Probes Included**

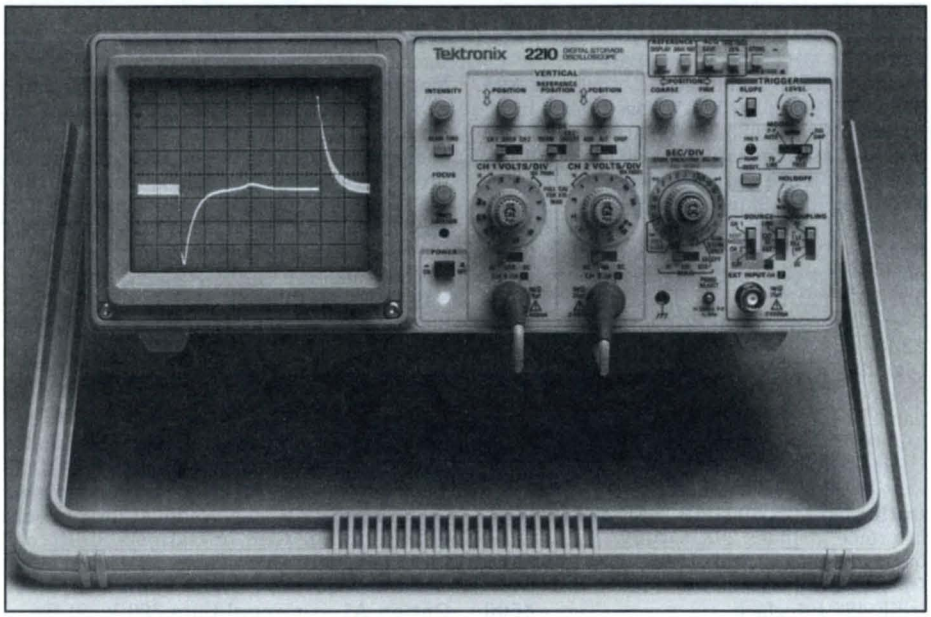
Now you can get the best of both worlds, analog and digital, in a low-cost, 50 MHz oscilloscope featuring 20 MS/s digitizing along with familiar, full-bandwidth analog operation. There is no similar combination of features, performance and price.

With digital storage you can freeze waveforms, capture events invisible to non-storage scopes and store acquired waveforms into long records. If there's a question about a digital measurement, just push a button for real-time display analysis.

With its outstanding ease of use, the new 2210 is perfect for first-time digital users. Seasoned operators will appreciate its superior versatility, convenience and value—all backed by Tek quality and a 3-year warranty.

Store/Non-Store Flexibility
The 2210 combines digitizing power with familiar 50 MHz analog performance. This combination means measurement flexibility with high user confidence.

Pre/Post Trigger Capability
With digital storage you can view events occurring before and after a trigger event. This means that either 25 or 75% of the displayed waveform can be prior to the trigger event.



20 MS/s Per Channel Maximum Digitizing rate
Sampling with 8-bit vertical resolution at 20 MS/s per channel provides faster waveform acquisition than many comparable digital storage scopes.

4 k Record Length Per Channel/Save Reference Memory
4 k record length per channel provides excellent time resolution of viewed waveforms. Because the 2210 displays all 4 k points onscreen, digitized waveforms look as familiar as an analog display. One screen of information can be saved in reference memory for later analysis or waveform comparison.

CHARACTERISTICS

VERTICAL SYSTEM
(2 Identical Channels)

Nonstorage-Bandwidth (−3dB) and Rise Time—50 MHz and 7.0 ns, derated to 40 MHz and 8.8 ns outside 5 to 35°C. 5 MHz BW with X10 Vertical Mag.
Deflection Factor and Accuracy—5 mV to 5 V/div at ±3%; ±5% with X10 Vertical Mag. UnCal at least 2.5:1.
Vertical Operating Modes—CH 1, CH 2, CH 2 INVERT, ADD, ALT, CHOP (500 kHz), X10 Vertical Mag.
CMRR—at least 10:1 at 20 MHz.
Imput R & C—1 MΩ, approx. 25 pF.
Max Input Voltage—400 V (dc + peak ac) or 800 V (p-p to 10 kHz).
Channel Isolation—at least 100:1 at 10 MHz.
Trace Shift—0.25 div with VOLTS/DIV switch rotation; 1 div with VOLTS/DIV variable; 1.5 div with CH 2 INVERT; 2 div with X10 Vertical Mag.

HORIZONTAL SYSTEM

Sweep Speeds—Nonstore: 0.05 μs to 0.5 s/div. Store: 20 μs to 50 s/div.
Accuracy—±3%. Derated outside +15 to +35°C.
Horizontal Operating Modes—Main Sweep, X-Y.
External Clock—DC to 10 MHz.

STORAGE SYSTEM

Sampling Rate—20 MS/s per channel.
Useful Storage Bandwidth—2 MHz (calculated as 10 points per signal period for single shot or repetitive signals).
Vertical Resolution—8-bit (256 levels).
Horizontal Resolution—4K (400 points/div).
Record Length—4K per channel.
Memory—One Save Reference.
Display Modes—Record, Roll, Triggered Roll (Single Sweep).

TRIGGER SYSTEM

Trigger Sensitivity—Internal: 0.35 div at 5 MHz; 1.0 div at 50 MHz. External: 40 mV at 5 MHz; 150 mV at 50 MHz.
TV Triggers—TV Field triggering with 1.0 div. of composite sync.
Trigger Operating Modes—Peak to Peak Automatic (also for TV Line), Normal, TV field, and Single Sweep.
Trigger Coupling—AC, DC, HF Rej, LF Rej, Line.
External Trigger Input—AC, DC, or DC/10.
Variable Holdoff—at least 8:1.

X-Y MEASUREMENTS

Deflection Factors—Same as Vertical system.
X-Y Operating Modes—X-Axis is CH 1; Y-Axis is CH 2 (non-store only).
Accuracy—X-Axis: ±5%; Y-Axis: same as vertical system.
Bandwidth—Y-Axis same as vertical system. X-Axis: 2 MHz.
Phase Difference—±3° from dc to 150 kHz.

CRT

Display—8×10 cm, 12.6 kV nominal voltage.
Controls—Beam Find, Focus, Intensity, Trace Rotation.
Z-Axis—Sensitivity: 5 volts causes noticeable modulation. Usable to 5 MHz.

POWER REQUIREMENTS

Line Voltage Range—Low; 95 V ac to 128 V ac; High: 185 V ac to 250 V ac.
Line Frequency—48 Hz to 440 Hz.
Maximum Power Consumption—70 W (80 V A).

ENVIRONMENTAL

Ambient Temperature—Operating: 0 to 40°C Nonoperating: −55 to +75°C.
Altitude—Operating: 4,570 m (15,000 ft.). Nonoperating: To 15,240 m (50,000 ft.).
Vibration—Operating: 15 minutes along each of the major axes. 0.015 inch p-p displacement 10 to 55 to 10 Hz in one minute cycles. Held for 10 minutes at 55 Hz (2.4 g at 55 Hz).
Humidity (Operating and non-operating)—95%, five cycles (120 hours) referenced to MIL-T-28800C, paragraph 4.5.5.1.2.2.
Shock (Operating)—30 g, ½ sine, 11 ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.
EMC—Meets Class B requirements per VDE 0871-B for radiated and conducted emissions and FCC requirements.

SAFETY

U.L. 1244 listed, CSA Certification

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width w/handle	380	15.0
Height	138	5.4
Depth w/o fnt cover	438	17.2
Weight ≈	**kg**	**lb**
Net	7.6	16.8

ORDERING INFORMATION

2210—50 MHz Single Time-Base Digital Storage Oscilloscope **$2,395**
Includes: Two P6103 10X, 2 m Probes with Accessories, Operators Manual (070-6847-00).

OPTIONS

Option 02—Front Panel Cover and Accessories Pouch **+$50**
Option 1R—Rackmount Kit (016-0819-00) **+$150**
Option 1C—C-5C Option 04 camera. **+$495**
Option 1K—K212 Portable Instrument Cart. **+$350**
Option 1T—Transit Case. **+$215**

INTERNATIONAL POWER PLUG OPTIONS

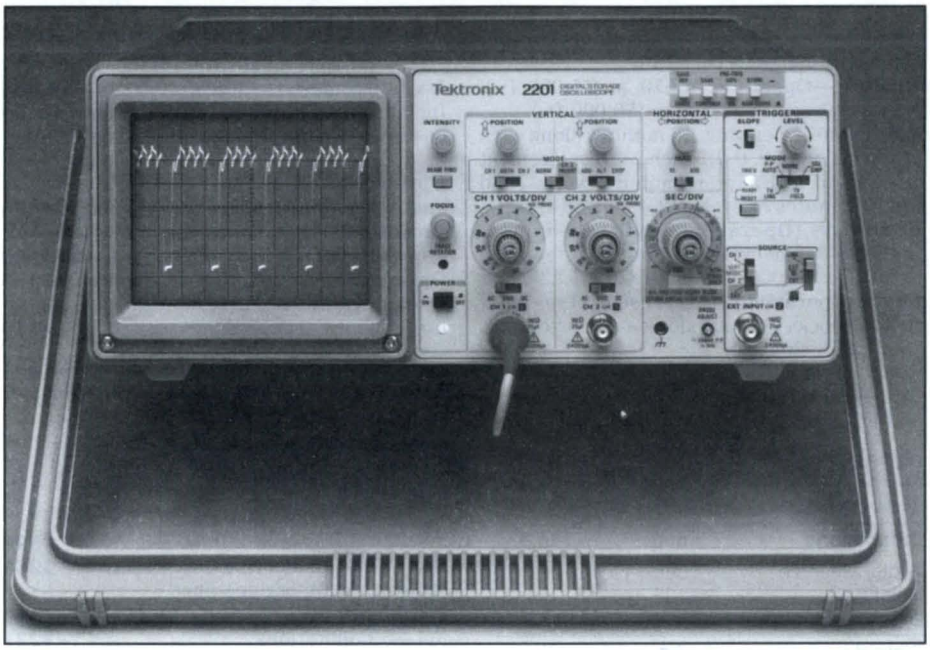
Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

WARRANTY-PLUS SERVICE PLANS

M1—2 Calibrations **+$92**
M2—+2 years Service **+$263**
M3—+2 Years Service plus 4 Calibrations **+$446**
M4—5 Calibrations **+$221**
M5—9 Calibrations plus 2 Years of Service **+$661**

OPTIONAL ACCESSORIES

See page 231 for complete listing.



NEW 2201 Digital Oscilloscope

TYPICAL APPLICATIONS

- **Field Service**
- **Process Control**
- **Electromechanical**
- **Power Supply Testing**

BENEFITS

- **Three-Year Warranty; Five-Year Optional**
- **U.L. Listed, CSA and VDE Approved**

FEATURES

- **20 MHz Bandwidth in Non-Storage Mode; 1 MHz Storage Bandwidth**
- **10 MS/s per Channel Maximum Sampling Rate**
- **2k per Channel Record Length**
- **50 s/div to 20 μs/div Storage Time Base Range; 0.1 μs/div Non-Storage**
- **Two P6103 10X Voltage Probes Included**

The 20 MHz 2201 Digital Storage Oscilloscope is Tek's newest member of the 2200 Series of oscilloscopes, combining the familiar analog operation of the 2205 with powerful digital capabilities. No other DSO offers the performance benefits of the 2201 at such an affordable price.

Ease of Use

The 2201 is based on the proven design of other 2200-Series oscilloscopes, which feature a well-organized, easy to use front panel design. Such outstanding ease of use make the 2201 perfect for first-time users and seasoned operators alike.

Powerful Features

Features such as a full-sized bright CRT, sensitive 5 mV vertical deflection, a fast 10 ns/division sweep capability, and a flexible triggering system make the 2201 ideal for a wide variety of applications, such as field service or electronic test and repair. Triggering functions include Peak-to-Peak Auto, which provides the convenience of triggering within automatic level limits; TV Line and Field, for synchronization with video signals; and Vertical Mode coupling, for triggering alternately between channels in dual channel operation.

Analog/Digital Flexibility

The 2201 gives you the flexibility of both storage and non-storage operation at the push of a button. When switched to storage mode, the 2201 can easily capture and display single-shot events on-screen for analysis. Slow repetition rate signals can be easily viewed without the usual flicker of analog display. Digital storage also allows for viewing of pre-trigger data. With the 2201, 50 percent of the waveform display can be events leading up to a trigger point. A save reference memory allows for newly acquired signals to be compared against a previous acquisition, or a known-good waveform (including in horizontal expansion mode). And with a serial interface option, what is being displayed on-screen can be sent to a printer for convenient hardcopy documentation and record-keeping.

Digital Performance

The 2202 features many performance characteristics found only on much more expensive DSOs. These include 10 MH/s channel sampling rate, 8-bit vertical resolution, and 2048-point (200 points/division) per channel record length. Excellent resolution is thus provided for crisp, clear display or waveform details.

Built-In Reliability

The 2201 is backed with Tek's standard three-year warranty, being designed and built to Tek's standards for quality and reliability. Safe operation is assured by U.L. and C.S.A. safety certification. Tek also provides superior service and support worldwide, including expert sales support, trainingmaterials, applications assistance, service and calibration.

Education Packages

The 2201 is also part of Tek's low cost packages for education customers. The CRS2201 combines the 2201 with low-cost lab bench equipment (function generator, digital multimeter, and power supply) at one low package price. See page 136 for details.

Cost Effective Solution

With its performance, reliability, and ease of use, combined with affordable price and flexibility, the 2201 assures you of cost effectiveness over the long run.

CHARACTERISTICS

VERTICAL SYSTEM (2 Identical Channels)

Nonstorage-Bandwidth (–3 dB) and Rise Time—20 MHz and 17.5 ns, 5 MHz BW with X10 Vertical Mag.
Deflection Factor and Accuracy—5 mV to 5 V/div at ±3%, ±5% with X10 Vertical Mag. UnCal at least 2.5:1.
Vertical Operating Modes—Ch 1, CH 2, CH 2 INVERT, ADD, ALT, CHOP (500 kHz), X10 Vertical Mag.
CMRR—At least 10:1 at 10 MHz.
Input R and C—1 MΩ, approx. 25 pF.
Max Input Voltage—400 V (dc + Peak ac) or 800 V (p-p to 10 kHz).
Channel Isolation—At lease 100:1 at 10 MHz.
Trace Shift—0.25 div with VOLTS/DIV switch rotation; 1 div with VOLTS/DIV variable; 1.5 div with CH 2 INVERT; 2 div with X10 Vertical Mag.

HORIZONTAL SYSTEM

Sweep Speeds—Nonstore: 0.1 μs to 0.5 s/div. Store: 20 μs to 50 s/div.
Accuracy—±3%. Derated to ±4% outside 15 to 35 °C and ±5% X10 Mag.
Horizontal Operating Modes—Main Sweep, X-Y (nonstore).

STORAGE SYSTEM

Sampling Rate—10 MS/s per channel.
Useful Storage Bandwidth—1 MHz (calculated as 10 points per signal period for single shot or repetitive signals).
Vertical Resolution—8-bit (256 levels).
Horizontal Resolution—2K (200 points/div).
Record Length—2K per channel.
Memory—One Save Reference (up to 2 channels).
Display Modes—Record, Scan, Triggered Scan (Single Sweep).

TRIGGER SYSTEM

Trigger Sensitivity—Internal: 0.35 div at 5 MHz; 1.0 div at 20 MHz. External: 40 mV at 5 MHz; 150 mV at 20 MHz.
TV Triggers—TV Field triggering with 1.0 div of composite sync.
Trigger Operating Modes—Peak to Peak Automatic (also for TV Line), Normal, TV field, and Single Sweep.
Trigger Sources—Internal CH 1, CH 2, Vert Mode, Line; External, and External ÷10.
Trigger Coupling—DC only.

X-Y MEASUREMENTS

Deflection Factors—Same as Vertical system.
X-Y Operating Modes—X-Axis is CH 1; Y-Axis is CH 2 (nonstore only).
Accuracy—X-Axis: ±5%; Y-Axis, same as vertical system.
Bandwidth—Y-Axis same as vertical system. X-Axis: 2 MHz.
Phase Difference—±3° from dc to 150 kHz.

CRT

Display—8×10 cm, 12.6 kV nominal voltage.
Controls—Beam Find, Focus, Intensity, Trace Rotation.
Z-Axis—Sensitivity: 5 volts causes noticeable modulation. Usable to 5 MHz.

POWER REQUIREMENTS

Line Voltage Range—Low; 95 V ac to 128 V ac; High: 185 V ac to 250 V ac.
Line Frequency—48 Hz to 440 Hz.
Maximum Power Consumption—70 W (80 V A).

ENVIRONMENTAL

Ambient Temperature—Operating: 0 to 40 °C Nonoperating: –55 to +75 °C.
Altitude—Operating: 4,570 m (15,000 ft.).
Vibration—Operating: 15 minutes along each of the major axes. 0.015 inch p-p displacement 10 to 55 to 10 Hz in one minute cycles. Held for 10 minutes at 55 Hz (2.4 g at 55 Hz).
Humidity (Operating and nonoperating)—95%, five cycles (120 hours) referenced to MIL-T-28800C, paragraph 4.5.5.1.2.2.
Shock (Operating)—30 g, ½ sine, 11 ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.
EMC—Meets Class B requirements per VDE 0871-B for radiated and conducted emissions and FCC requirements.

SAFETY

U.L. 1244 listed, CSA Certification.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width w/handle	380	15.0
Height	138	5.4
Depth w/o fnt cover	438	17.2
Weight ≈	**kg**	**lb**
Net	7.6	16.8

ORDERING INFORMATION

2201 20 MHz Single Time-Base Digital Storage Oscilloscope. **$1,495**
Includes: Two P6103 10X, 2 m probes with accessories, reference card; operators manual (070-7190-00).

OPTIONS

Option 02—Front Panel Cover and Accessories Pouch. **+$50**
Option 12—Serial Port (HP-GL and EPSON). **+$300**
Option 1C—C-5C Option 04 camera. **+$495**
Option 1K—K212 Portable Instrument Cart. **+$350**
Option 1R—Rackmount Kit. **+$150**
Option 1T—Transit Case. **+$215**
Option 2V—Operator's Training Package. **+$60**

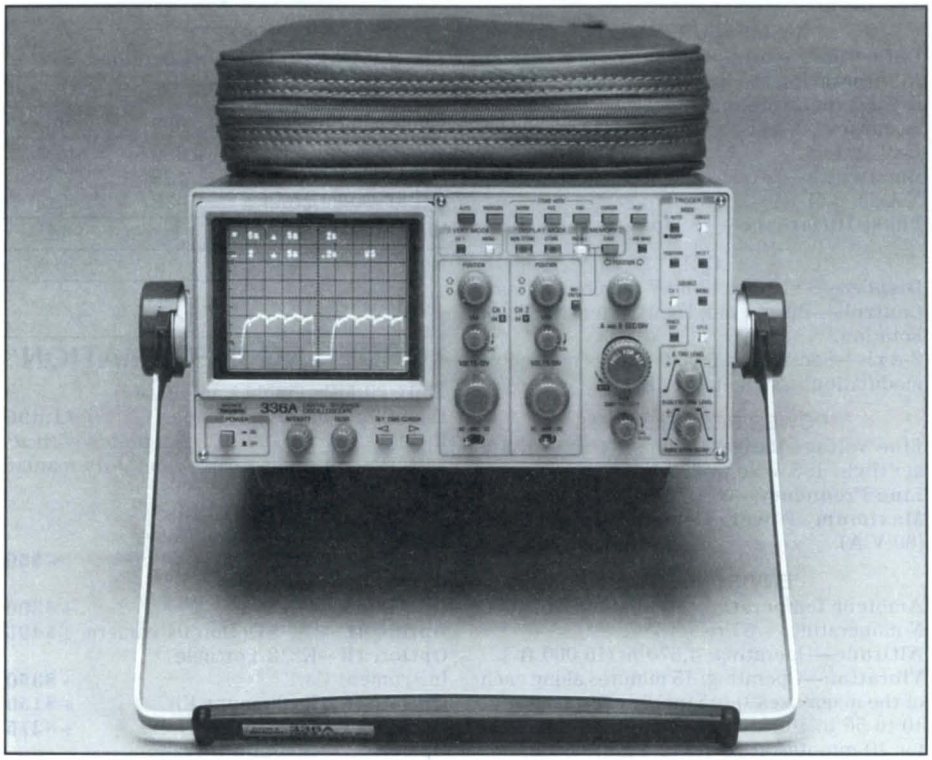
INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

WARRANTY-PLUS SERVICE PLANS

M1—2 Calibrations. **+$92**
M2—+2 years Service. **+$157**
M3—+2 years Service plus 4 Calibrations. **+$340**
M4—5 Calibrations. **+$221**
M5—9 Calibrations plus 2 years of Service. **+$555**

SONY®/TEKTRONIX® 50-MHz DUAL-TRACE DIGITAL-STORAGE OSCILLOSCOPE



NEW 336A

GPIB IEEE-488

The 336A with Option 01 complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

TYPICAL APPLICATIONS

- **Medical Systems**
- **Communication-Equipment Service**
- **Electronic Design**
- **X-Ray Equipment Maintenance**

FEATURES

- **1 MS/s, 140 kHz Useful Storage Bandwidth**
- **Cursors for Time and Voltage Measurements**
- **Signal Averaging**
- **Envelope Mode**
- **GPIB and Eight-Screen Memory Option (16K)**
- **50-MHz Nonstorage Bandwidth**
- **CRT Readout**

The SONY®/TEKTRONIX® 336A is a combination nonstorage and digital-storage portable oscilloscope. It is capable of displaying analog and digitized waveforms simultaneously, and can store up to 18 digitized waveforms for recall and display. The 336A is a microprocessor-controlled instrument that incorporates alphanumeric CRT readouts of the vertical and horizontal scale factors, the delay time position, and voltage and time readouts of the cursor positions. Many of the oscilloscope features and modes are chosen from a menu displayed on the CRT rather than from hardwired front-panel switches. Also included is an Auto mode for both vertical volts per division and horizontal time per division which allows "hands off" operation in many applications.

The 336A has a dual-channel, dc to 50-MHz vertical-deflection system for both nonstorage and equivalent-time digitizing. Storage bandwidth for single-sweep events (waveforms acquired as the result of a single triggering event) is dc to 140 kHz. The vertical channels have calibrated deflection factors from 5 mV to 10 V per division with a choice of either ac or dc input coupling. In the Nonstore mode, the 336 operates like a conventional oscilloscope.

GPIB (talker only) includes a memory back-up of up to eight screens (two 1K waveforms each) of information.

CHARACTERISTICS

DIGITIZER AND MEMORY

Speed—Digitizing rates up to 1 megasample/s.
Useful Storage Bandwidth—Real-Time Sampling: DC to 140 kHz (−3 dB). Equivalent-Time Sampling: DC to 50 MHz (−3 dB).
Resolution—Vertical: 8-bit. Horizontal: 10-bit.
Memory Size—Standard: 2K byte (one frame of two waveforms). Option 01: 16K byte (up to eight frames of two 1K waveforms each storage capacity). Data Retention: At least 3 days (after eight hours of operation).

VIEW DISPLAY MODE

This is the saved "store" waveform (saved from Store display mode). Process functions are the same as Store display mode.

NONSTORED AND STORED DISPLAY MODES

The following characteristics apply to both modes unless otherwise indicated.

VERTICAL SYSTEM (2 IDENTICAL CHANNELS)

Bandwidth and Rise Time[*1]

0 to 40°C	40 to 55°C
DC to at least 50 MHz	DC to at least 40 MHz

[*1] *At all deflection factors from a 50-Ω source.*

Deflection Factor—Range: 5 mV to 10 V/div. Accuracy is ±3%. Uncalibrated, continuously variable between steps, and to at least 25 V/div.
Vertical Modes—Stored Mode: CH 1, CH 2, Chop, Dual and Trigger View. Nonstored Mode: CH 1, CH 2, Chop and Dual.
Normal Mode (Store Mode Only)—Acquired displayed signal.
Envelope Mode (Store Mode Only)—1, 8, 16, 32, 64, 128, 256 sweeps, or continuous at s/div settings of 2 ms to 0.2 s/div.
Average Mode (Store Mode Only)—8, 16, 32, 64, 128 or 256 sweep averages.
Process Mode (Store and View Mode Only)—Waveform: CH 1 + CH 2 is within 6%. CH 1—CH 2 is within 6%. CH 1 × CH 2 is within 7%. Parameters (Selectable): RMS is within 3% + 6% of V/div setting. Mean is within 3+4% of V/div setting. P-P is within 3+4% of V/div setting. Store or view waveforms must acquire initial ground-reference level.
Common-Mode Rejection Ratio—At least 10:1 at 10 MHz (5-MHz storage).
Input R and C—1 MΩ ±2% paralleled by 33 pF.
Maximum Input Voltage—200 V (dc + peak ac) or 200 V p-p ac to 1 kHz.

HORIZONTAL SYSTEM (NONSTORE MODE ONLY)

Time Base A—0.2 s to 0.1 μs/div in a 1-2-5 sequence. X10 Mag extends the maximum sweep rate to 10 ns/div. (At sweep speeds slower than 0.2 s, the scope automatically goes to Roll mode.)

Time Base B—50 ms to 0.1 μs/div in a 1-2-5 sequence. X10 Mag extends the maximum sweep rate to 10 ns/div.

Variable Time Control—Continuously variable between calibrated settings of the A s/div switch. Extends the slowest sweep rate to at least 0.5 s/div.

Time Base Accuracy

	20 to 30°C	0 to 55°C
Unmagnified	±2%	±3%
Magnified	±3%	±4%

DIGITAL STORAGE HORIZONTAL ACQUISITION

Resolution—Ten bit. 1024 data points.

Range—Equivalent-Time Sampling: 50 ns to 0.1 ms/div. Single-Sweep Storage: 0.2 s to 0.1 ms/div. Roll Mode: 20 to 0.5 s/div. Envelope Mode: 0.2 s to 2 ms/div.

Accuracy—3% from +20 to +30°C; 4% from 0 to +55°C.

Horizontal Display Modes—Nonstore: A sweep, B delay, alternate, X-Y. Storage: A sweep, B delay, X-Y.

CALIBRATED SWEEP DELAY

Differential Time Measurement Accuracy (Nonstore Mode)

+15 to +35°C	Within 1% of indicated value
0 to +55°C	Within 2.5% of indicated value

Delay Time Jitter (Nonstore Mode)—≤1 part in 10,000.

Delay Time Resolution (Store Mode)—14-bit.

Cursor Accuracy (Store Mode)—ΔV: Within 3%. ΔT: Real-time sampling is ±0.1% of full scale. Equivalent-time sampling from +20 to +30°C is ±3%; from 0 to +55°C is ±4%.

TRIGGERING A AND B

A Trigger Modes—Normal: Sweep generator requires a trigger to generate a sweep. Automatic: Sweep generator free runs in the absence of a trigger. Single sweep: One sweep is initiated by the first trigger after reset.

Trigger Sources—Internal, CH 1, CH 2, composite, or external.

Sensitivity and Coupling

Coupling	To 10 MHz	To 50 MHz
AC	0.3 div above 30 Hz	1.5 div
LF Rej	0.5 div above 50 kHz	1.5 div
HF Rej	0.5 div, 30 Hz to 50 kHz	—
DC	0.3 div	1.5 div
External	70 mV	350 mV
TV	Stable video rejection and sync separation from sync-negative NTSC or PAL composite video	

Trigger Jitter—Nonstore Mode: 1 ns or less at 50 MHz. Storage Mode: ±1 sample period.

External Trigger View—Deflection Factor: Ext is 100 mV/div. Ext÷10 is 1 V/div.

External Trigger Input—R and C=1 MΩ paralleled by 33 pF. 200 V (dc + peak ac) maximum input.

Acquisition-Window Trigger Point—Pretrigger: $^{7}/_{8}$ of waveform occurs before trigger point. Midtrigger: $^{1}/_{2}$ of waveform occurs before trigger point. Posttrigger: $^{1}/_{8}$ of waveform occurs before trigger point.

X-Y OPERATION (NONSTORE)

Full Sensitivity X-Y (CH 1 Horizontal, CH 2 Vertical)—5 mV to 5 V/div with bandwidth of dc to 1 MHz. Phase difference is 3° from dc to 50 kHz.

CRT AND DISPLAY FEATURES

CRT—8×10 div (0.6 cm/div) display, GH (P31) phosphor. 12 kV operating potential.

Graticule—Internal. Vertical and horizontal centerlines marked in 5 minor div/major 0.6 cm/div.

Z-Axis Input—Range +3 to +25 V with 1-MHz usable frequency range. Input resistance of at least 10 kΩ.

ENVIRONMENTAL

Ambient Temperature—Operating: 0 to 55°C. Nonoperating: −25 to +75°C. Option 01: −20 to +55°C.

Altitude—Operating: To 4600 m (15,000 ft). Decrease maximum operating temperatures 1°C for each 1,000 ft above 5,000 ft. Nonoperating: To 15 000 m (50,000 ft).

Vibration—0.025 p-p (4 g's at 55 Hz) displacement, 15 minutes along each axis from 10 to 55 Hz.

Humidity—120 hrs of MIL-STD-202D, method 106°C, minus freezing and vibration.

Shock—30 g's half sine, 11-ms duration on each axis.

OTHER CHARACTERISTICS

Chart Output—Clock Rate: Fast or slow. Amplitude: 500 mV/div. Output Impedance: 220 Ω.

Calibrator—Output Voltage: 0.3 V ±1%. Output Resistance: 50 Ω. Frequency: ≈1 kHz.

AC Power Requirements—Line-Voltage Ranges: 90 to 132 V ac, 180 to 250 V ac. Line Frequency: 48 to 440 Hz. Power Consumption: 50 W maximum.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	237	9.3
Height	112	4.4
Depth		
Handle Not Extended	370	14.6
Handle Extended	482	19.0
Weight ≈	**kg**	**lb**
Net	5.0	11.1
Shipping	10.5	23.1

ORDERING INFORMATION

336A Digital-Storage Portable Oscilloscope*[1]

Includes: Two 10X P6148A attenuator probes; accessory pouch (016-0718-00); Front-panel cover (016-0719-00); CRT filter (378-0225-00); Operator manual (070-4421-00); and Service manual (070-4420-00).

*[1] *Contact your local sales office.*

OPTIONAL ACCESSORIES

HC100 Plotter—Works through GPIB. **$825**
Option 01—GPIB Cable **+$140**

RECOMMENDED PROBES

P6148A—10X Probe. **$130**
A6303—Current Probe. **$1,180**
AM 503—Current Probe Amplifier. **$1,240**

RECOMMENDED CAMERA

C-30BP Option 01— **$1,665**
Camera Mounting Adapter—
Order 016-0327-01 **$175**

RECOMMENDED CART

K212—For on-site mobility. **$350**

The SONY®/TEKTRONIX® 336A is manufactured and marketed in Japan by Sony/Tektronix Corporation, Tokyo, Japan. Outside of Japan, the 336A is available from Tektronix, Inc., its marketing subsidiaries, and distributors.

Choose one of two human interfaces. If you are comfortable with left-to-right logical manupulations, choose the Tek T201 with a calculator-like interface. If you excel at scope operation, choose the Tek T202 with a traditional oscilloscope interface.

NEW T201/ NEW T202

TYPICAL APPLICATIONS

- Field Service
- Manufacturing Process Control
- Plant Maintenance
- Communications

BENEFITS

- Sophisticated Capabilities Made Ultra-Portable and Easy to Use
- LCD Display
- Multiple Display Modes
- Standard Battery Pack
- Light Weight—0.85 kg (1.9 lb)
- One-Year Warranty

FEATURES

- Industry-Standard 20 MS/s Sample Rate with 500 ns Resolution
- Single-Shot Bandwidth of 2 MHz; 5 MHz for Repetitive Signals
- Two Channels with Independent Time-Bases
- Automatic Setup of Time and Trigger Functions
- 10 mV to 20 V per Division Sensitivity
- Elevated Ground Measurements to 42 Volts
- Front-Panel Setup Save/Recall
- Save Reference Memory for Waveform Data
- Signal Processing for Fast, Convenient Differential/Ratio Measurements
- Signal *Zoom* for Detailed Waveform Characterization
- Cursors/Screen Readout
- Multimeter Mode

Sophisticated Capabilities Made Ultra-Portable and Easy to Use

The Tek T202 and T201 are light, compact and fit easily in a tool box, briefcase, glove compartment and in the palm of your hand. Only Tek packs so much in so little and makes it easy enough for even a new user to make basic measurements in minutes.

A battery pack is included and permits up to six hours of operation away from the bench. It recharges easily: just plug the pack in overnight and you're ready to go in the morning.

A Choice of Two Human Interfaces

If you're a pro at scope operation, choose the Tek T202 with a traditional oscilloscope interface (shown here). If your are comfortable with left-to-right logical manipulations, you'll want to look at the Tek T201 with a calculator-like interface.

Big-Scope Performance

For single-channel acquisitions, the T201 and T202 provide an indistry-standard sampling rate of 20 MS/s. You can dititize, store and process single-shot events from dc to 2 MHz and repetitive signals to 5 MHz—all with 7-bit vertical and horizontal resolution.

Two channels provide chopped, alternate or algebraically summed displays in the multiple vertical modes. Sensitivity to 5 mV gives amplitude range for most applications. The T202 retains up to nine front-panel setups and nine waveforms in non-volatile memory for time-saving convenience, especially in the field.

Digital voltmeter and time/counter capabilities are built in. The T200 Series virtually eliminates taking extra voltage and timing equipment on call. Between 1 Hz and 6 MHz, typical accuracy ranges from 0.5% to 0.04%. The scopes can produce power diagrams and display true RMS, DC, peak to peak and peak voltages with accuracies to within 1%.

A Pleasure to Use—Anywhere

Operation is as simple as capabilities are sophisticated. Time base and trigger functions can be set automatically. Just press the Auto Set button. The scope does the rest. All important settings can also be entered via simple programming sequences.

Waveform information is displayed in multiple screens at the top and bottom of the display. They can be scrolled horizontally for fast information access. Readouts include time, voltage and trigger information.

Four cursors are provided for each channel (two vertical, two horizontal) for measuring waveform characteristics with pushbutton convenience. Automatic setup for signal period, signal ground and peak voltage makes measurement results immediate and effortless.

You can rely on the the T200 Series even in high ambient light conditions. Bright LCD display makes the scopes ideal for shop, office or outdoor use.

CHARACTERISTICS

VERTICAL SYSTEM

Deflection Factor
Range—0.01 to 20 volts/div in a 1-2-5 sequence of 11 steps. DC Accuracy: Within 1% ±1 LSB to six divisions full scale. Increases ±0.01% per °C above 20°C.
Linearity—±0.5 LSB.
Step Response—70 ns.
Maximum Sample Rate—20 MS/s for single channel acquisitions or 10 MS/s for in chop to alternate vertical mode.
Vertical System Bandwidth (–3 dB)—DC to greater than 5 MHz.
Useful Bandwidth—Up to 5 MHz for repetitive signals and up to 2 MHz for single-shot events (determined by requiring 10 samples per signal period).
Resolution—7 bits, 20 levels per division.
Chop Mode Switching Rate—(Chop mode not allowed above 20 μs per division). 20 μs/div to 8MS/div: 40÷Seconds/Division Setting ≥8 ms/div: 5 kHz.
Input Resistance and Capacitance—1 MΩ±0.25%; 25 pF±5 pF.
Channel 1/Channel 2 Isolation—100:1 at 5 MHz.
Maximum Safe Input voltage potential between probe common plus input circuit to earth ground—42 V max (dc + peak ac) at 5 MHz or less.

HORIZONTAL SYSTEM

Sweep Rate Sec/Div and Delta Time Calibrated Range—1 hour/div to 50 ns/div settable to within at least 1.0% of range or 50 ns/div, whichever is greater.
Accuracy—±0.1% of calibrated range.
Time Difference between Sec/div and Delta Time—±0.1 division.
Resolution—7 bits, 128 display points.
Record Length—256 points for CH1 and CH2 in single and alternating operation; 128 points each in chop operation.
Minimum Resolution in Time Measurement (at 50 ns/div)—Continuous Sweeps: 2.5 ns per data point. Single Sweep: 50 ns/data point.
Reference System of Time Base—40 MHz ±50 parts per million (quartz crystal controlled).

MEMORY

Save Reference Memory—Nine 256-point single channel acquisitions may be saved in reference memory.
Save Setup Memory—Memory locations are available for storage of up to nine keyboard setups; Vertical sensitivity and coupling are not capable of being saved.

CURSORS

Delta Time Measurement Accuracy—±0.1 division.
Delta Voltage Measurement Accuracy—Same as vertical system.

TRIGGERING SYSTEM

Sensitivity—Internal: 0.5 division. External: Set at 1.5 volts.
Jitter—±2 display points.
Level Range—At least ±2.5 div from 0.0 V.
Trigger Delay
Pretrigger—Up to 12.8 divisions (two display screens) of pretrigger information are available.
Post-Trigger—Up to 198.4 divisions (31 display screens) of post-trigger information are available.
External Trigger Input maximum safe input voltage potential between probe common plus input circuit to earth ground—Shall not exceed 42 volts (dc + peak ac) at 5 MHz or less.
Input Resistance and Capacitance—2.2 MΩ ±0.25%; 25 pF±5 pF.

DVM/COUNTER (VOLTAGE AND TIME)

Frequency and Period—
1 to 100 Hz at ±0.5%,
101 Hz to 500 kHz±0.08%,
500 kHz to 5 MHz at ±0.04%.
(Frequency and period are automatically calculated if signal duty cycle is greater than 33%.)
Voltage Measurement of True RMS, Average, Peak to Peak, and Zero to Peak—Refer to display accuracy.

DISPLAY

Dimensions of Display Area—57.6×57.6 mm with 6.4×6.4 divisions with 20 display points per division.
Usable Signal Area—100 points vertically by 128 points horizontally.

BATTERY PACK ELECTRICAL CHARACTERISTICS

Changing Current (Switch-Selectable)—Low: 100 mA (1 ampere-hour batteries);
High: 200 mA (4 ampere-hour batteries).
Changing Time—(Full recharge of nickel-cadmium batteries)
1 Ampere-hour batteries: 12 to 14 hours.
4 Ampere-hour batteries: 24 to 30 hours.
Battery Charger Power Source—Input power to the battery charger is supplied by the ac power source.
Battery Overcurrent Protection Fuse—3 amps.

BATTERY OPERATION

Voltage Range—Normal Operation: +3.5 to +6.5 V. Non-Destructive Limits: –0.5 to +15.0 V.
Battery Current Drain—Approximately 0.6 A to a maximum of 2.8 A, dependent upon the battery voltage and load.
Leakage Current from Battery to Internal Circuitry—300 μA maximum, when battery output is 6 V.
Low Battery Voltage Warning—Threshold: 4.75 V ±5%. Flashing Frequency: Approximately 1 Hz.
Typical Battery Operating Time (Operating a T201/T202 between 20 and 30°C)—Nickel-Cadmium (4 ampere-hour batteries)
Single Channel Operation: 5 hours.
Dual Chanel Operation: 3 hours.
Alkaline Single Channel Operation: 6 hours.
Dual Channel Operation: 2.5 hours.

EVNIRONMENTAL CHARACTERISTICS

Temperature—Operating: 0 to 40°C. Nonoperating: –30 to +75°C.
Altitude—Operating: To 4500 meters (15,000 feet). Maximum operating temperature decreased one degree C per 1,000 feet above 5,000 feet. Nonoperating: To 15,000 meters (50,000 feet).
Humidity—(Operating and Nonoperating) 5 cycles (120 hours) referenced to MIL-T-28800C paragraph 4.5.5.1.2.2 for Type III, Class 5 instruments. Nonoperating and operating at 90% relative humidity +0% or –5%. Operating at +30 and +40°C. Nonoperating at +30 to +60°C.
EMI (Electromagnetic Interference)—Does not meet radiated or conducted emission requirements per VDE-0871, Class B.
Vibration (Operating)—Sinusoidal vibration in the X, Y, and Z axes with the frequency varied 10 to 55 Hz in one minute cycles for a duration of 15 minutes. Total displacement 0.025 inch p-p (4 g at 55 Hz).
Shock—(Operating and nonoperating) 150 g, half-sine, 2 ms duration, 2 shocks per axis for a total of 12 shocks.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	111	4.4
Height	257	10.1
Depth	48	1.9
Weight ≈	**kg**	**lb**
Net	0.85	1.9
Shipping	3.2	6.9

ORDERING INFORMATION

T201 5 MHz Digital Storage Oscilloscope. **$1,995**
Includes: Two P6115, 1X Voltage Probe Packages; ac/dc Adapter; Operator's Manual; Battery Pack/Carrying Case.
T202 5 MHz Digital Storage Oscilloscope. **$1,995**
Includes: Same as T201.

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland, 220 V, 50 Hz.

LABORATORY DIGITAL STORAGE OSCILLOSCOPES

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DIGITAL OSCILLOSCOPES AND WAVEFORM DIGITIZERS

Type	Analog Digitizing BW	Maximum Digitizing Rate	Vertical Resolution	Data Words per Waveform	Maximum Stored Waveforms	Single-shot*1 Storage BW	Equiv*2 Storage BW (rep)
11801	20 GHz*6	200 KS/s	8 bits	Up to 5,120	500K pts	N/A	20 GHz
11802	20 GHz*5*6	200 KS/s	8 bits	Up to 5,120	500K pts	N/A	20 GHz*5
11201	400 MHz	20 MS/s	9 bits	Up to 10,240	180K pts	2 MHz	400 MHz
11401	500 MHz	20 MS/s	10 bits*3	Up to 10,240	100K pts	2 MHz	500 MHz
11402	1 GHz						1 GHz
7D20	100 MHz					10 MHz	
7854	400 MHz*4	500 kHz Ext Clock	10 bits	Up to 1024	Up to 40	50 kHz	400 MHz

*1 *Single-shot Storage Bandwidth is a measure of the highest frequency sine wave that can be stored in a single sweep and displayed in a visually useful manner. This is dependent on both the maximum digitizing rate as well as the display reconstruction technique used.*

*2 *Equivalent Storage Bandwidth indicates the highest frequency repetitive signal that can be stored and displayed with less than 3 dB loss of signal amplitude using equivalent-time digitizing techniques.*

*3 *14 bits with averaging.*

*4 *14 GHz with sampling.*

*5 *5 GHz if delay lines are used.*

*6 *With SD24 or SD26 sampling head. The analog bandwidth is a function only of the sampling head.*

11000-SERIES PROGRAMMABLE DIGITIZING OSCILLOSCOPES

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11401 500 MHz Oscilloscope 246
11402 1 GHz Oscilloscope 246
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THE NEW STANDARD IN HIGH-PERFORMANCE OSCILLOSCOPES

TEK's NEW 11000-Series Digitizers offer the widest selection of performance features and models.

- NEW 11801 Digital Sampling Oscilloscope with 17.5 ps rise time, eight channels (expandable 136), choice of dual-channel TDR/acquisition or dual-channel acquisition only heads.
- NEW 11802 Digital Sampling Oscilloscope with 17.5 ps rise time, two internal pre-trigger delay lines, four channels, choice of dual-channel TDR/acquisition or dual-channel acquisition only heads.
- NEW 11201 400 MHz Digitizing Oscilloscope with four channels of signal acquisition (eight channels of display) in a high-value monolithic package.
- 11401 500 MHz Digitizing Oscilloscope with up to eight channels of signal acquisition, plug-in modularity.
- 11402 1GHz Digitizing Oscilloscope with up to eight channels of signal acquisition, plug-in modularity.

All these products share these important features and benefits, each designed to offer you high value and performance.

- High Bandwidth—to 20 GHz with 11800-Series Sampling oscilloscopes, to 1 GHz with 11402-Series Digitizing System.
- Full Programmability—provides control from either IEEE-488 (GPIB) or RS-232C interfaces, both of which are standard.
- Intuitive User Interface—convenient screen menus and touch screen eliminate front-panel clutter and confusion.
- Large, High-resolution Display—9-inch diagonal monochrome display for easy viewing.

DIGITAL OSCILLOSCOPE AND WAVEFORM DIGITIZER SELECTION GUIDE

Type	Analog Digitizing BW	Maximum Digitizing Rate	Vertical Resolution	Data Words per Waveform	Maximum Stored Waveforms	Single-shot*1 Storage BW	Equiv*2 Storage BW (rep)
11201	400 MHz	20 MS/s	9 bits	Up to 10,240	100K pts	2 MHz	400 MHz
11401	500 MHz						500 MHz
11402	1 GHz	20 MS/s	10 bits*3	Up to 10,240	100K pts	2 MHz	1 GHz
11801	20 GHz	200 KS/s	8 bits	Up to 5,120	500K pts	N/A	20 GHz
11802	20 GHz*4	200 KS/s	8 bits	Up to 5,120	500K pts	N/A	20 GHz*4

*1 *Single-shot Storage Bandwidth is a measure of the highest frequency sine wave that can be stored in a single sweep and displayed in a visually useful manner. This is dependent on both the maximum digitizing rate as well as the display reconstruction technique used.*

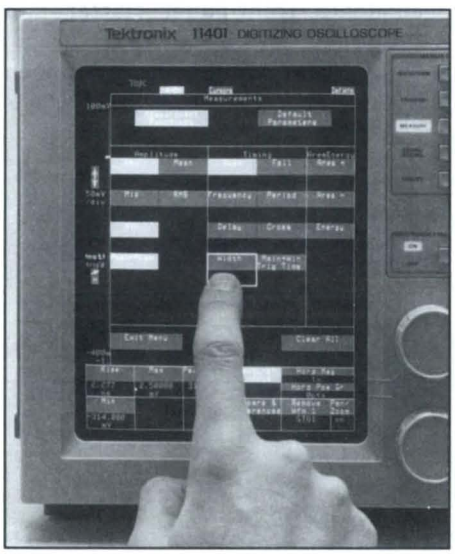
*2 *Equivalent Storage Bandwidth indicates the highest frequency repetitive signal that can be stored and displayed with less than 3 dB loss of signal amplitude using equivalent-time digitizing techniques.*

*3 *14 bits with averaging.*

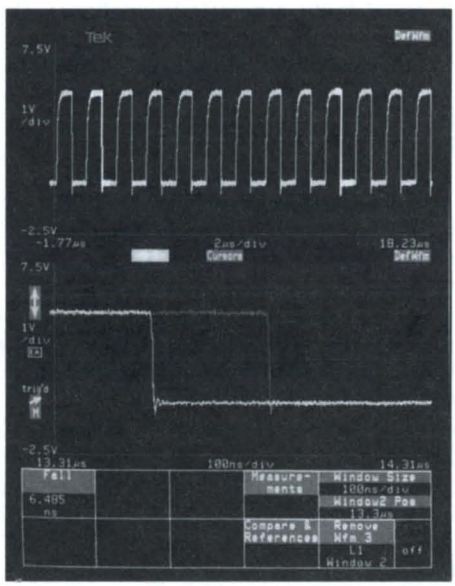
*4 *5 GHz when using internal delay lines.*

11000 SERIES SCOPE/PLUG-IN MAXIMUM BANDWIDTH MATRIX

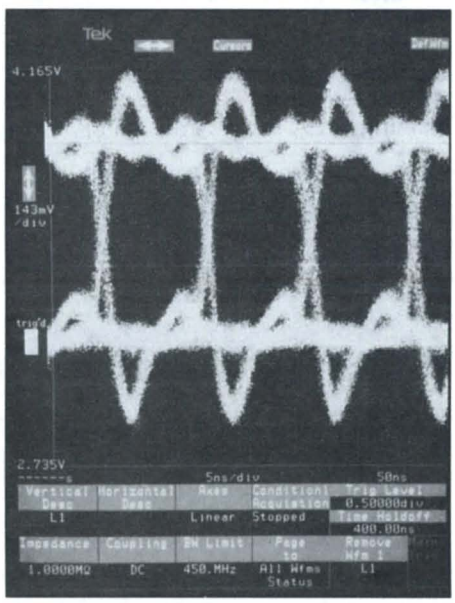
Scope/Plug-in	11A71 Single Channel	11A52 Dual Channel	11A32 Dual Channel	11A34 Four Channel	11A33 Differential
11401	500 MHz	500 MHz	350 MHz	300 MHz	150 MHz
11402	1 GHz	600 MHz	400 MHz	300 MHz	150 MHz



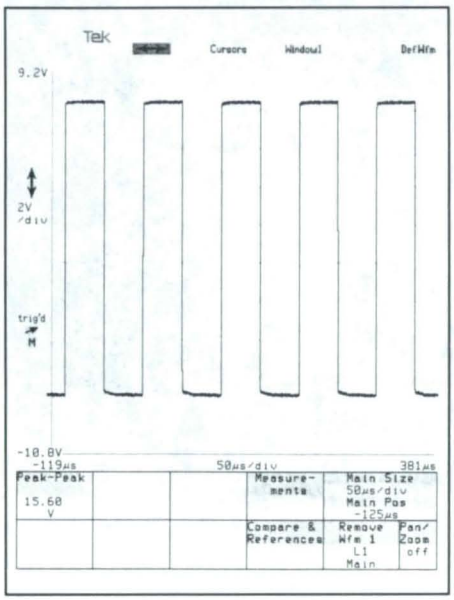
Unparalled Ease of Use with a large touch screen and simple menus. All but a few of the buttons and knobs have been eliminated in favor of a system that only presents selections when they are valid and/or useful.



Vectoring gives your sampled displays almost the look of analog, removes visual aliasing, speeds your analysis.



Eye patterns can be created for checking digital communications systems.



What you see is what you get. 11000-Series Digitizing Oscilloscopes give you high-fidelity representations of your signal. Low-noise and high-resolution displays increase measurement confidence and accuracy, as in this measurement of peak-to-peak amplitude.

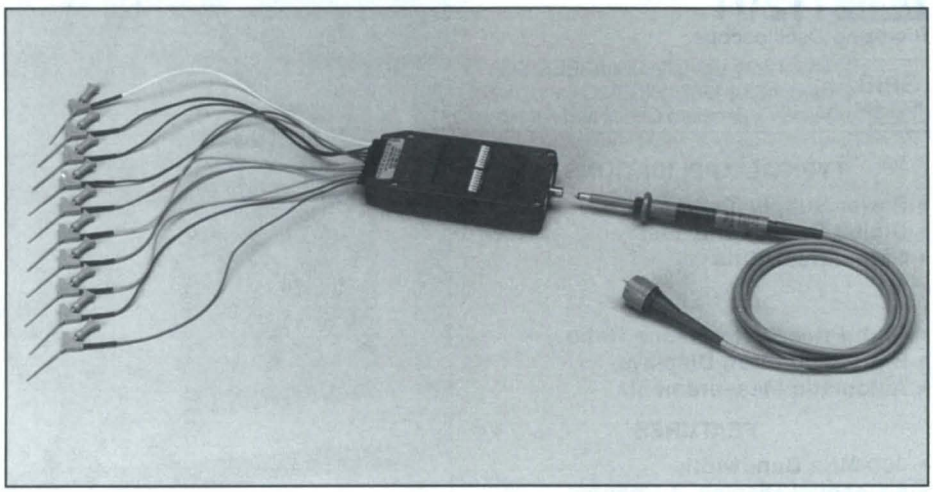
Unmatched Waveform Processing—automatic measurement features with convenient user-defined controls speed measurement tasks.

Multiple Long Record Lengths—up to 10,240 points each with the 11201, 11401 and 11402.

TEKPROBE™ Interface—convenient power and communication link between probe and oscilloscope, plus high-quality signal path.

A complete line of accessories—passive and active probes, optical-electrical converters, carts, and recording devices complement your measurement system.

On-site Warranty-Plus Service—this option provides fast response to keep you productive.



Logic-state triggering with the NEW P6408 Probe gives you 16 channels of word recognition, for use with 11000-Series and other oscilloscopes. The trigger word is manually programmed via 16 miniature DIP switches on the probe pod. Qualifier line allows synchronous triggering.

NEW 11201

Digitizing Oscilloscope

GPIB IEEE-488

The 11201 complies with IEEE Standard 488.1-1987, RS-232C, and with Tektronix *Standard Codes and Formats*.

TYPICAL APPLICATIONS

- **Power Supply Testing**
- **Digital Design and Test**
- **Communications**

BENEFITS

- **High Price/Performance Ratio**
- **High-Resolution Displays**
- **Automatic Measurements**

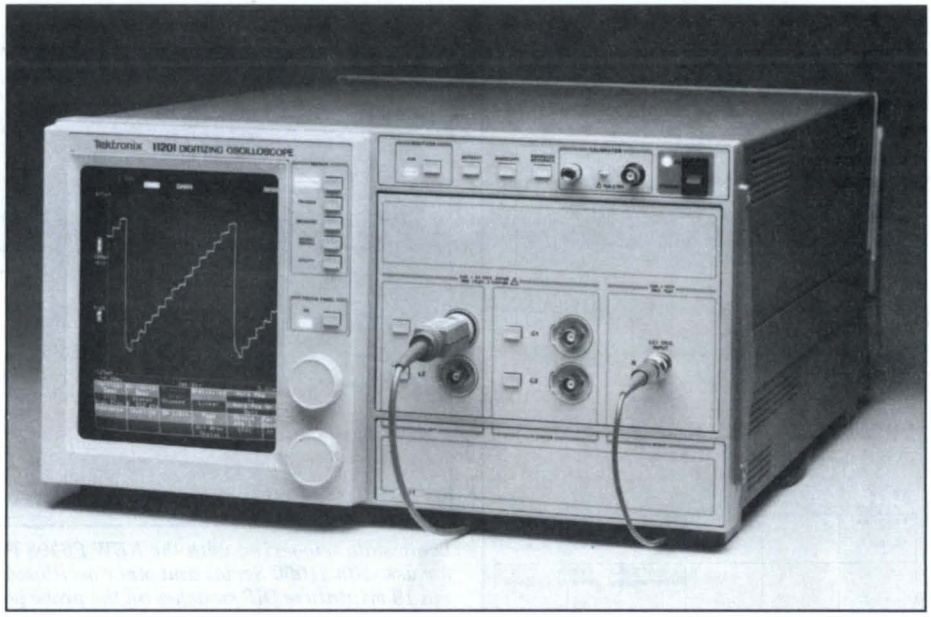
FEATURES

- **400-MHz Bandwidth**
- **8 Channel Display, 4 Channel Acquisition**
- **Switchable Impedance 50Ω, 1 MΩ**
- **10-ps Horizontal Resolution, 9-bit Vertical Resolution**
- **Waveform Processing and Automatic Pulse parameters**
- **Multiple 10,240-Point Waveform Records**
- **Simplified Feature Access**
- **External Trigger**
- **Fully Programmable via GPIB and RS-232C**

With all the waveform processing power of the best digital storage oscilloscope, the 11201 offers a new level of value in high-performance measurement. Its monolithic design includes state-of-the-art features that make it extremely easy to use in your lab or system.

Choose Your Computer Interface

The 11201 has both IEEE-488 and RS-232C interfaces as standard features for data transfer and instrument control. The RS-232C port lets you control the instrument with a PC, upload or download waveforms from a workstation or mainframe, or run diagnostics over a modem. GPIB and RS-232C menus let you match interface parameters with a controller, modem, or host. If speed is a consideration, the parallel interface provided by the IEEE-488 port should be used. A DMA option can be added to make GPIB data transfers even faster. Whichever bus is chosen, the 11201 responds to a logical set of Tektronix *Standard Codes and Formats* commands that make it easy to write your test procedures.



Accurate, Automatic Measurements

The 11201 performs waveform-processing fucntions, pulse-parameter analysis, cursor functions, and trigger-to-trigger measurements that cover a full range of measurement needs. A special annotation mode shows where measurements are being made on the trace so users can feel confident that they are on target. Dot cursors can be split between two waveforms to make propagation-delay measurements or to compare voltages. Measurement zones can be set to limit the automatic measurement to a portion of a displayed trace. Users can set proximal, distal, and mesial levels to customize timing measurements. Up to six measurement results can be displayed and continuously updated as the data changes. This lets users make adjustments and see the results quicker than ever before. A direct hard-copy output includes time and date of the measurement for archiving.

CHARACTERISTICS

VERTICAL SYSTEM

Equivalent-Time Bandwidth—
≥10 mV: 400 MHz
5 to 9.95 mV: 350 MHz
2 to 4.98 mV: 250 MHz
1 to 1.99 mV: 200 MHz.

Vertical Resolution—9 bits (512 levels).

Two built-in four-pole bandwidth-limit filters (100 and 20 MHz) may be activated to reduce unwanted high-frequency noise at 24 dB/octave for each channel.

Both coarse and fine deflection-factor steps are fully calibrated. At 1 mV/div, the high-resolution calibrated dc offset has a setability of 25 μV and a range of ±1 V (equivalent to 16 bits), giving an effective screen height of 2000 div.

Number of Channels—Four.

Calibrated Deflection Factors—Coarse steps: 1 mV to 10 V/div in 1-2-5 sequence. Fine steps: Between coarse steps in 1% increments of next more-sensitive coarse step.

Accuracy—
ΔVolts dc accuracy: ±(1.4% +0.012 div).
DC Balance, 1 to 99.5 mV/div: ±(1.0 mV+0.10 div).
Offset Accuracy, 1 to 99.5 mV/div (±1 V range): ±(0.4%+0.5 mV).
For absolute dc accuracy of single-point measurements using offset, add the Offset Accuracy and DC Balance terms.

Offset Range—
1 to 99.5 mV/div: ±1 V; Resolution: 25 μV.
100 mV to 0.995 V/div: ±10 V; Resolution: 250 μV.
1 to 10 V/div: ±100 V; Resolution: 2.5 mV.

Typical Noise (RMS)—
1 to 1.99 mV/div: 0.22 div.
2 to 4.98 mV/div: 0.13 div.
4 to 9.95 mV/div: 0.07 div.
10 mV to 10 V/div: 0.06 div.

Input Impedance—Switchable 1 MΩ in parallel with 15 pF, or 50 Ω ±2.0%.

Input Coupling Modes—AC, DC, and off.

Maximum Input Voltage—1 MΩ: 500 V (dc + peak ac). 50 Ω: Input automatically disconnects when the input signal exceeds safe limits. Manual reset.

HORIZONTAL SYSTEM

Time Bases—Two identical built-in time bases. Record Duration—5.12 ns to 1024 s in 1-2-5 sequence.

Time Base Accuracy—100 ps +0.002% of measurement interval.

Record Length—512 points to 10,240 points.

Sampling Rate—20 MS/s maximum.

Main Record Positioning—Position the main record with respect to the trigger point of the main record. Pretrigger: 1 record duration. Post trigger: 1 record duration. Resolution: 1 main record point.

Windows—In addition to the main record, either one or two window records may be acquired and displayed. The window records may be of a different length (duration) and may have a smaller time/div than the main record.

If two window records are used, they have the same duration and time/div settings and can be positioned independently.

Window Record Positioning—The window records are positioned relative to a window trigger point, which may be positioned relative to the main record's trigger point delayed by either time or events.

Main → Window Time Measurement—The time between the MAIN record trigger and the WINDOW trigger can be measured precisely, even if each trigger occurs only once. Repetitive events allow this measurement to be averaged for better resolution and accuracy. Single Trigger Precision: 200 ps. Repetitive Precision: 10 ps, after 100 averages. Accuracy: 250 ps +0.002% of record duration.

TRIGGERING SYSTEM

Range—±Full screen.

Bandwidth—400 MHz maximum.

Coupling and Sensitivity—
Internal DC Coupled: 0.75 div from dc to 50 MHz, increasing to 2 div at 400 MHz.
Noise Reject Coupled: 1.8 div or less from dc to 50 MHz, increasing to 4 div at 400 MHz.
AC Coupled: 0.75 div from 60 Hz to 50 MHz, increasing to 2 div at 400 MHz. Attenuates signals below 50 Hz.

HF Reject Coupled: 1.0 div from dc to 30 kHz.

LF Reject Coupled: 1.0 div from 80 kHz to 50 MHz, increasing to 2 div at 400 MHz.

External Coupling and Sensitivity—DC Coupled: 750 mV. Noise Reject Coupled: 1.8 V from DC to 50 MHz increasing to 40 V at 400 MHz. AC Coupled: 1 V from 60 Hz to 50 MHz, increasing to 40 V at 400 MHz; attenuates signals below 60 Hz. HF Reject Coupled: 1 V from DC to 30 kHz. LF Reject Coupled: 2 V from 80 kHz. To 50 MHz: Triggering signal requirements increase to 2 V at 400 MHz with DC, AC, and LF Reject coupling. For Noise Reject Coupling above 50 MHz, triggering signal requirements increase to 4 V at 400 MHz.

Maximum Input—150 V (dc + peak ac).

Impedance—1 MΩ paralleled by 15 pF.

Holdoff Range—500 ns to 10 s.

MEASUREMENT SYSTEM

Waveform-Processing Functions

Measurement Set—
Amplitude Measurements
Timing Measurements
Area and Energy
Cursors
Horizontal and Vertical Bars
Measurement-zone Delimiters

CRT AND DISPLAY FEATURES

Standard CRT—9 in. diagonal, monochrome, magnetic deflection. Vertical raster-scan orientation.

Standard Phosphor—GH (P31).

Video Resolution—552 horizontal by 704 vertical displayed pixels.

INPUTS/OUTPUTS

Printers and Plotters—Centronics Interface supports Epson or dot matrix printers.

POWER REQUIREMENTS

Line-Voltage Ranges—90 to 132 V RMS. 180 to 250 V RMS.

Line Frequency—48 to 440 Hz.

Maximum Power Consumption—320 W.

ENVIRONMENTAL AND SAFETY

Temperature—Operating: 0 to +50 °C. Nonoperating: −40 to +75 °C.

Humidity—Operating and Nonoperating: Up to 95% relative humidity, up to +50 °C.

Altitude, Vibration, Shock, Bench Handling—Meets MIL-T-28800C, Type III, Class 5.

Electromagnetic Compatibility—Meets MIL-T-28800C; MIL-STD-461B; FCC Part 15, Subpart J, Class B; VDE 0871/6.78 Class B; CE-01 Part 4 with exceptions; CE-03 Part 4, Curve 1; CE-03 Part 4, Curve 4, Navy, NB, BB (with exceptions); CS-01 Part 7; CS-02 Part 4 (with exceptions); CS-06 Part 5; RE-01 Part 4 (with exceptions); RE-02 Part 4; RS-01 Part 4; RS-03 Part 7 (limited to 1 GHz).

Safety—Listed UL 1244; CSA Bulletin 556B, September 1973; Tektronix self-certification to comply with IEC 348 recommendations.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	599	23.6	550	21.6
Weights ≈	**kg**	**lb**	**kg**	**lb**
Net	19	41.6	22.0	48.0
Shipping	28.0	62.0	31.4	68.0

ORDERING INFORMATION

11201—400-MHz Programmable Digitizing Oscilloscope.*1
Includes: Introduction manual (070-7274-00); Service manual (070-7279-00); User Reference (070-7275-00); Programmer Reference (070-7276-00); Programmer Quick Reference (070-7277-00); Incoming Inspection Procedure (070-7278-00); Power cord (161-0066-00).

OPTIONS

Option 23—Includes four P6134 probes.*1

Option 1R—Rackmount.*1
Includes: Hardware, tooling, and instructions for converting bench model to rackmount configuration.

Option 2D—Memory Expansion. Expands total waveform memory.*1

Option 4D—DMA Controller. Increases data transfer speed over GPIB.*1

RECOMMENDED SOFTWARE

For more information on utility and application software, see the Test and Measurement Software Section.

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.

Option A2—UK 240 V, 50 Hz.

Option A3—Australian 240 V, 50 Hz.

Option A4—North American 250 V, 60 Hz.

Option A5—Switzerland 240 V, 50 Hz.

WARRANTY-PLUS SERVICE PLANS

See Customer Services and Information section.

Q0—On-Site Product Installation and Set-Up.*1

Q1—One year on-site service.*1

OPTIONAL ACCESSORIES

Power-Supply Extended Diagnostics—Order 067-1264-00. **$320**

Camera—C-4 Option 10. **$450**

Cables—
(GPIB) 2 m. Order 012-0991-00. **$160**
(RS-232C) 10 ft. Order 012-0911-00. **$100**
(Centronics) 10 ft for hard copy output. Order 012-0555-00. **$125**

Recommended Probes—See recommended probes in plug-in section, page 277.

Recommended Cart—K217. **$510**

SOFTWARE SUPPORT

11201-Series/IBM PC Utility—
Order S47P109*1

11201-Series Asyst Driver—
Order S47P304*1

*1 *Contact your local sales office.*

TECHNICAL ASSISTANCE SERVICES

When you need technical assistance to supplement your own resources, Tektronix can arrange the services of an application engineer skilled in meeting your needs. For more information, see the Total Solution/New Products section, page 35.

TRAINING

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. See Customer Training section for information or call 1-800-835-9433 ext. 430. In Oregon, call 1-629-1017 (collect).

11400 Series

Digitizing Oscilloscopes

GPIB IEEE-488

The 11400 Series comply with IEEE Standard 488.1-1987, RS-232C, and with Tektronix *Standard Codes and Formats.*

TYPICAL APPLICATIONS

- **Waveform Characterization**
- **Prototype Troubleshooting and Debugging**
- **Measurement Against a Standard**

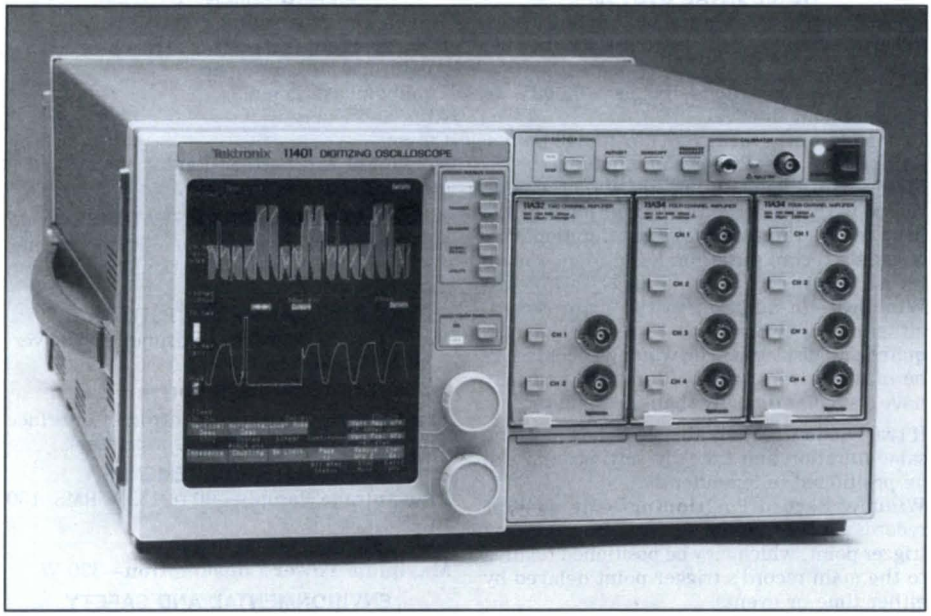
BENEFITS

- **Plug-in Modularity**
- **Look and Feel of Analog Scopes**
- **Uncluttered Easy-to-Use Controls**

FEATURES

- **1-GHz and 500-MHz Bandwidth**
- **Eight Channels of Display and Acquisition**
- **Waveform Processing and Automatic Pulse Parameters**
- **Multiple 10,240-Point Waveform Records**
- **Accepts Differential, High-Impedance, and 50 Ω Input Amplifiers**
- **Fully Programmable via GPIB and RS-232C**

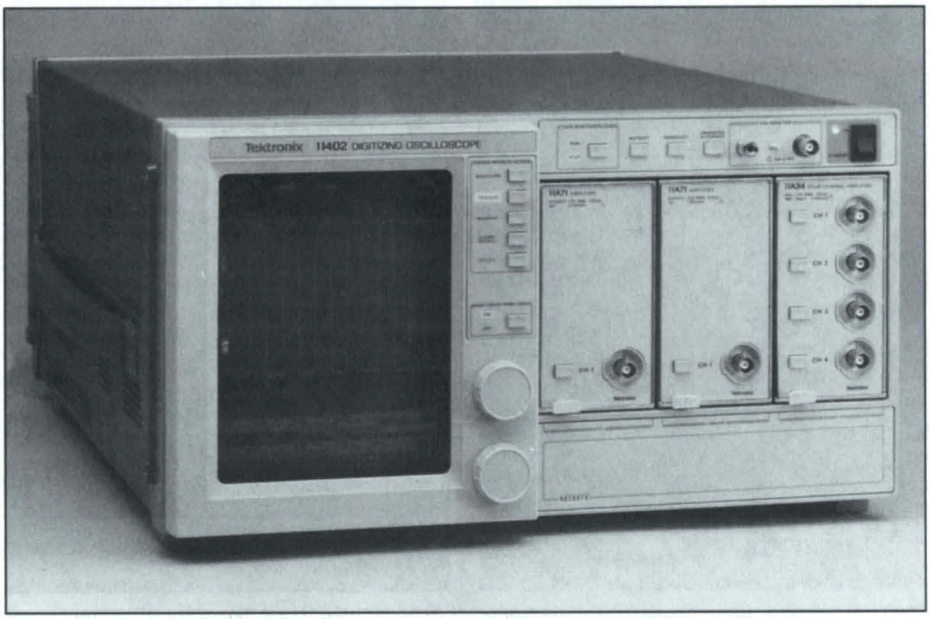
These versatile scopes, with their array of supporting plug-ins and probes, solve measurement problems equally well on a designer's bench or in a programmable test system. Digital designers will benefit from flexible triggering features and an eight-channel display. Analog and power-supply designers can apply extensive waveform processing to signals acquired through high-performance differential and single-ended amplifiers. 11000-Series digitizing scopes can follow your designs into production. Full programmability via either IEEE-488 or RS-232C and features like a DMA controller for fast waveform transfers make these scopes a perfect fit for systems. 11000-Series digitizing oscilloscopes set new standards in performance.



The 11401/11402 are ideal for digitizing and accurately measuring repetitive waveforms. 10–14 bit vertical resolution, 20 MS/s A/D conversion system provides a cost-effective solution to a wide range of measurement problems.

Live Display of Up to Eight Traces

The 11401/11402 each support three vertical-amplifier plug-ins. This means you can acquire up to eight channels of data at 300 MHz, up to three channels of data at 1 GHz. You can, of course, mix and match the plug-ins to design the system that works best for you. The update rate is so fast that the 11401 and 11402 have the look and feel of analog scopes.



The 11402 Digitizing Oscilloscope with 1-GHz System bandwidth.

High Vertical and Horizontal Resolution

The 11401 and 11402 uniquely combine wide bandwidth with 10-ps horizontal resolution and 10-bit vertical resolution (vertical resolution can be increased to 14 bits when signals are averaged). Other vendors have made a tradeoff: bandwidth for vertical resolution or vertical resolution for bandwidth. The 11401/11402 give you both for making demanding voltage and timing measurements in one box. In addition, the 11401/11402's trigger-to-trigger measurement feature delivers 200-ps precision on single-shot time A→B measurements and can even provide 10-ps precision with averaging. Trigger-to-trigger measurements of this nature are only available on the 11401/11402 and a few expensive, standalone counter/timers. Also, window records can be used to increase horizontal resolution on specific segments of main records to provide a clear picture of signal details.

Multiple Long Record Lengths

The 11401/11402 can acquire multiple records of up to 10,240 points each. No other scope can capture as much data at once on repetitive waveforms. The mainframes can contain up to 102,400 points of waveform memory with Option 2D. Long records and large storage capacity combine to let users gather data over relatively long periods of time with high resolution and improve measurement accuracy. One doesn't need a computer to log waveform data. Waveforms can be stored in the scope for later analysis.

Versatility for a Wide Range of Applications

Five plug-ins and new probes bring outstanding versatility to the 11401/11402. The measurement-system and waveform-processing functions lead to quick solutions to a wide variety of voltage, time, area, and energy problems. These scopes can process and measure signals from high-bandwidth 50-ohm amplifiers, high-impedance amplifiers, and differential amplifiers. 1-mV sensitivity and 500-V maximum input voltage let users capture small signals from transducers or monitor ac power lines. Fast overdrive recovery and up to 2000 divisions of dynamic range give the 11401/11402 the power to look at even the smallest detail on difficult-to-capture waveforms.

Unparalleled Ease of Use

The 11401 and 11402 use simple parallel menus and touch screen to give easy access to their measurement and display features. All but a few of the buttons and knobs have been eliminated in favor of a system that only presents selections when they are valid and/or useful. An autoset function sets up the scope for you based upon the signal characteristics of the selected trace. This function can be activated from the probe tip, allowing for hands-off operation of the scope. Autoset frees the operator to concentrate on the measurement problem and the probe connection. The most commonly used functions are no deeper than a second menu level. Icons let you assign the knobs to waveform size and position no matter what operating mode you are in.

Pop-up menus present choices and fold down when those selections are made. One-button hard-copy generation is made possible by software drivers compatible with low-cost Epson dot-matrix printers. Overall, the operation of the 11401/11402 is intuitive. The instrument can be used easily even if it is not used every day. Acquisition, measurement, and documentation is as simple as six touches: Autoset, measure, measurements, rise, exit, hard copy. It doesn't get any simpler.

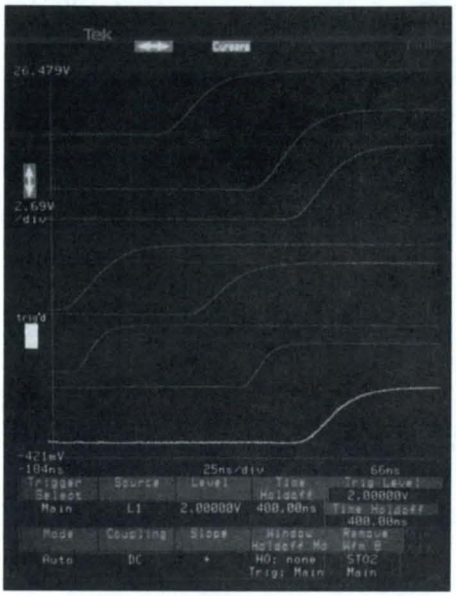
Plug-In Modularity

The 11401 and 11402 accept five different vertical amplifiers. Each scope will accept three of these amplifiers in its plug-in compartments. You can configure a scope to meet your particular needs, for example:

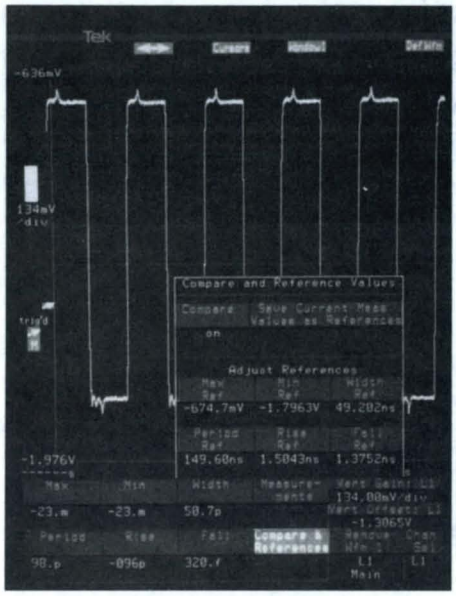
- **Timing Measurements on High-Speed Logic**
  Use three 11A71s in the 11402 for three 1-GHz bandwidth channels.
- **Characterization of Waveforms in a Lab**
  Select an 11A52 for two 600 MHz bandwidth 50-ohm channels, an 11A33 for high-bandwidth differential measurements, and an 11A34 for four high-impedance channels.
- **Prototype Troubleshooting and Debugging**
  Use two four-channel amplifiers and a two-channel high-bandwidth amplifier. This configuration gives you eight channels of acquisition for timing analysis and two high-bandwidth channels for exacting pulse response measurements.
- **Power-Supply Evaluation**
  Use three differential amplifiers to determine efficiency and stability and to measure noise and ripple.
- **DAC and Operational-Amplifier Settling Time**
  Fast overdrive recovery and up to 14 bits of resolution make possible settling-time measurements to within a fraction of a percent.

The Most Accurate Instruments of Their Kind

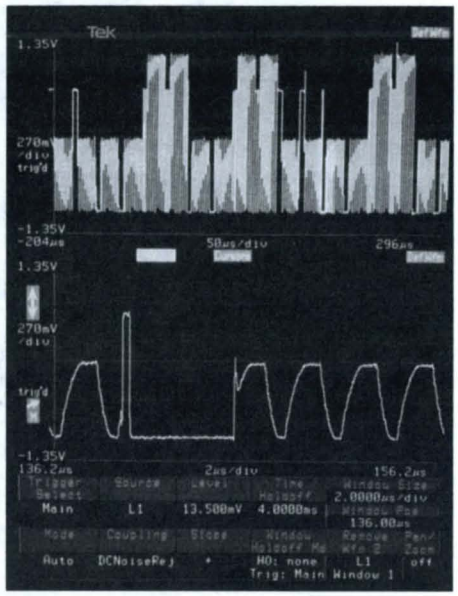
The 11401 and 11402 are the most accurate high-bandwidth scopes on the market. They combine the timing accuracy inherent in digital time bases with 1% vertical accuracy. The Enhanced Accuracy feature ensures that the highest accuracy is maintained. The scope prompts the user to start the routines whenever temperature or configuration changes warrant it. You can even assign the 11401/11402 to start Enhanced Accuracy routines automatically. Timebase accuracy is 100 ps +0.002% of the measured time interval.



The 11401 and 11402 can display up to eight traces from a variety of sources. Display eight channels of live waveforms for timing analysis on digital systems, or display combinations of live and stored waveforms.



Multiple waveform-parameter measurements can be performed and are updated continuously. A compare-and-reference measurement mode allows measurement results to be compared to a standard, and the difference of two results to be displayed.



Two built-in time bases provide the functionality of delaying and delayed sweeps in analog scopes. The main time base defines the overall acquisition interval and the window time base allows high-resolution acquisition of small portions of complex waveforms.

The 11401 and 11402's accurate, automatic measurements can replace dedicated counter/timers and ac voltmeters. Devices and subassemblies can be tested to tighter tolerances, improving end product performance and quality.

On-Site Serviceability

These scopes are card modular; they have extensive self-test and diagnostic routines and reliability built-in. On-site *Warranty-Plus* service options help you keep the instruments up and running when down time might otherwise halt your production line. Tektronix service technicians can be at your facility repairing these products within eight working hours if you are within 75 miles of designated U.S. service centers.

Probe Interface

We've set a new standard for probe interfacing. Signal and probe-power connections are all made at the amplifier input, eliminating extra probe-power lines. We can support as many active probes as you have channels. A smart serial interface between the probe and the scope lets you stop worrying about the proper termination impedance; it is set automatically. You can autoset the scope or sequence through a series of front-panel set-ups all from the probe-ID button. This leaves your hands free to probe your circuit. A full complement of active and passive probes with this new interface is ready to assist in the solution to your measurement problems.

Choose Your Computer Interface

The 11401 and 11402 have both IEEE-488 and RS-232C interfaces as standard features for data transfer and instrument control. The RS-232C port lets you control the instrument with a PC, upload or download waveforms from a workstation or mainframe, or run diagnostics over a modem. GPIB and RS-232C menus let you match interface parameters with a controller, modem, or host. If speed is a consideration, the parallel interface provided by the IEEE-488 port should be used. A DMA option can be added to speed up GPIB data transfers even further. Whichever bus is chosen, the instruments respond to a logical set of Tektronix *Standard Codes and Formats* commands that make it easy to write your test procedures.

Accurate, Automatic Measurements

The only reason oscilloscopes exist is for making measurements. The 11401 and 11402 perform waveform-processing functions, pulse-parameter analysis, cursor functions, and trigger-to-trigger measurements that combine to cover a full range of measurement needs. A special annotation mode shows where measurements are being made on the trace so users can feel confident that they are on target. Dot cursors can be split between two waveforms to make propagation-delay measurements or to compare voltages. Measurement zones can be set to limit the automatic measurement to a portion of a displayed trace. Users can set proximal, distal, and mesial levels to customize timing measurements. Up to six measurement results can be displayed at once and continuously updated as the data changes. This lets users make adjustments and see the results quicker than ever before. A direct hard-copy output is provided that includes time and date of the measurement for archiving.

A Measurable Advance in Oscilloscope Technology

Higher bandwidths, better resolution, more accuracy, more versatility, hardware and software modular, easier to use and service, the 11400 Series sets new standards for digitizing oscilloscopes.

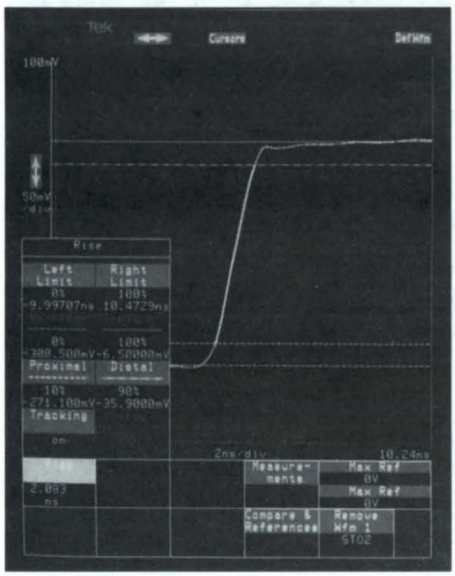
CHARACTERISTICS

VERTICAL SYSTEM

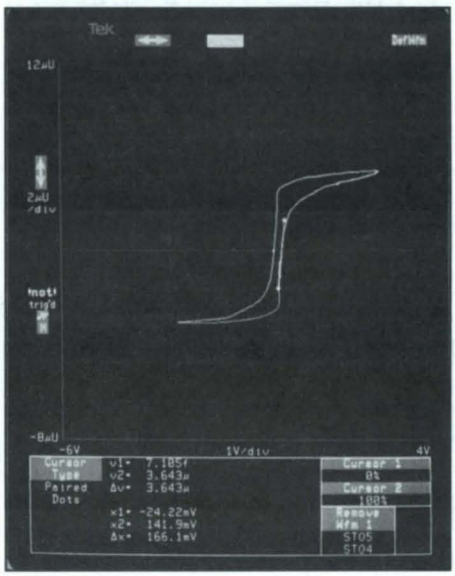
Accuracy With Enhanced Accuracy—Depends on plug-in unit.

Equivalent-Time Bandwidth—Depends on plug-in used. (See Maximum Bandwidth Matrix in the 11000-Series Reference section.)

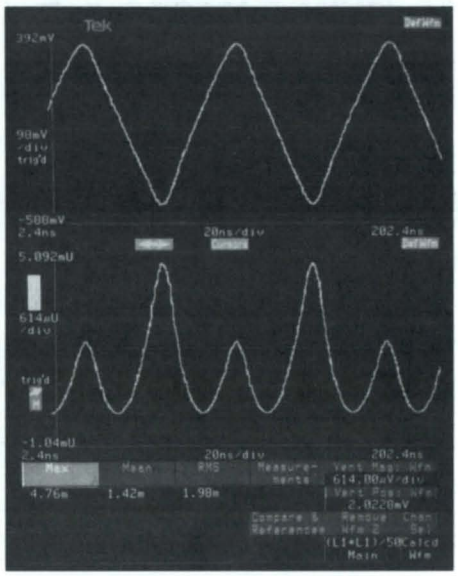
Vertical Resolution—10 bits (1024 levels.) Resolution can be increased to 14 bits (16384 levels) using signal averaging.



High bandwidth allows capture and measurement of fast rise times. Measurements can be customized and annotated to clearly show where and how the measurement is being made.



Advanced waveform processing allows live measurements to replace simulation for many applications Shown is an example of a transformer core-loss measurement at the component's operating conditions.



Powerful waveform-processing functions let users defne traces such as the power waveform shown above. The top waveform is a voltage waveform and the bottom waveform is a power waveform created by squaring the voltage waveform and dividing it by a load resistance.

HORIZONTAL SYSTEM

Time Bases—Two identical built-in time bases. Record Duration—5.12 ns to 1024 s in 1-2-5 sequence.

Time-Base Accuracy—100 ps +0.002% of measurement interval.

Record Length—512 points to 10,240 points.

Sampling Rate—20 MS/s maximum.

Main Record Positioning—Position of the main record with respect to the trigger point of the main record. Pretrigger: 1 record duration. Posttrigger: 1 record duration. Resolution: 1 main record point.

Windows—In addition to the main record, either one or two window records may be acquired and displayed. The window records may be of a different length (duration) and may have a smaller time/div than the main record.

If two window records are used, they have the same duration and time/div settings and can be positioned independently.

Window Record Positioning—The window records are positioned relative to a window trigger point, which may be positioned relative to the main record's trigger point delayed by either time or events.

Main→Window Time Measurement—The time between the MAIN record trigger and the WINDOW trigger can be measured precisely, even if each trigger occurs only once. Repetitive events allow this measurement to be averaged for better resolution and accuracy. Single Trigger Precision: 200 ps. Repetitive Precision: 10 ps, after 100 averages. Accuracy: 250 ps +0.002% of record duration.

TRIGGERING SYSTEM

Range—±Full screen.

Bandwidth—500 MHz maximum.

Coupling and Sensitivity—

DC Coupled: 0.35 div from dc to 50 MHz, increasing to 1 div at 500 MHz.

Noise Reject Coupled: 1.2 div or less from dc to 50 MHz, increasing to 3 div at 500 MHz.

AC Coupled: 0.35 div from 60 Hz to 50 MHz increasing to 1 div at 500 MHz. Attenuates signals below 50 Hz.

HF Reject Coupled: 0.5 div from dc to 30 kHz.

LF Reject Coupled: 0.5 div from 80 kHz to 50 MHz, increasing to 1 div at 500 MHz.

Holdoff Range—500 ns to 10 s.

MEASUREMENT SYSTEM

Waveform-Processing Functions—Waveform Functions: Differentiate, integrate, interpolate, smooth, average, and envelope. Arithmetic Operators: Plus, minus, multiply, divide, square root, log, logn, absolute value, signum, exp.

Measurement Set—Amplitude Measurements: Min, max, mid mean, peak-peak, RMS gain. Timing Measurements: Rise, fall, width, delay 1, main→window, period, propagation delay, and frequency. Area and Energy: Area +, Area −, energy. Cursors: Single or dual dots, split or paired mode, horizontal and vertical bars, measurement-zone delimiters.

CRT AND DISPLAY FEATURES

Standard CRT—9 in. diagonal, monochrome, magnetic deflection. Vertical raster-scan orientation.

Standard Phosphor—GH (P31).

Video Resolution—552 horizontal by 704 vertical displayed pixels.

POWER REQUIREMENTS

Line-Voltage Ranges—90 to 132 V RMS. 180 to 250 V RMS.

Line Frequency—48 to 440 Hz.

Maximum Power Consumption—320 W.

ENVIRONMENTAL AND SAFETY

Temperature—Operating: 0 to +50°C. Nonoperating: −40 to +75°C.

Humidity—Operating and Nonoperating: Up to 95% relative humidity, up to +50°C.

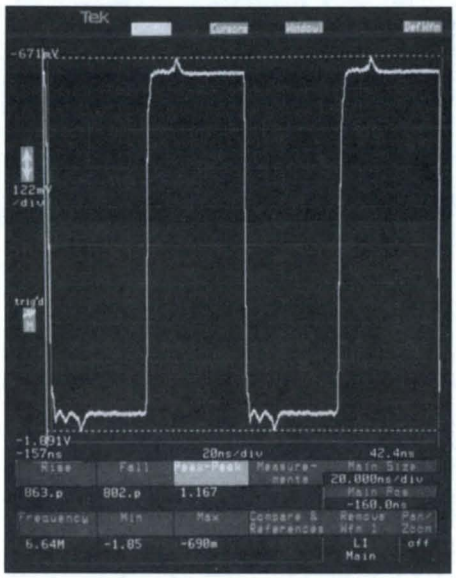
Altitude, Vibration, Shock, Bench Handling—Meets MIL-T-28800C, Type III, Class 5.

Electromagnetic Compatibility—Meets MIL-T-28800C; MIL-STD-461B; FCC Part 15, Subpart J, Class B; VDE 0871/6.78 Class B; CE-01 Part 4, with exceptions; CE-03 Part 4, Curve 1; CE-03 Part 4, Curve 4, Navy, NB, BB (with exceptions); CS-01 Part 7; CS-02 Part 4 (with exceptions); CS-06 Part 5; RE-01 Part 4 (with exceptions); RE-02 Part 4; RS-01 Part 4; RS-03 Part 7 (limited to 1 GHz).

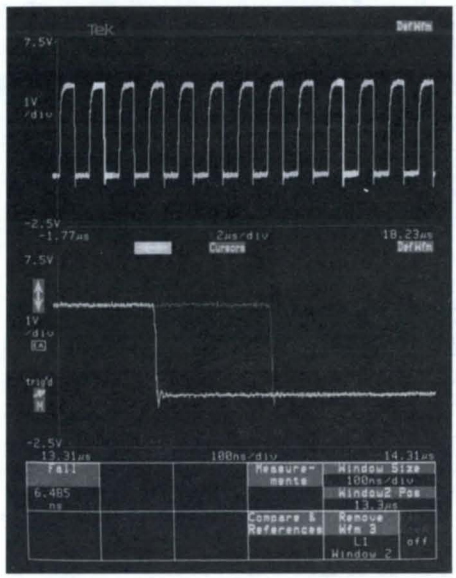
Safety—Listed UL 1244; CSA Bulletin 556B, September 1973; Tektronix self-certification to comply with IEC 348 recommendations.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	599	23.6	550	21.6
Weights ≈	**kg**	**lb**	**kg**	**lb**
Net	19	41.6	22.0	48.0
Shipping	28.0	62.0	31.4	68.0



The 11401 and 11402 offer a unique combination of accurate timing and accurate amplitude measurements in one instrument.



Single or dual 10×10-division axes may be brought up for waveform display. Each axis represents a full 10-bit digitizing window.

Options for rack conversion, rear-to-front signal routing, and DMA transfer of waveform data and measurement results make the 11401/11402 ideal for systems applications.

ORDERING INFORMATION

11401 500 MHz Programmable Digitizing Oscilloscope **$13,000**
Includes: Operator Guide (070-6103-01); Operator Reference (070-5791-01); power cord (161-0066-00); incoming inspection procedure (070-6694-00).

11402 1-GHz Programmable Digitizing Oscilloscope **$15,500**
Includes: Same as 11401.

OPTIONS

Option 1C—Cable Feedthroughs. Adds eight rear-to-front feedthroughs. **+$200**

Option 1R—Rackmount. **+$250**
Includes: Hardware, tooling, and instructions for converting bench model to rackmount configuration.

Option 2D—Memory Expansion. Expands total waveform memory to 102,400 points for storage of waveform records. **+$600**

Option 4D—DMA Controller. Increases data transfer speed over GPIB. **+$300**

Option 25—PEP301 Instruments/System Controller and S47P102 Utilities software. **+$7,870**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 250 V, 60 Hz.
Option A5—Switzerland 240 V, 50 Hz.

WARRANTY-PLUS SERVICE PLANS

See Customer Information section.

S0—On-Site Product Installation and Set-Up. **+$475**

S1—(11401) 1 Year On-Site Service. **+$390**

S1—(11402) 1 Year On-Site Service. **+$465**

OPTIONAL ACCESSORIES

Power-Supply Extended Diagnostics—Order 067-1264-00 **$320**

Service Manual—Order 070-6779-02*[1] **$450**

Camera—C-4 Option 10 **$450**

Cables—
(GPIB) 2 m. Order 012-0991-00 **$160**
(RS-232C) 10 ft. Order 012-0911-00 **$100**
(Centronics) 10 ft for hard copy output. Order 012-0555-00 **$125**

Blank Panel—For empty compartments. Order 016-0829-00 **$95**

Extender Board—Order 067-1267-00. **$650**

Recommended Probes—See recommended probes in the Oscilloscope plug-in section, page 277.

Recommended Cart—K217S. See Instrument/Cart Compatibility chart in the Cart section. **$625**

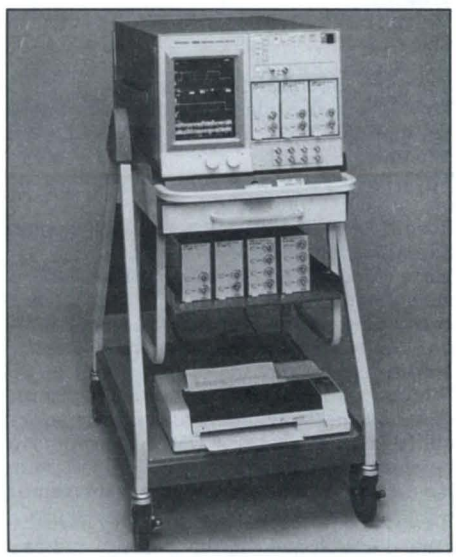
*[1] *To order, contact your local Tektronix Sales Office.*

SOFTWARE SUPPORT

For more information on utility and application software, see the Test and Measurement Software section.

11400-Series/IBM PC Utility—Waveform/measurement data logging, graphics, and statistical analysis. GPIB and RS-232C support. Order S47P102. **$450**

11400-Series Asyst Driver—Menu-driven package for scope control, waveform acquisition, data logging, and FFT analysis. Order S47P303 **$395**



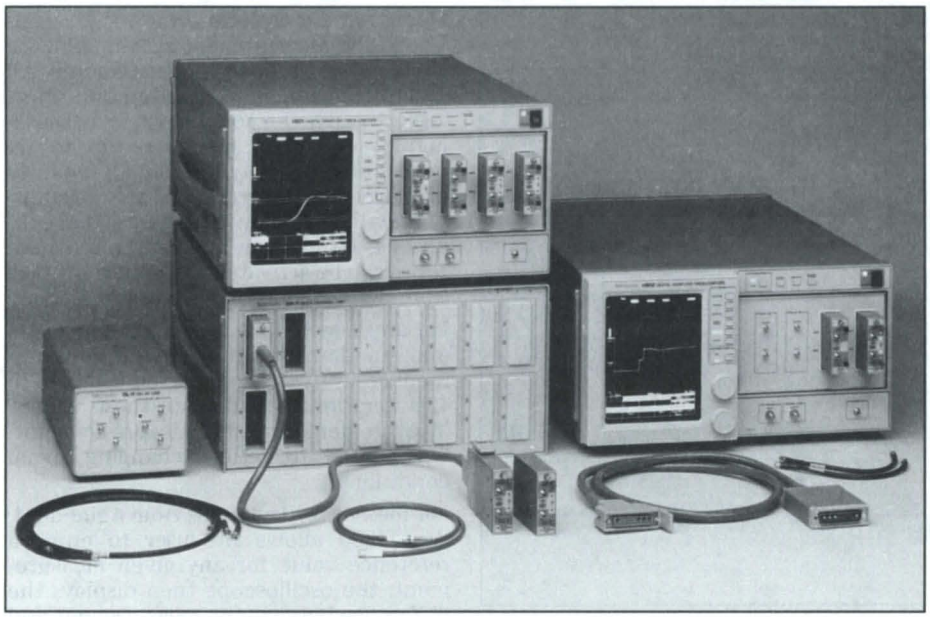
217S Instrument Cart supports 11000 Series oscilloscope plus any other rack-width instrument.

TECHNICAL ASSISTANCE SERVICES

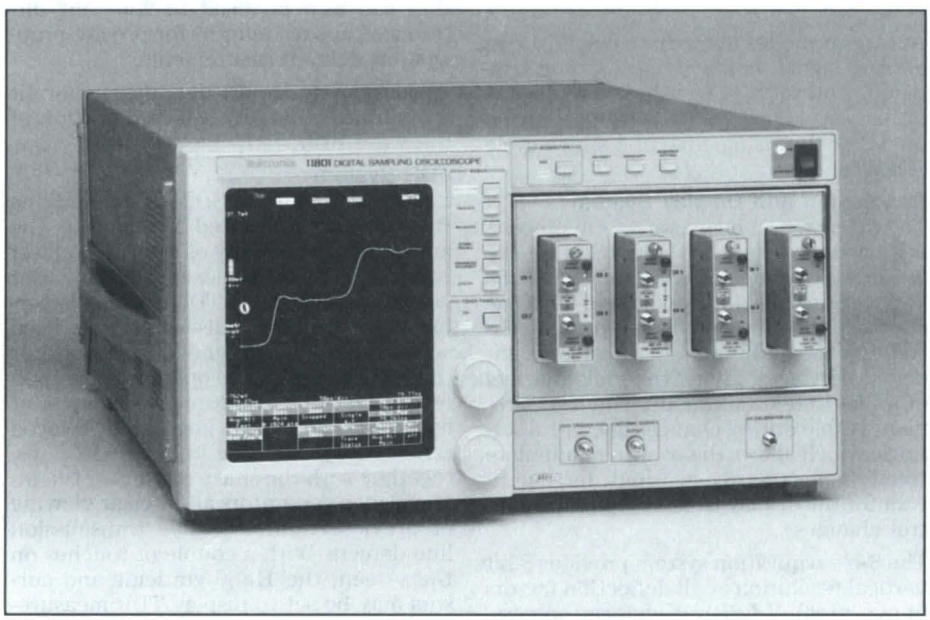
When you need technical assistance to supplement your own resources, Tektronix can arrange the services of an application engineer skilled in meeting your needs. For more information, see the Total Solution/New Product Section, page 35.

TRAINING

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. See Customer Training section for information or call 1-800-835-9433 ext. 430. In Oregon, call 1-629-1017 (collect).



11800 Product Family.



11801 Digital Sampling Oscilloscope is capable of 17.5-ps rise time with an SD24 or SD26 installed.

NEW 11800 Series

Digital Sampling Oscilloscopes

GPIB IEEE-488

The 11800 Series complies with IEEE Standard 488.1-1987, RS-232C, and with Tektronix *Standard Codes and Formats.*

TYPICAL APPLICATIONS

- **Semiconductor Device Testing**
- **Multi-Channel Time Domain Transmission (TDT)**
- **Multi-Channel Time Domain Reflectometry (TDR)**
- **Multi-Channel Differential TDR**

BENEFITS

- **High-Resolution Displays**
- **Automatic Measurements**
- **Modularity**

FEATURES

- **17.5-Picosecond Rise Time**
- **Multi-Channel and Differential TDR**
- **Eight Channels, Expandable to 136 (11801/with SM11 Multi-Channel Unit)**
- **Internal Trigger Pick-Off (11802)**
- **Fast Autoset**
- **Multiple Windows**
- **Statistical Analysis**
- **Fully Programmable via GPIB and RS-232C**

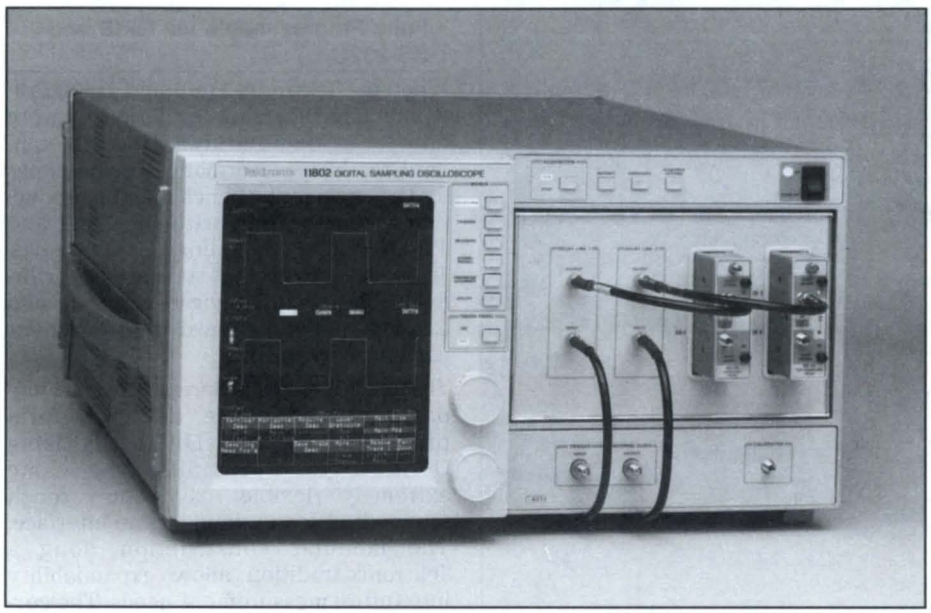
When the Tektronix 11401 and 11402 Programmable Digitizing Oscilloscopes were introduced, they quickly set the new standard for high-performance oscilloscopes for the engineering bench and the production test area. Now, with the 11801 and 11802 Digital Sampling Oscilloscopes, Tektronix extends that standard of performance into the multi-gigahertz range, and expands the on-board measurement capability as well.

The Tektronix 11800 Series draws heavily on the architecture and waveform processing of the 11400 Digitizing Oscilloscopes, providing the same extremely flexible, easy-to-use touch screen display and simple menu interface. The modular construction, long a Tektronix tradition, allows expandability into future measurement needs. The current 11800 Series offering provides multichannel single-ended and differential TDR, rise times down to 17.5 picoseconds, and equivalent-time sweep rates to 1 picosecond per division. Statistical analysis—mean and standard deviation—is provided on all of its 16 on-board automatic measurement functions.

Configurations Available

Two mainframes are currently available: the 11801, expandable through the use of four SM11 Multi-Channel Units to 136 channels of acquisition and TDR; and the 11802, with built-in delay lines that allow internal triggering and viewing of the leading edge of the trigger event. Two sampling heads are available: the two-channel SD24, with signal acquisition and TDR capability; and the more economical SD26 that offers signal acquisition only (without the additional TDR capability). The 11801 accepts up to four sampling heads; the 11802 accepts up to two sampling heads.

With the exception of the expandability of the 11801 and the built-in delay lines of the 11802, the two mainframes are identical in performance. Each carries the widest range of on-board measurement and waveform processing capability of any multi-gigahertz oscilloscope on the market today. Each provides full programmability through its IEEE-488 and RS-232 interfaces, and each has a Centronics port to provide hard-copy capability with any Centronics-compatible printer. Each provides multiple windowing capability, which allows a high-resolution look at any portion of a main record.



11802 Digital Sampling Oscilloscope features two internal delay lines for viewing the trigger event.

Ease of Use

Virtually all of the operation of the 11800 Digital Sampling Oscilloscopes is accomplished through the touch screen and two control knobs located at the lower right of the screen. Six major menu buttons to the right of the screen call up menus on the touch screen from which further selections are made. All major menus are immediately accessible at all times. A parallel menu scheme allows the user to move from any point in any menu immediately to the top level in any other menu; there is no need to *back out* of a menu or perform a paging action to reach another major menu.

Along the top and left side of the display are several icons that allow adjustments to be made on the most frequently used scope functions. There are two control knobs that allow the user to control two functions simultaneously without having to make a further menu selection. By touching the horizontal, vertical, or trigger icon on the screen, the two knobs will control horizontal size and position, vertical size or position, or triggering level, respectively. For most functions, the knobs may be incremented in either fine or coarse increments to allow very precise setting of measurement and display parameters without giving up the ability to reach new settings rapidly. Soft detents provide tactual feedback as a knob is moved from one increment to the next.

A touch screen key pad allows direct numerical input of any valid setting number; it also allows the user to quickly select the minimum or maximum setting for any parameter. The key pad disappears when not in use.

Autoset provides immediate display of an applied signal, correctly scaled and triggered. Autoset may be selected to display either several cycles of a signal (*Period* mode) or the rising edge of a single cycle (*Edge* mode).

Acquisition and Display System

The extensive on-board waveform processing capability of the 11800 Series—the 80286 executive processor and the 80186 digitizer and display controllers, plus the 6809 acquisition controllers—provide extremely fast update of up to eight displayed traces, giving the look and feel of a real-time oscilloscope. The traces remain visible during changes in control settings, which allows the user to manipulate traces conveniently without having to wait for the display to catch up to the control changes.

The 8-bit acquisition system provides 8-bit vertical resolution at all deflection factors (down to 80μV LSB). Waveform processing allows usable deflection factors down to tens of microvolts per division on averaged traces, giving resolution well beyond the basic 2-mV/div sensitivity of the sampling system itself.

The horizontal system provides equivalent-time sweep rates from 1 picosecond per division to 5 milliseconds per division, with record lengths from 512 points to 5120 points, and sample intervals down to 10 femtoseconds.

Measurement System

The 11800 measurement system allows a choice of 16 on-board measurements. All 16 are conveniently displayed and selectable though the touch-screen measurement menu. The results of up to six measurements may be simultaneously displayed on the screen and are constantly updated to follow changing signal conditions. Annotation lines and intensified zones can be activated to indicate the portion of the signal being measured.

For any selected measurement, the mean and standard deviation of the measurement results can be displayed using up to 128 iterations to calculate these values. Measurements and statistics are constantly updated to reflect changing signal conditions.

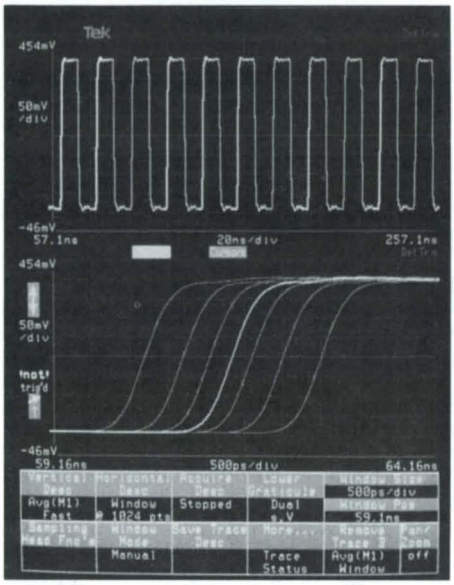
For measuring deviations from a standard, the 11800 allows the user to enter a reference value for any given measurement; the oscilloscope then displays the difference between its measurement and that reference value. This compare function can also be used to zero out differences in path lengths for precise propagation delay measurements.

Measurement zone delimiters permit measurement on any selected portion of the waveform.

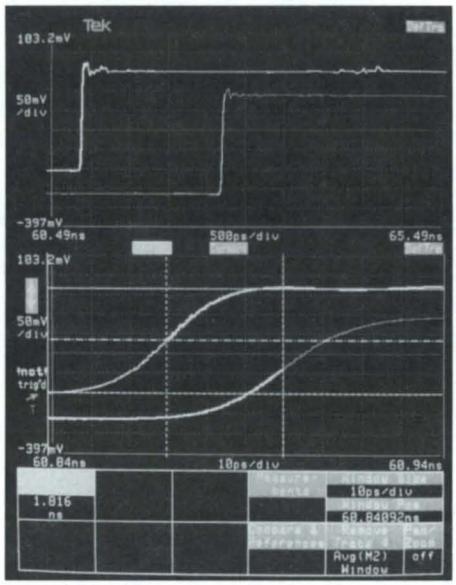
TDR System

Each channel of the SD24 TDR/Sampling Head has an associated TDR pulser. The amplitude and polarity of each TDR pulser is separately adjustable, allowing the user great flexibility in the TDR work to be performed. The TDR pulsers may be used separately for single-ended TDR work, or the two pulsers can be operated push-pull for differential TDR measurements of balanced transmission lines. The displayed reflected system rise time of $\leq$35 ps, together with the sharp corners of the internal step generators allow clear viewing of previously unresolvable transmission line defects. With a couple of touches on the screen, the 11800 graticule and cursors may be set to display TDR measurement results in rho and meters or feet. With the 11801/SM11 combination, up to 136 channels of TDR may be acquired without the need for multiplexing or moving signal connections from one point to another.

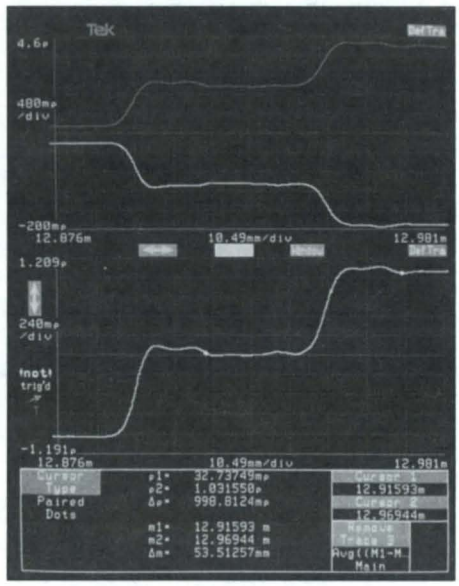
The SM11 Multi-Channel Unit is capable of accepting up to 16 sampling heads, 32 channels using SD24s or SD26s. Up to four SM11s can be connected to one 11801, giving a maximum of 136 channels.



The 11800 oscilloscopes can display up to eight waveforms in any combination of main traces and windows.



The 11800 windowing capability can be used to make more precise measurements, including progagation delay measurements.



With an SD24 in an 11800 oscilloscope, differential time-domain reflectometry (TDR) measurements can be made.

CHARACTERISTICS

VERTICAL SYSTEM

Rise Time/Bandwidth—Depends on sampling head used.*1,2

Vertical Resolution—8 bits full screen (80 μV LSB at 2 mV/div deflection factor).

Amplifier Gain Accuracy—±1% of all settings in 1 mV/div steps.

Deflection Factors—2 to 255 mV/div in 1 mV/div increments 4 to 510 mV/div in 2 mV/div increments when using the internal delay lines of the 11802.

Offset Range—±2 V.

*1 *See Sampling Head Characteristics for SD24 and SD26. The 11801 and 11802 mainframes have no acquisition bandwidth limit; bandwidth is a function only of the sampling head. 11801 accepts up to four SD series heads; 11802 accepts two SD series heads. SM11 Multi-Channel Unit accepts up to 16 SD series heads.*

*2 *Using delay lines in 11802 limit bandwidth to 5 GHz and attenuate signal 50%.*

HORIZONTAL SYSTEM

Main and Window Time Base—1 ps/div to 5 ms/div, settable to 1-2-5 sequence or in 1 ps increments.

Time Base Accuracy—≥2 ns/div: 0.1%; 100 ps/div: 2%; 10 ps/div: 10%; 1 ps/div: 25%; interpolate linearly between cardinal points.

Record Length—512, 1024, 2048, 4096, 5120 samples.

Windows—Any number of window records may be placed on any number of main records, up to the maximum of eight displayed traces. All window records have the same duration, but may be independently positioned on any main record. Windows may be set to automatically track a moving edge on the main record.

Max Sample Rate—200 kHz.

TRIGGER SYSTEM*1,2

Trigger Bandwidth—1 GHz.

Trigger Sensitivity—DC Coupled: 50 mV p-p, dc to 100 MHz, 150 mV p-p to 800 MHz; increasing to 250 mV at 1 GHz; AC Coupled: Attenuates signals below 10 kHz, 50 mV p-p from 10 kHz to 100 MHz; 150 mV p-p at 1 GHz.

Delay Jitter—5 ps +20 ppm of selected delay (rms).

Internal Clock—100 kHz (Drives TDR, Internal Clock Output, and Calibrator).

Trigger Level Range—±1.0 V (±5.0 V with 10X trigger attenuator activated).

*1 *11801 has external trigger only; requires 50 ns pre-trigger.*

*2 *11802 provides internal pre-trigger pickoff in both delay lines.*

MEASUREMENT SYSTEM

Waveform Processing Functions—Add, subtract, multiply, divide, absolute, average, differentiate, envelope, exponent, integrate, natural log, log, signum, square root, smoothing.

Measurement Set—Max, min, mid, p-p, mean, rms, rise, fall, frequency, period, prop delay, cross, width, area +, area −, energy. Measurements constantly updated; mean and standard deviation available on all measurements.

Measurement Parameters (proximal, mesial, distal, start/stop levels)—May be set to relative or absolute values.

Cursors—Paired or split dots, vertical bars, horizontal bars.

CRT AND DISPLAY FEATURES

Standard CRT—9-inch diagonal, monochrome, magnetic deflection. Vertical raster-scan orientation.

Standard Phosphor—GH (P31)

Video Resolution—552 horizontal by 704 vertical displayed pixels.

POWER REQUIREMENTS

Line-Voltage Ranges—90 to 132 V rms, 180 to 250 V rms.

Line Frequency—48 to 440 Hz.

Maximum Power Consumption—214 W.

ENVIRONMENTAL AND SAFETY

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

Humidity—Operating and Non-operating: Up to 95% relative humidity; up to +50°C.

Altitude, Vibration, Shock, Bench Handling—Meets MIL-T-28800C, Type III, Class 5.

Electromagnetic Compatibility(with sampling heads or optional blank panels installed in all sampling head compartments).

Meets the following requirements of MIL-STD-461C:

CE-03 Part 4 Curve 1,
CS-01 Part 7,
CS-02 Part 4,
CS-06 Part 5,
RE-02 Part 7,
RS-01 Part 4,
RS-02 Part 5,
RS-03 Part 7 (limited to 1 GHz).

Meets FCC Part 15, subpart J, Class A.

Meets VDE 0871/6.78 Class B.

Safety—Listed UL 1244, CSA Bulletin 556B September 1973, Tektronix self-certification to comply with IEC 348 recommendation.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
11801,11802				
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	599	23.6	550	21.6
Weights	**kg**	**lb**	**kg**	**lb**
11801				
Net	22.3	49	23.2	51
Shipping	25.9	57	26.8	59
11802				
Net	24.1	53	25.0	55
Shipping	27.7	61	28.6	63

ORDERING INFORMATION

11801 Digital Sampling Oscilloscope **$23,500**
Includes: Introduction Manual (070-7036-00); User Reference Manual (070-7037-00); Programmer Reference Manual (070-7038-00); Programmer's Pocket Reference Manual (070-7039-00); Service Reference Manual (070-7041-00); Tutorial disk (062-9881-00); one 12-inch SMA cable (174-1364-00).

11802 Digital Sampling Oscilloscope **$22,000**
Includes: Introduction Manual (070-7042-00); User Reference Manual (070-7043-00); Programmer Reference Manual (070-7044-00); Programmer's Pocket Reference Manual (070-7045-00); Service Reference Manual (070-7047-00); Tutorial disk (062-9881-00); one 12-inch SMA cable (174-1364-00); Two 8.5-inch SMA cables (174-1120-00).

OPTIONS

Option 1R—Rackmount **+$250**
Includes: Hardware, tooling, and instructions for converting bench model to rackmount configuration. Available with 11801, 11802, and SM11.

Option 1M—Multi-Channel Conversion (11801 only). **+$1,000**
Modifies 11801 to permit operation with up to four SM11 Multi-Channel Units (not available for 11802).

Option 25—Includes a PEP 301 Controller and S47P108 11800/IBM PC Utility Software. (Does not include installation of PEP 301.) **+$7,870**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz
Option A2—UK 240 V, 50 Hz
Option A3—Australian 240 V, 50 Hz
Option A4—North American 250 V, 60 Hz
Option A5—Switzerland 240 V, 50 Hz

WARRANTY-PLUS SERVICE PLANS

See Customer Services and Information Section.

Q0—On-site product installation and setup.*1
Q1—1-Year on-site service.*1

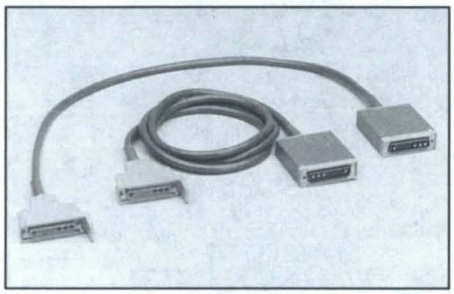
*1 *Contact your local sales office.*

OPTIONAL ACCESSORIES

Service Manuals—
(11801) Order 070-7041-00.*1
(11802) Order 070-7041-00.*1

Calibration Pulser—Used to verify performance specifications for SD24 and SD26 sampling heads. Order 067-1338-00.*1

Blank Panel—For empty sampling head compartments. Order 200-3395-00.*1



Sampling Head Extender Cables, 1 and 2 meters, can be used for placing a sampling head closer to circuits of interest. One end attaches to a sampling head; the other end can be inserted into an 11801, 11802, or SM11.

CABLES/EXTENDERS

Sampling Head Extender Cables—
(1M) Order 012-1220-00. **$470**
(2M) Order 012-1221-00. **$535**
GPIB Cable—2M. Order 012-0991-00 **$160**
RS-232C Cable—10 ft.
Order 012-0911-00. **$100**
Centronix Cable—10 ft.
Order 012-0555-00. **$125**
Acquisition Extender—
Order 067-1324-00. **$95**
Acquisition System Extender—
Order 067-1323-00. **$600**
Card Cage Extender—
Order 067-1267-00. **$650**

RECOMMENDED PROBES

P6150—DC to 9 GHz, 10X.
See page 529. **$1,250**
P6156—DC to 3.5 GHz, 10X.
See page 529. **$200**

SUPPORT SOFTWARE

For more information on utility and application software, see Test and Measurement Software.

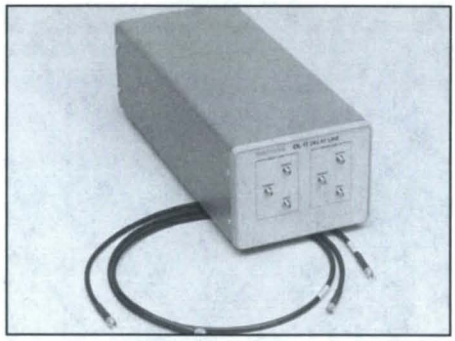
11800-Series/IBM PC Utility—
Waveform/measurement data logging, graphics, and statistical analysis, GPIB and RS-232C support. Order S47P108.*1

11800-Series Asyst Driver—
Menu-driven package for scope control, waveform acquisition, data logging, and FFT analysis. Order S47P305.*1

11800-Series EYEPATTERN—
Timing and voltage measurements with statistical analysis, displayed using histogram techniques. Order S47P107.*1

11800-Series Template Software—
Provides "Save on Delta" and "Go/No-Go Testing."*1

*1 *Contact your local sales office.*



DL11 Delay Line contains two delay lines each with 47.5 ns delay. The DL11 is used for showing the triggering event of a signal displayed on an 11801.

DL11 Delay Line

The DL11 Delay Line provides approximately 47.5 ns of delay from the signal input to the signal output. The DL11 contains two delay lines that when connected, allow the user to view the triggering event through the 11801.

A delay line can reduce horizontal jitter and provide more accurate measurements, because it lets you take measurement ention the first rising edge or the triggering event.

ENVIRONMENTAL AND SAFETY

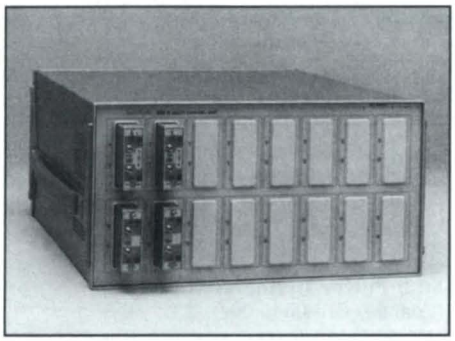
Temperature—Operating: 0 to +50 °C; Non-operating: −40 to +75 °C.
Humidity—Operating and Non-operating: Up to 95% relative humidity; up to +50 °C.
Altitude, Vibration, Shock, Bench Handling—Meets MIL-T-28800C, Type III, Class 5.
Safety—Listed UL 1244, CSA Bulletin 556B September 1973, Tektronix self-certification to comply with IEC 348 recommendation.

PHYSICAL CHARACTERISTICS

	Cabinet	
Dimensions	**mm**	**in.**
Width	159	6.3
Height	119	4.7
Depth	356	14.1
Weights ≈	**kg**	**lb**
Net	4.56	10
Shipping	5.33	12

ORDERING INFORMATION

DL11 Delay Line **$4,000**
Includes: Installation/User Manual (070-7050-00); Instruction Sheet (070-7051-00); two 20-inch SMA cables (174-1427-00); two 48-inch SMA cables (174-1428-00).



SM11 Multi-Channel Unit can accept up to four sampling heads. Up to 16 sampling heads can be used in an SM11 option 01.

SM11

Multi-Channel Unit

The SM11 Multi-Channel Unit provides the means to expand the 11801 Digital Sampling Oscilloscope to 136 channels. Each SM11 accepts up to 16 of the SD Series sampling heads; an 11801 mainframe with Option 1M added is capable of driving up to four SM11 Units. The entire system can then be driven through a single GPIB address.

The 11801 acquisition system is designed to acquire half of all active channels in a single acquisition cycle. Thus, in two acquisition cycles, all 136 channels can be acquired, and measurements performed on them. The hardware measurement capability of the 11800 system allows timing measurements to be taken in a single acquisition cycle. This greatly increases the throughput of a large multi-channel system over that of a system where the signals must be multiplexed through a small number of acquisition channels and then processed in software to determine measurement results.

There are two versions of the SM11 Multi-Channel Unit. The standard version can accept up to four sampling heads. With Option 01, the SM11 can be expanded to accept up to 16 sampling heads.

POWER REQUIREMENTS

Line-Voltage Ranges—90 to 132 V rms, 180 to 250 V rms.
Line Frequency—48 to 440 Hz.
Maximum Power Consumption—214 W.

ENVIRONMENTAL AND SAFETY

Temperature—Operating: 0 to +50°C; Nonoperating: −40 to +75°C.
Humidity—Operating and Nonoperating: Up to 95% relative humidity; up to +50°C.
Altitude, Vibration, Shock, Bench Handling—Meets MIL-T-28800C, Type III, Class 5.
Electromagnetic Compatibility (with sampling heads or optional blank panels installed in all sampling head compartments)—
Meets the following requirements of MIL-STD-461C:
CE-03 Part 4, Curve 1,
CS-01 Part 7,
CS-02 Part 4,
CS-06 Part 5,
RE-02 Part 7
RS-01 Part 4,
RS-02 Part 5,
RS-03 Part 7 (limited to 1 GHz).

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions SM11	**mm**	**in.**	**mm**	**in.**
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	599	23.6	550	21.6
Weights	**kg**	**lb**	**kg**	**lb**
Net	20.0	44	20.9	46
Shipping	23.6	52	24.5	54

ORDERING INFORMATION

SM11 Multi-Channel Unit **$10,000**
Up to 4 sampling heads can be installed. Order Option 01 for 16 sampling-head capability. Includes: Installation/User Manual (070-7048-00); Service Reference Manual (070-7049-00); Incoming Inspection Procedure (070-7054-00).

OPTIONS

Option 01—Expands standard SM11 to allow up to 16 heads to be installed **+$5,000**
Includes: Installation Manual 1070-7048-001.
Option 1R—Rackmount **+$250**
Includes: Hardware, tooling, and instructions for converting bench model to rackmount configuration.

INTERNATIONAL POWER PLUG OPTIONS

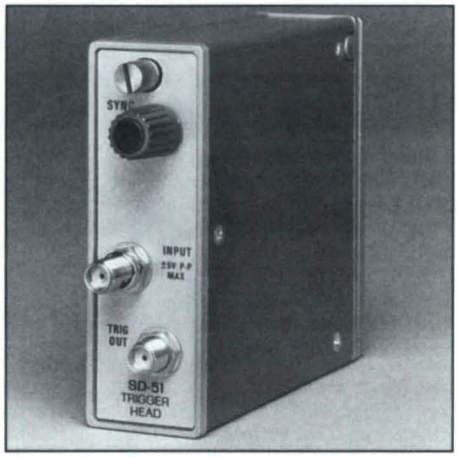
Option A1—Universal Euro 220 V, 50 Hz
Option A2—UK 240 V, 50 Hz
Option A3—Australian 240 V, 50 Hz
Option A4—North American 250 V, 60 Hz
Option A5—Switzerland 240 V, 50 Hz

WARRANTY-PLUS SERVICE PLANS

See Customer Services and Information Section.
Q0—On-site product installation and setup.*1
Q1—1-Year on-site service.*1

OPTIONAL ACCESSORIES

Service Reference Manual—
Order 070-7049-00.*1
Incoming Inspection Procedure—
Order 070-7054-00.*1



NEW SD51

- **20 GHz Trigger Head**
- **≤7 ps rms Trigger Jitter into 11800 Series Oscilloscopes**

The SD51 Trigger Head is a free-running tunnel-diode oscilator designed to provide stable sampling displays of sine waves from 1 to 20 GHz. The SD51 has a front-panel sync control that synchronizes the oscillator frequency to a subharmonic of the input signal. The output from the SD51 is coupled to the 11800 Series trigger input connector. 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 to 20 GHz. Stable synchronization on signals of at least 100 mV p-p, as measured separately into 50 Ω, 5 V p-p maximum.

Input Characteristics—50 Ω SMA (3 mm) connector. Open termination paralleled by 1 pF.

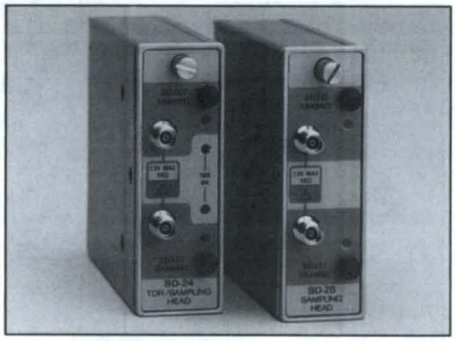
Trigger Output—Trigger output is ≈ or approximately 200 mV into 50 Ω. Jitter is 6 ps rms less with signals from 5 to 20 GHz; 7 ps rms or less with signals from 1 to 5 GHz. Kickout at signal-input connector is 180 mV peak; kickout occurs between successive samples.

Weight—Net: 0.5 kg (1.0 lb). Shipping: 2.3 kg (5.0 lb).

ORDERING INFORMATION

SD51 Trigger Head*1
Includes: Installation/User manual, Service Reference Manual, 12″ SMA cable (174-1364-00).

*1 *Contact your local sales office.*



SD24 TDR/Sampling Head and SD26 Sampling Head. Both have two acquisition channels and 17.5 pS risetimes. The SD24 also generates two 35 pS TDR reflected pulses.

NEW SD24/ NEW SD26

Sampling Heads

- **17.5 ps Rise Time**
- **2 Channels**
- **TDR Step Output (SD24 Only)**
- **Selectable TDR Polarity (SD24 Only)**

The SD24 is a dual-channel TDR/Sampling Head. The SD26 is a dual-channel Sampling Head. These sampling heads have a rise time of 17.5 ps or less, with a typical 20 GHz equivalent-time bandwidth. The input impedance of the SD24 and SD26 is 50 ohms, and the maximum safe input voltage is ±3 V. The SD24 and SD26 can be inserted into an 11801, 11802, SM11, or they can be attached to Sampling Head Extender Cables.

Each channel of the SD24 is also capable of generating a TDR pulse. The TDR pulse is a fast-rising step that is activated when the SD24 is in TDR mode. Each TDR pulse is applied to the input signal path for that channel. The acquisition portion of the sampling head is still functional for monitoring the incident pulse and this pulse's reflected components. The polarity of each channel's TDR pulse can be selected independently of the other channel. This allows for differential or common-mode testing of two coupled lines, besides independent testing of isolated lines.

CHARACTERISTICS

Dot Transient Response—Adjustable to ±5% for signals from 0 to 0.5 V p-p; adjustable to unity for signals from 0.5 V to 1.0 V p-p.
Input Termination—50 ±0.5 Ω.
Displayed Noise—With unity dot response: typically 1.3 mV RMS; with smoothing: typically 0.6 mV RMS.
Max (Nondestructive) Input Voltage—±3.0 V.
Isolation Between Channels—≤1% p-p voltage of channel driven by 067-1338-00 will be observed on other channel.

ACQUISITION SYSTEM

Rise Time—≤17.5 ps.
Bandwidth—≥20 GHz typical.
Time Coincidence Between Channels—≤10 ps.
Dynamic Range—1 V p-p within a ±1.6 V range.
Typical Aberrations—10 ns to 20 ps before step ≤±3%
Less than 300 ps after step ≤+10%, −5%
300 ps to 5 ns after step ≤±3%
5 ns to 100 ns after step ≤±1%
Elsewhere: ≤0.5%.

TDR SYSTEM (SD24 ONLY)

Displayed Incident Rise Time—≤28 ps, typical.
Displayed Reflected Rise Time—≤35 ps.
TDR Pulse Amplitude—Adjustable to ±250 mV (polarity of either pulse may be inverted).
Time Coincidence Between TDR Pulses—Adjustable to less than 1.5 ps.
Aberrations (±250 mV amplitude)—10 ns to 20 ps before step: ≤±3%; Less than 300 ps after step: (≤+10%, −5%) typical; 300 ps to 5 ns after step: ≤±3%; Elsewhere: ≤1%.

PHYSICAL CHARACTERISTICS

	Cabinet	
Dimensions	**mm**	**in.**
Width	24.1	1.0
Height	73.7	2.9
Depth	965	3.8
Weights ≈	**kg**	**lb**
Net	0.31	0.7
Shipping	0.91	2.0

ORDERING INFORMATION

SD24 Dual TDR/Sampling Head **$5,000**
Includes: Installation/User Reference Manual (070-7052-00); two Shorting caps (015-1020-00).
SD26 Dual Sampling Head **$3,500**
Includes: Installation/User Reference Manual (070-7226-00); two Shorting caps (015-1020-00).

WARRANTY-PLUS SERVICE PLANS

See Customer Services and Information Section.
Q0—On-site product installation and setup.
(SD24)*1
(SD26)*1
Q1—1-Year on-site service.
(SD24)*1
(SD26)*1

OPTIONAL SAMPLING ACCESSORIES

Service Reference Manual—
(SD24) Order 070-7053-00. **$50**
(SD26) Order 070-7227-00. **$50**
Recommended Probes—
P6150—DC to 9 GHz, 10X.
See page 529. **$1,250**
P6156—DC to 3.5 GHz, 10X, low impedance.
See page 529. **$200**

OPTIONAL SAMPLING HEAD ACCESSORIES WITH SMA (3MM) CONNECTORS

Combination Wrench—1 each.
Order 003-0247-00. **$9**
SMA Accessory Kit—Order 020-1693-00.*1
Includes the following:
50-Ω Attenuators—2 each
(2X) 015-1001-00;
(5X) 015-1002-00.
50-Ω Termination—2 each 015-1004-00.
SMA Terminations—2 each
(Male Short-Circuit) 015-1020-00.
(Female Short Circuit) 015-1021-00.
(Male 50 Ω) 015-1022-00.
50-Ω Signal Cables—2 each
(2 ns) 015-0560-00.
500-ps 50-Ω Semi-Rigid Cable—2 each 015-1015-00.
Adapters—2 each
(Male-to-Male) 015-1011-00.
(SMA Male-to-BNC Female) 015-0554-00.
(Female-to-Female)—015-1012-00.
50-Ω Power Divider T—1 each
(Female) 015-0565-00.

INDIVIDUAL ACCESSORIES

50-Ω Attenuators—
(2X) Order 015-1001-00. **$150**
(5X) Order 015-1002-00. **$150**
(10X) Order 015-1003-00. **$155**
50-Ω Termination—
Order 015-1004-00. **$75**
ECL Terminator—Order 015-0558-00.*1
50-Ω Signal Cables—
(2 ns) Order 015-1005-00. **$120**
(5 ns) Order 015-1006-00. **$185**
500-ps 50-Ω Semi-Rigid Cable—
Order 015-1015-00. **$30**
High Quality, Low Dielectric Cables—
(1 ns) Order 015-0562-00.*1
(2 ns) Order 015-0560-00.*1
(4 ns) Order 015-0561-00.*1
Adapters—
(Male-to-7 mm) Order 015-1010-00. **$215**
(Male-to-Male) Order 015-1011-00. **$27**
(Female-to-Female) Order 015-1012-00. **$11**
Coupling Capacitor—
Order 015-1013-00. **$230**
50-Ω Power Divider T—
(Male) Order 015-1014-00. **$270**
(Female) Order 015-0565-00.*1
SMA Adapters—
(T) Order 015-1016-00. **$41**
(Male-to-BNC Female)
Order 015-1018-00. **$10.25**
SMA Male-to-BNC Female Adapter—
Order 015-0554-00.*1
Slip on Connector—
Order 015-0553-00.*1
1-ns 50-Ω Cable—Order 015-1019-00 **$150**
SMA Terminations—
(Male Short-Circuit) Order 015-1020-00. **$25**
(Female Short-Circuit) Order 015-1021-00. **$27**
Male 50 Ω) Order 015-1022-00. **$40**
Connector Savers—
(SMA) Order 015-0549-00.*1
(APC) Order 015-0552-00.*1

WITH 50-Ω BNC CONNECTORS

Feed-Through Termination—
Order 011-0049-01. **$32**
Feed-Through (5 W)—
Order 011-0099-00. **$55**
Attenuators—
(2X) Order 011-0069-02. **$45**
(2.5X) Order 011-0076-02. **$44**
(5X) Order 011-0060-02. **$45**
(10X) Order 011-0059-02. **$45**
Coaxial Cables—
(18 in) Order 012-0076-00. **$18.25**
(42 in) Order 012-0057-01. **$19.25**
Combination Wrench—
Order 003-0247-00. **$9**

*1 *Contact your local sales office.*

7000-SERIES DIGITAL STORAGE OSCILLOSCOPES

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DIGITAL OSCILLOSCOPES AND WAVEFORM DIGITIZERS

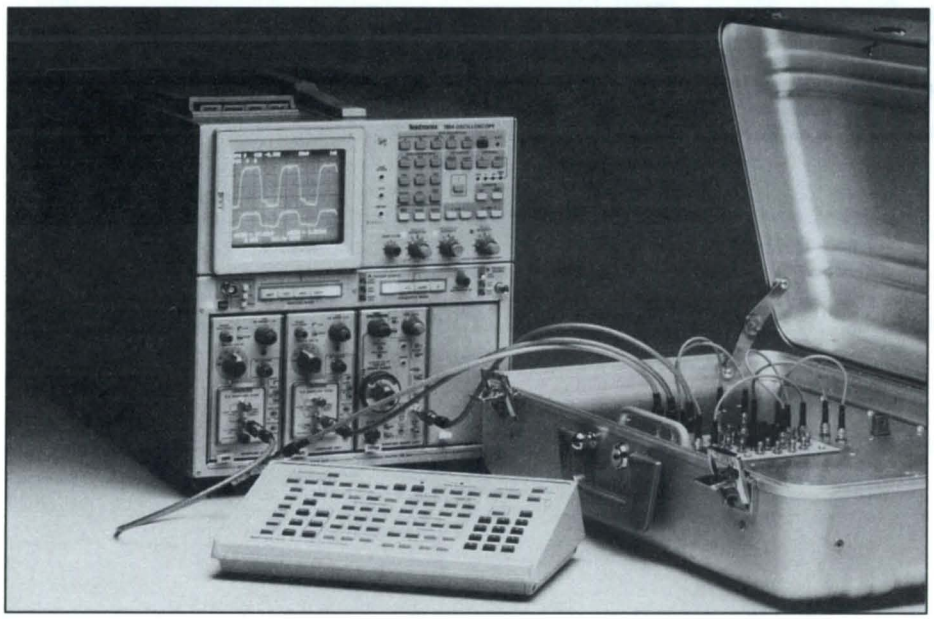
Type	Analog Digitizing BW	Maximum Digitizing Rate	Vertical Resolution	Data Words per Waveform	Maximum Stored Waveforms	Useful*1 Storage BW (SS)	Equiv*2 Storage BW (rep)
7854	400 MHz*4	500-kHz Ext Clock	10 bits	Up to 1024	Up to 40	50 kHz	400 MHz
7D20	70 MHz	40 MHz	8 bits	Up to 1024	6	10 MHz	70 MHz

*1 *Useful Storage Bandwidth is a measure of the highest frequency sine wave that can be stored in a single sweep and displayed in a visually useful manner. This is dependent on both the maximum digitizing rate as well as the display reconstruction technique used.*

*2 *Equivalent Storage Bandwidth indicates the highest frequency repetitive signal that can be stored and displayed with less than 3 dB loss of signal amplitude using equivalent-time digitizing techniques.*

*3 *14 bits with averaging.*

*4 *14 GHz with sampling.*



7854

GPIB IEEE-488 The 7854 is designed to support other products that comply with IEEE Standard 488-1975.

TYPICAL APPLICATIONS

- **Power-Supply Switching**
- **Semiconductor Testing**
- **Fiber Optic Testing**

BENEFITS

- **Wide Selection of Plug-ins and Sampling Heads**
- **Real time Analog and Digitizing Oscilloscope in a Single Mainframe**
- **Stored or Down-loaded Programmability**
- **On-board Calculations**

FEATURES

- **Waveform Parameters at the Touch of a Key**
- **DC to 400-MHz Real-Time Bandwidth at 10 mV/Div**
- **Calibrated Sweep Rates to 500 ps/Div**
- **Stores Repetitive Waveforms Up to 14 GHz With Sampling Plug-Ins**
- **Signal Averaging**
- **Resolution Up to 0.01 Div on Stored Data (10-Bits)**
- **Choose 128, 256, 512, 1024 Points/ Waveform**
- **Keystroke Programming**

See 7000-Series Reference section for available Application Notes.

The 7854 Waveform-Processing Oscilloscope combines the features of a high-performance real-time oscilloscope with digital storage and waveform processing. When integrated with any of a wide variety of 7000-Series plug-ins, it becomes a powerful measurement system. The 7854 offers programmable measurement routines, GPIB interface for mass data and program storage, plus simultaneous display of real-time and stored waveforms. The 7854's on-board memory stores up to 40 waveforms and 2000 keystrokes.

Mainframe and calculator keyboard functions provide cursor control and waveform-parameter information at the touch of a button, e.g., maximum, minimum, peak-to-peak, risetime. Additional calculator-keyboard features enable arithmetic manipulation of waveforms such as differential, integral, log, and absolute value.

Signal averaging recovers signals buried in random noise and improves measurement accuracy. One or two cursors are selectable for voltage and time measurements. One cursor provides voltage measurements referenced to ground and time measurements referenced to time zero. Two cursors enable Δtime and Δvoltage measurements. Cursors may also be used to bracket an area of interest for measurement.

The 7854's keystroke programming (simply storing a series of keystrokes to be executed) assures repeatable measure ment results and lowers the skill level needed to operate the system. Measurement loops save time, log results, and make pass/fail decisions. Full subroutine and conditional branching capabilities are provided.

TekMAP Software Support

The TekMAP (Tektronix Measurement Application Programs) software supports the Tektronix 7000-Series GPIB Programmable Digitizers in automated engineering or research and manufacturing environments.

CHARACTERISTICS

VERTICAL REAL-TIME SYSTEM

Input—Two plug-in compartments; compatible with 7000-Series plug-ins.
Modes—Left, Alt, Add, Chop, Right.
Mainframe Bandwidth—400 MHz with 7A29 or 7A19 Amplifier plug-ins.
Mainframe Step Response—0.9 ns or less with 7A29 or 7A19 Amplifier plug-ins.
Chopped Mode—Chop rate is ≈1 MHz.
Trace Separation Range—In dual-sweep modes, B trace can be positioned 4 div above or below the A trace.

CRT AND DISPLAY FEATURES

CRT Display Modes—Scope (conventional display); Stored (digital data display); Both (stored display plus real-time waveforms); Program Entry (user program text display).

HORIZONTAL REAL-TIME SYSTEM

Input—Two plug-in compartments; compatible with 7000-Series plug-ins.
Modes of Operation—A, Alt, Chop, B.
Fastest Calibrated Sweep Rate—0.5 ns/div.
Chopped Mode—Rep rate is ≈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).

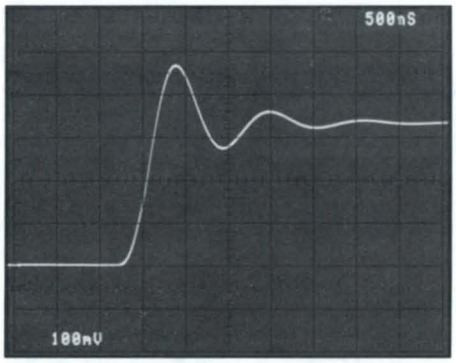
DIGITAL STORAGE

Equivalent-Time Bandwidth—400 MHz. See 7000-Series system bandwidth specifications.
Accuracy—Refer to plug-in specifications.
Acquisition Channels—One or two simultaneous channels (Plug-in Chop mode not valid).
Acquisition Window—±5 div from center screen both vertical and horizontal.
Resolution—Vertical: 0.01 div. Horizontal: Selectable points/waveform on remote keyboard.

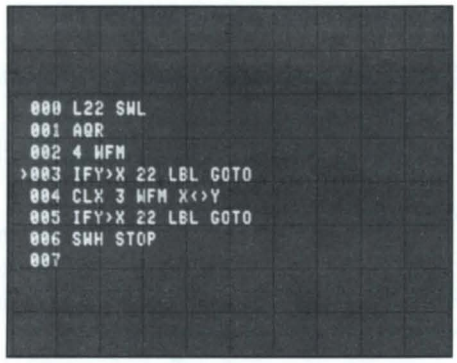
Horizontal Resolution (divs)	Points/Waveform
0.01	1024
0.02	512
0.04	256
0.08	128

PLUG-IN COMPATIBILITY

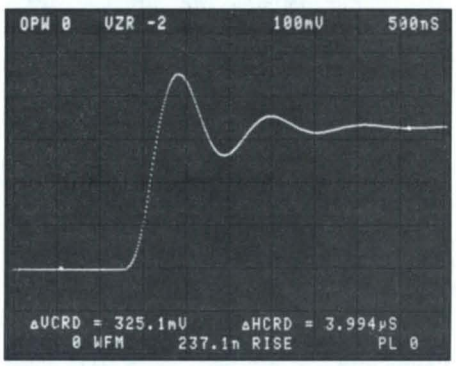
All 7000-Series plug-ins are compatible in the standard oscilloscope display mode. The 7L5 and 7L18 Spectrum Analyzers require factory modification for optimum use with digital-storage operation. The 7D01 and 7D02 are not compatible in Stored mode.



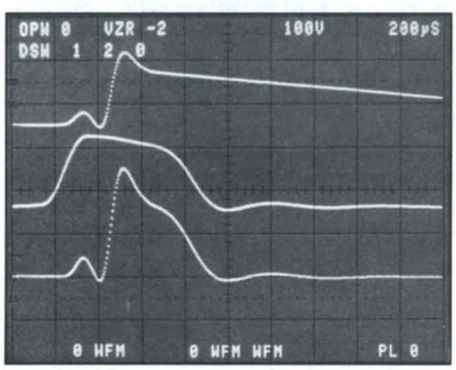
Conventional Scope: In the SCOPE mode, the 7854 provides a complete plug-in scope giving standard displays like other Tektronix high-performance scopes.



Waveform Processing: Keystroke Programming enables the user to design measurement routines tailored to individual tests or experiments.



Storage Scope: Rise time is calculated by pushing a single key. Time and voltage differences between cursors are shown on the line above rise time.



Multiple Storage and Calculation: Volts, current, and power are all shown on the display. Power is a simple two- or three-keystroke calculation.

OUTPUTS/INPUTS

+Sawtooth—Positive going with baseline at 0 V ±1 V into 1 MΩ. Voltage is 1 V/div (±10%) into 1 MΩ, 50 mV/div (±15%) into 50 Ω. Output R is ≈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 ≈950 Ω. Source is selectable from A gate, B gate, or Delayed gate.

Vertical Signal Out—Selected by A Trigger Source switch. Output voltage is 0.5 V/div into 1 MΩ, 25 mV/div into 50 Ω. Output R is ≈950 Ω. Bandwidth depends upon vertical plug-in.

Remote Single-Sweep Reset—Rear-panel BNC, ground closure activated.

TTL Output—Rear-panel BNC, TTL output under remote-keyboard control (SWH and SWL).

External Z-Axis Input—2 V p-p for full intensity range from dc to 1 MHz. Positive signal blanks the trace. Maximum input voltage is 15 V (dc plus peak ac).

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.

GPIB Interface Subsets Implemented—SH1, AH1, T5, L3, SR1, RL1, DC1, DT1, PP0, C0.

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%; rep rate is 1 kHz within 0.25%.

Current Output—40 mA available through Calibrator output with optional BNC-to-current-loop adaptor.

POWER REQUIREMENTS

Line-Voltage Ranges—90 to 132 V. 180 to 250 V.

Line Frequency—48 to 440 Hz.

Maximum Power Consumption—230 W.

PHYSICAL CHARACTERISTICS

	Mainframe		Waveform Calculator	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	305	12.0	277	10.9
Height	348	13.7	69	2.7
Depth	627	24.7	165	6.5
Cord Length ±76 mm			1420	56.0
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	20.4	45.0		
Shipping	28.2	62.0		

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

7854 Oscilloscope, Including Waveform Calculator **$15,275**

Includes: Power cord (161-0066-00); BNC-to-BNC cable (012-0208-00); instruction manual (070-2873-00).

OPTIONS

Option 02—X-Y Phase Correction. **+$260**
Option 03—EMC Modification. **+$395**
Option 78—BE (P11) Phosphor. **+$100**

CONVERSION KIT

4K Expanded Memory—Order 040-0941-00 **$330**

TekMAP SOFTWARE

For more information on utility and application software, see the Test and Measurement Software Section or consult your local sales or applications engineer.

S42P101 7854 IBM PC Software **$450**
Includes: Software operator manual.

S42H202 7854 HP Series 200 Software **$950**
Includes: Software operator manual.

S42P202 7854 IBM PC TAMS Software **$495**
Includes: Software operator manual.

OPTIONS

Option 01—5¼ inch media. **NC**
Option 02—3½ inch media. **NC**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

OPTIONAL ACCESSORIES

Recommended Plug-Ins—See Plug-ins section, page 277.

Recommended Probes—See Signal Acquisition section.

Recommended Camera—See Instrumentation Documentation Devices section.

Recommended Cart—K213. A keyboard tray for the 7854 and a storage area for plug-ins are available as Options 10 and 12, respectively, Option 22 for both. See Cart section. **$625**

Recommended Plotter—HC100 Color Pen Plotter. **$825**

TECHNICAL ASSISTANCE SERVICES

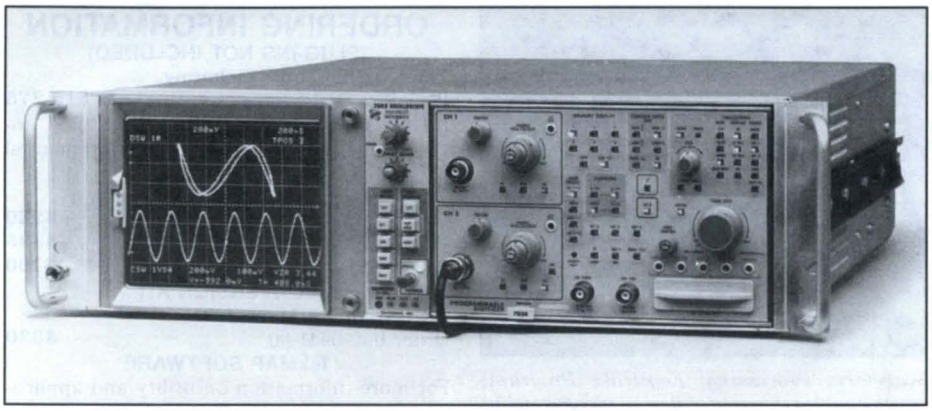
When you need technical assistance to supplement your own resources, Tektronix can arrange the services of an application engineer skilled in meeting your needs. For more information, see the Tektronix Solutions/New products section or consult your local sales engineer.

TRAINING

Tektronix offers service training classes on the 7854 Waveform Processing Oscilloscope.

For further training information, contact your local Sales Office and request a copy of the Tektronix Service Training Catalog.

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. Information is in Customer Training section. For further information, or to enroll, call us at 1-800-835-9433, ext. 430. In Oregon, call 1-629-1017 (collect).



The 7D20 is used with 7000-Series oscilloscopes, such as the R7603 shown above in a rackmount configuration. See 7000-Series Instruments for details.

7D20

GPIB IEEE-488

The 7D20 complies with IEEE Standard 488-1978 and with Tektronix *Standard Codes and Formats.*

TYPICAL APPLICATIONS

- **Ultrasonics**
- **Digital Design**
- **RF Modulation**
- **Automated Production Testing**

FEATURES

- **Digital Storage for 7000-Series Mainframe**
- **70-MHz Bandwidth for Repetitive Signals**
- **10-MHz Single-Shot Bandwidth**
- **Two Channels Simultaneous Acquisition**
- **Totally Programmable**
- **Storage of Six Independent Waveforms**
- **Enveloping and Signal Averaging**
- **Cursor Measurements**
- **Pretrigger and Posttrigger**

See 7000-Series Instruments for available Application Notes.

The 7D20 is a GPIB programmable plug-in compatible with all 7000-Series mainframes (including the USM 281C) except the 7104. With a 7000-Series mainframe, it creates a fully programmable, digitizing oscilloscope.

The 7D20 accurately measures amplitudes of 50-ns-wide transient events. Dual samplers simultaneously acquire two channels like a "dual beam" scope.

The 7D20 offers signal averaging to reduce uncorrelated noise, envelope displays to compare dynamic characteristics of changing signals, pretrigger for viewing prior to the trigger event, storage of six independent waveforms plus a reference waveform, cursors for more accurate two-dot measurements, and user prompting and menu displays to improve user-interface effectiveness.

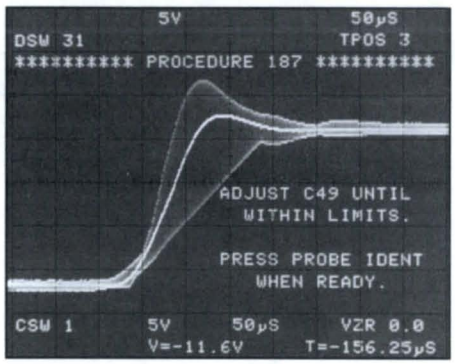
Digital Storage
40-MHz maximum sampling rate provides approximately 10-MHz single-shot bandwidth and up to 70-MHz bandwidth with repetitive signals.

Storage and Recall Front-Panel Settings
Up to six different front-panel set-ups can be stored and recalled. These settings, plus the last panel set-up, are saved in nonvolatile memory and are restored automatically when power is applied.

Fully Automated Measurements
Since the 7D20 is completely programmable, fully automated measurement and testing is possible. Tektronix programmable signal sources, multifunction interface, and RF scanner provide and control the test signals while the 7D20 acquires waveforms for the computer or controller.

TekMAP Software Support
For the Tek 4041, IBM PC, or HP Series 200 computers, Tektronix Measurement and Application Programs (TekMAP) tap the full potential of the 7D20. The 7D20/Tek 4041 software package supports the 7D20 when used in conjunction with the Tek 4041 Controller. It provides automated pulse-parameter analysis and storage and retrieval of waveforms on DC-100 tape. Data results are available in graphic or tabular form.

The 7D20/HP Series 200 software package supports the 7D20 when used with the HP Series 200 (216, 226, 236) Technical Computers. It provides automated pulse-parameter analysis, propagation-delay measurements, FFT, and storage and retrieval of front-panel settings and waveforms. Data results are available in graphic or tabular form.



Automated Testing
Interactive test procedures, text messages, waveforms, and front-panel set-ups may be transmitted and received from the 7D20 to a controller or computer. This envelope was initially constructed using the 7D20's envelope feature while a test signal was varied to its allowable limits. The waveform was then transferred and saved by the controller to serve as the test reference or overlay.

CHARACTERISTICS

VERTICAL SYSTEM

Input—Two channels, simultaneous sampling, BNC connectors.
Acquire Modes—CH 1, CH 2, Add, Both (dual channel).
Sensitivity—5 mV to 5 V/div; 1-2-5 sequence.
Bandwidth—70 MHz maximum. (AC-Coupled Low-Frequency Response: 10 Hz or less.)
Step Response—5 ns or less.
Input Impedance—1 MΩ paralleled by ≈20 pF.
Maximum Input Voltage—DC Coupled: 250 V, 1 kHz or less (dc + peak ac). AC Coupled: 400 V, 1 kHz or less (dc + peak ac).
Signal Isolation—100:1 dc to 20 MHz.
Vertical Resolution—8 bits, 256 levels, 0.04 div/level.
Gain Ratio Accuracy—<2%. Maximum error throughout the V/div range with acquire gain calibrated at 10 mV/div. Measurement valid with Cursors or GPIB.
Noise—Mean value of 50 measurements taken at 0.02-div increments.

Volts/Div	Full Scale*1/ RMS Noise	% of Full Scale*1
5 mV	52 dB	0.25
10 mV to 5 V	55 dB	0.18

*1 *Full scale=10.24 divisions.*

Phase Match X-Y—<2° from dc to 10 MHz.

HORIZONTAL SYSTEM

Time/Division Range—External Clock, 20 s to 50 ns/div in 1-2-5 sequence.
Digitizing Technique vs Time/Division—Real Time (Rolling Display): External Clock, 20 to 0.1 s/div. Real Time: 50 ms to 500 µs/div. Extended Real Time: 200 to 2 µs/div. Equivalent Time: 1 µs to 50 ns/div.

Note: Single events can be captured as fast as 2 µs/div. For 1 µs to 50 ns/div, repetitive events are required to build a complete waveform.

Time-Measurement Accuracy—One Cursor: 0.1% of reading +0, −1 sample interval ±300 ps. Two Cursors: 0.1% of reading ±600 ps.

Horizontal Resolution

Time/Division	Points/ Waveform	Resolution Points/ Division
External, 20 s to 500 μs	1024	100
200 to 2 μs	820*1	80*1
1 μs to 50 ns	1024	100

*1 *Waveform interpolation to 1024 points is available for transfer over the GPIB Interface.*

Trigger Position

Pretrigger: 0 to 10 div in 1-div increments. Posttrigger (delay): 0 to 1500 div in 1-div increments (disabled during Roll with Envelope or Average).

HMAG ALL (Horizontally Magnify All Waveforms): Displays all waveforms at 10 times horizontal magnification.

VS (Versus): Creates a Y versus X display of any two waveforms.

GPIB INTERFACE

Interface Function Subsets Implemented:

SH1	Complete source handshake
AH1	Complete acceptor handshake
T5	Complete talker—no secondary address
L3	Complete listener—no secondary address
SR1	Complete service request
RL1	Complete remote local
DC1	Complete device clear
DT1	Complete device trigger
PP0	No parallel poll
C0	No controller
E2	Three state

	Frequency Range*1	Sensitivity Internal	Sensitivity External
Normal (DC Coupling)	DC to 30 MHz	0.4 div	60 mV
	30 to 70 MHz	1.0 div	150 mV
P-P and Auto	30 to 200 Hz	2.0 div	300 mV
	200 Hz to 30 MHz	0.6 div	90 mV
	30 to 70 MHz	1.2 div	200 mV

*1 *The ac-coupling low-frequency limit is 30 Hz. In Time/ Div settings of 1 μs to 50 ns, when using P-P or Auto, low-frequency limit is 300 Hz.*

SIGNAL PROCESSING

Cursors Readout—With one cursor (ΔOff), vertical and horizontal coordinate values are referenced to zero volts and the trigger position as zero time. With two cursors (ΔOn), vertical and horizontal coordinate values are the difference between the two cursors.

Signal Averaging

AVE N: A self-terminating, stable average processes "N" number of waveforms and then holds the result in memory. The "N" value may be selected using the SET N function (N=8, 16, 32, 64, 128, 256).

AVE: A continuous, stable averaging process. N waveforms are averaged as in AVE N, then additional waveforms are weighted at 1/N. In Roll mode, a running average (smooth) is available to provide high-frequency filtering.

Enveloping

ENV N: A self-terminating recording of waveform maxima and minima. When N waveforms are processed, the result is held in memory.

ENV: A continuous (infinite) recording of waveform maxima and minima.

Waveform Modifiers

VPUP ↑ (Vertical Position Up), VPDN ↓ (Vertical Position Down): Provide vertical positioning control of any stored waveforms.

VCMP ↕ (Vertically Compress), VXPD ↕ (Vertically Expand): Provide vertical display expansion or compression. Two expansions or compressions in 1-2-5 calibrated steps from the original V/div are available.

HMAG (Horizontal Magnify): Displays the cursor waveform horizontally magnified by a factor of 10.

Programmable Functions—All instrument settings and operating modes are programmable except for Variable V/div and Horizontal Position. However, these uncalibrated controls can be overridden and forced into the "CAL" position on command from the GPIB Interface. The display of Menu and ID is selectable from the front panel only.

Format—Device-dependent commands in ASCII. Waveform data points selectable as BINARY or ASCII.

Waveform Output Time—250 ms minimum for BINARY and 2.5 s minimum for ASCII. Actual transfer times depend upon the speed of the receiving device.

INPUTS

External Trigger (Front Panel)—Maximum Input Voltage: 250 V (dc + peak ac).

Signal Input Impedance—1 MΩ, paralleled by ≈20 pF.

Hold Next (Mainframe Rear Panel)—Initiates Hold Next condition; connected to Single-Sweep Reset connector.

OUTPUTS

Hold Next Ready—High level indicates unit is in Hold Next condition; output level remains low when unit is not in Hold Next condition; connected to Single-Sweep Ready connector.

+ Gate Out—Provides high-level output signal for duration of waveform/character readout.

PLUG-IN COMPATIBILITY

The 7D20 is compatible with all 7000-Series mainframes with the exception of the 7104. Use with the 7104 will void the 7104 warranty.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	206	8.1
Height	127	5.0
Depth	371	14.6
Weight ≈	**kg**	**lb**
Net	3.6	8.1
Shipping	8.0	17.8

ORDERING INFORMATION

7D20 Programmable Digitizer (Plug-In) **$7,590**
Includes: Instruction manual (070-3857-01); pocket reference guide (070-3205-01).

TekMAP SOFTWARE

S42P201 7D20/IBM PC Software **$450**
Includes: Operator manual.
Option 01—5¼ in. double-sided, dual density. **NC**

S42H201 7D20/HP Series 200 Software **$950**
Includes: Operator manual.
Option 01—5¼ in. double-sided, dual density. **NC**
Option 02—3½ in. double-sided, dual density. **NC**

7D20/Tek 4041 Software DC-100 Tape. Order 062-7732-00 **$150**
Includes: Operator manual.

UTILITY SOFTWARE

For more information on utility and application software, see the Test and Measurement Software Section or consult your local sales or applications engineer.
(7D20/4041) Order 062-6959-01 **$150**
(7D20/4052A) Order 062-6961-01 **$150**

RECOMMENDED PROBE

P6053B—Identify Probe for remote service request via probe's "Identify" button. 10X attenuation; 200-MHz bandwidth; scale factor coding; 6 ft. **$150**

RECOMMENDED MAINFRAME FOR 7D20

R7603 Option 20—The R7603 mainframe provides a 6-inch diagonal CRT display and three-wide plug-in compartment in a 5¼-inch-high rackmount configuration. Option 20 permits rear-panel access to the 7D20's GPIB Interface and includes cable 175-7151-00 required inside 7D20. **$5,015**

OPTIONAL ACCESSORIES

R7603 Field Kit—Adds Option 20 to a previously purchased standard R7603. This kit provides parts to connect the 7D20's GPIB Interface to the R7603 mainframe.
Order 040-1093-01. **$500**

HC100 Plotter—See Instrumentation Documentation Devices section. **$825**

TECHNICAL ASSISTANCE SERVICES

When you need technical assistance to supplement your own resources, Tektronix can arrange the services of an application engineer skilled in meeting your needs. For more information, see the Tektronix Solutions/New Products section or consult your local sales engineer.

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CRT-STORAGE OSCILLOSCOPES
In Order of Stored Writing Speed

Product	Stored Writing Speed	View Time	Type of Storage	Bandwidth*1	Maximum Sensitivity	Number of Channels	Delayed Sweep	Plug-In	Price
7934	8900 div/μs	30 s*3	Fast variable persistence	500 MHz	10 mV/div at BW	Up to 4	✓	✓	$13,620
	776 div/μs	30 min*4 minimum	Fast bistable						
	12 div/μs	30 s*3	Variable persistence						
	0.2 div/μs	30 min*4 minimum	Bistable						
7633	2200 div/μs	30 s*3	Fast variable persistence	100 MHz	5 mV/div at BW; 10 μV/div; 1 mA/div	Up to 4	✓	✓	$9,950
	400 div/μs	30 min minimum	Fast bistable						
	3 div/μs	30 s*3	Variable persistence						
	0.2 div/μs	30 min minimum	Bistable						
7623A	150 div/μs	30 s*3	Fast variable persistence	100 MHz	5 mV/div at BW; 10 μVdiv; 1 mA/div	Up to 4	✓	✓	$8,055
	50 div/μs	20 min minimum	Fast bistable						
	0.5 div/μs	30 s*3	Variable persistence						
	0.003 div/μs	30 min minimum	Bistable						
5441	5 div/μs	1 hr	Variable persistence	50 MHz	5 mV/div at BW; 10 μV/div; 0.5 mA/div	Up to 8	✓	✓	$6,675
5111A Opt 03	0.8 div/μs	10 hr	Bistable split screen	2 MHz	1 mV/div at BW; 10 μV/div; 0.5 mA/div	Up to 8	✓	✓	$3,645
5111A	0.05 div/μs								$3,440
214	0.5 div/μs	1 hr	Bistable	500 kHz	10 mV/div at BW; 1 mV/div	Up to 2			$2,865
314	0.5 div/μs	4 hr	Bistable	10 MHz	5 mV/div at BW	Up to 2			$5,085
SC 503*2	0.08 div/μs	4 hr	Bistable	10 MHz	1mV/div at BW	Up to 2			$4,160
5113	0.02 div/μs	10 hr	Bistable split screen	2 MHz	1 mV/div at BW; 10 μV/div; 0.5 mA/div	Up to 8 dual-beam	✓	✓	$4,815

*1 *Bandwidths are real time. Sampling plug-ins that extend bandwidth to 14 GHz are available for most 7000-series mainframes.*
*2 *The SC 503 is an oscilloscope that plugs into a TM 500/TM 5000 Mainframe for operation. See Modular Instruments section for details.*
*3 *View times are at full stored display intensity. They may be increased by using reduced intensity in the save display mode.*
*4 *Save intensity at minimum.*

PORTABLE CRT STORAGE OSCILLOSCOPES

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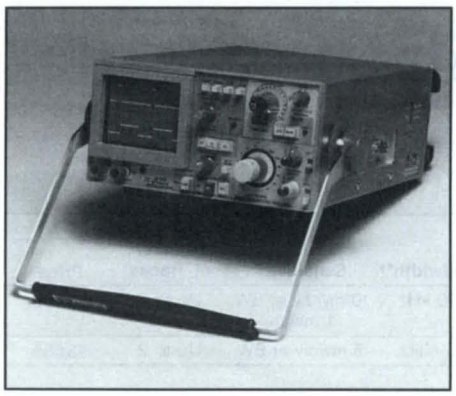
Product	Stored Writing Speed	View Time	Type of Storage	Bandwidth*[1]	Maximum Sensitivity	Number of Traces	Price
214	0.5 div/μs	1 hr	Bistable	500 kHz	10 mV/div at BW; 1 mV/div	Up to 2	$2,865
314	0.5 div/μs	4 hr	Bistable	10 MHz	5 mV/div at BW	Up to 2	$5,085

SONY®/ TEKTRONIX® 10-MHz DUAL-TRACE STORAGE OSCILLOSCOPE



314 Storage Oscilloscope

TYPICAL APPLICATIONS

- **Industrial Control Systems**
- **Biophysical Instrumentation**
- **Communication Equipment Service**

FEATURES

- **10 MHz at 1 mV/Div**
- **100-ns/Div Sweep Rate With X10 Sweep Magnifier**
- **Stored Viewing Time to 4 Hours**
- **Integrate Mode for Intensifying Fast Rise-Time, Low-Repetition-Rate Signals**
- **Operates From ac Line, 12, 24 V dc**

The 314 weighs only 10.5 pounds and provides four-hour stored viewing time. This long-term storage is useful for monitoring signal lines for suspected undesired transients. The compact size and ac or external dc operation allows the 314 to easily go where you need a storage scope. Additional applications include POS terminals, computer perepherals, and communication systems.

CHARACTERISTICS

VERTICAL SYSTEM

Bandwidth and Rise Time—DC to at least 10 MHz. Rise time: 35 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%. Uncalibrated: Continuously variable between steps to at least 25 V/div.

Display Modes—CH 1, CH 2 (normal or inverted), chopped, alternate, added, and X-Y.

Input R and C—1 MΩ paralleled by ≈ 47 pF.

Maximum Input Voltage—AC or DC coupled, 300 V (dc + peak ac).

Delay Line—Permits viewing leading edge of displayed waveform.

Amplitude Calibrator—0.5 V accurate ±1% from 20 to 30° C, ±2% from −15 to +55° C.

HORIZONTAL SYSTEM

Time Base—1 μs/div to 5 s/div. X10 magnifier 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*[1]

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%

*[1] *Center 8 divisions.*

TRIGGERING

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. Single sweep (one sweep is initiated by the first trigger after a reset).

Trigger Sources—Internal: CH 1, CH 2, or composite; external.

Sensitivity and Coupling

Coupling	1 MHz	10 MHz
DC Internal	0.3 div	1 div
DC 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 ≈62 pF.

CRT AND DISPLAY FEATURES

CRT—8×10-div (0.6 cm/div) display. Accelerating potential is 2 kV. GX (P44) phosphor.

Graticule—Internal, nonilluminated. Vertical and horizontal centerlines marked in 5 minor div per major 0.6 cm/div.

Z-Axis Input Range—+5 to +20 V (dc coupled) with a 100 kHz or greater usable frequency range. Maximum input voltage, 50 V (dc + peak ac).

STORAGE FEATURES

Display Modes—Direct view, bistable storage, and nonstore modes. Enhance mode to increase stored writing rate in the single-sweep mode. Autoerase mode to automatically erase stored display after each sweep. Viewing time before autoerase can be varied from 1 s or less to at least 5 s. 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.

POWER REQUIREMENTS

Line-Voltage Ranges—90 to 130 V ac or 180 to 264 V ac.

Line Frequency—48 to 440 Hz.

Power Consumption—29 W maximum at 115 V ac.

External DC Source—+11 to+14 V dc or +22 to +28 V dc.

DC Current Drain—1.6 A at +12 V or 0.8 A at +24 V.

ENVIRONMENTAL

Ambient Temperature—Operating: −15 to +55 °C. Nonoperating: −40 to +75 °C.

Altitude—Operating: 6000 m (20,000 ft) maximum, decrease maximum temperature by 1 °C/1000 ft from 5000 to 20,000 ft. Nonoperating: 15 000 m (50,000 ft) maximum.

Vibration— Operating: 15 minutes along each of the three major axes, 0.06 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.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width, w/handle	236	9.3
Height, w/o pouch	112	4.4
Depth, handle not extended	347	13.6
Weight ≈	**kg**	**lb**
Net, w/o accessories	4.7	10.5
Shipping	7.6	17.0

ORDERING INFORMATION

314 Storage Oscilloscope **$5,085**
Includes: Two P6149A 10X probes; carrying case and pouch (016-0612-00); strap (346-0131-02); external dc-cable assembly (012-0406-00); two 1.6-A fuses (159-0098-00); two 0.8-A fuses (159-0132-00); two 0.15-A fuses (159 0130-01); three 0.16-A fuses (159-0131-00); service manual (070-1824 00); operator manual (070-1823-00). The SONY®/TEKTRONIX® 314 is manufactured and marketed in Japan by Sony/Tektronix Corporation, Tokyo, Japan. Outside of Japan, the 314 is available from Tektronix, Inc., its marketing subsidiaries and distributors.

OPTIONAL ACCESSORIES

RECOMMENDED PROBES

P6149A—10X Probe **$115**

RECOMMENDED CAMERA

C-30BP Option 01—General Purpose Camera. **$1,665**

Camera Adapter—Required to mount the C-30BP to the 314. Order 016-0327-01 **$175**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

214 Storage Oscilloscope

TYPICAL APPLICATIONS

- **Industrial Control Systems**
- **Electromechanical Measurements**

FEATURES

- **500 kHz, 1 mV/Div to 50 V/Div**
- **Internal Battery**
- **Integral 1-MΩ Probe**
- **Weighs ≈1.6 kg (3.5 lb)**

The 214 is lightweight (only 3.5 pounds) and compact (3×5.3×9.5 inches). It offers bistable storage capabilities for viewing nonrepetitive or slow-moving signals.

Built of impact-resistant plastic and fully self contained, this miniature portable is ideal for applications in severe environments. It permits "floating" measurements since it is double insulated and can be elevated to 700 V (dc + ac) above ground when operated from batteries.

CHARACTERISTICS

VERTICAL SYSTEM

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 ≈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 (≈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—≈1 MΩ paralleled by ≈160 pF from 1 mV/div to 50 mV/div; and 140 pF from 100 mV/div to 50 V/div.

Maximum Input Voltage

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

*[1] *1X Probe only.*

HORIZONTAL SYSTEM

Time Base—5 μs/div to 500 ms/div, accurate ±5%.

Variable Magnifier—Increases each sweep rate X5 with a maximum 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 <3°. Input characteristics same as CH 1.

Maximum External Horizontal Input Voltage and Impedance—Same as for vertical inputs.

Input Impedance—R and C, 1 MΩ paralleled by ≈30 pF.

TRIGGERING

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

DC Coupling	To 500 Hz
Internal (w/composite trigger source)	0.2 div
Internal (w/CH 2 trigger source)	0.2 div
External	1 V

Maximum External Trigger Input Voltage—8 V (dc+peak ac), 16 V (p-p) at 500 kHz or less.

Single Sweep—Sweep generator produces one sweep when trigger is received.

CRT AND DISPLAY FEATURES

CRT—Bistable storage, 6×10-div (0.52 cm/div) display. GX (P44) phosphor.

Graticule—Internal, black line, nonilluminated.

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 fL at 25°C.

Storage Viewing Time—≈1 hour.

OTHER CHARACTERISTICS

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 1.4 times line voltage +dc +peak ac not to exceed 350 V.

Power Sources—Internal NiCad batteries provide ≈3.5 to 5 hours operation (≈2.5 to 3.5 hours in 214 stored mode) for a charging and operating temperature between +20 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 ≈10 V to protect batteries against deep discharge. Full recharge requires ≈16 hours. Extended charge times will not damage the batteries.

A pilot light battery-charge indicator light will extinguish when oscilloscope has about 5 minutes of operating time remaining in the batteries.

POWER REQUIREMENTS

Line-Voltage Range—110 to 126 V ac. Can be operated at 104 to 110 V with resulting slow discharge of batteries. Option 01 is 220 to 250 V. Option 02 is 90 to 110 V.

Line Frequency—58 to 62 Hz. Options 01 and 02 are 48 to 52 Hz.

Maximum Power Consumption—3 W.

ENVIRONMENTAL

Ambient Temperature—Operating (battery only): −15 to +55° C. Charging or operating from ac line: 0 to +40°C. Nonoperating: −40 to +60°C.

Altitude—Operating: 7600 m (25,000 ft), decrease maximum temperature by 1°C/1000 ft above 15,000 ft. Nonoperating: 15 000 m (50,000 ft).

Vibration—Operating and Nonoperating: 15 minutes along each of the 3 major axes, 0.06 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—95%, 5 cycles (120 hours). Referenced to MIL-T-28800C, par. 4.5.5.1.2.2.

Shock—Operating and Nonoperating: 150 g's, ½ sine, 2-ms duration in each direction along each major axis. Total of 12 shocks.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	133	5.3
Height	76	3.0
Depth	241	9.5
Weight ≈	**kg**	**lb**
Net w/o accessories	1.6	3.5
Shipping	3.2	7.0

ORDERING INFORMATION

214 Dual-Trace Storage Oscilloscope **$2,865**
Includes: Integral probe, batteries, viewing hood (016-0199-01); carrying case (016-0512-00); two 4-A fuses (159-0121-00); identification tags (000-7983-00); identification tag (334-2614 00); carrying strap (346-0104-00); service manual (070-5055-00); operator manual (070-5054-00).

OPTIONS

Option 01—For 220 to 250 V (48 to 52 Hz). **NC**

Option 02—For 90 to 110 V (48 to 52 Hz). **NC**

OPTIONAL ACCESSORIES

10X Attenuator Package—A slip-on tip to provide lower circuit loading (4.4 MΩ, ≈20 pF) and higher maximum input voltage 1000 V (dc +peak ac). Includes: flex tip (206-0060-00); 10X attenuator (010-0378-01); pincher tip (013-0071-00); banana tip (134-0013-00); IC adapter (206-0203-00). Order 010-0378-01 **$75**

Alligator Clip Kit—A pair of alligator clips that allow connecting the probe (or optional 10X attenuator) and ground lead to large (up to 3/8 in.) conductors. Includes: 6-32 to probe adapter (103-0051-01); red clip (015-0229-00); yellow clip (015-0230-01). Order 015-0231-00 **$32**

Probe Tips—BNC Adapters (Panel Connector) Order 013-0084-01 **$9.75**
(Cable Adapter) Order 103-0096-00 **$14**

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 **$9.25**

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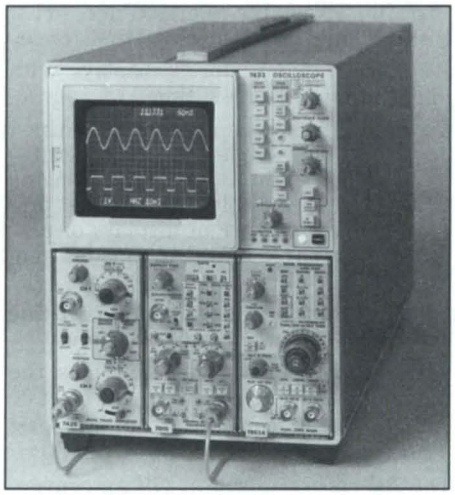
CRT-STORAGE OSCILLOSCOPES
In Order of Stored Writing Speed

Product	Stored Writing Speed	View Time	Type of Storage	Bandwidth*1	Maximum Sensitivity	Number of Traces	Delayed Sweep	Plug-In	Price
7934	8900 div/μs	30 s*2	Fast variable persistence	500 MHz	10 mV/div at BW	Up to 4	✓	✓	$13,620
	776 div/μs	30 min*3 minimum	Fast bistable						
	12 div/μs	30 s*2	Variable persistence						
	0.2 div/μs	30 min*3 minimum	Bistable						
7633	2200 div/μs	30 s*2	Fast variable persistence	100 MHz	5 mV/div at BW; 10 μV/div; 1 mA/div	Up to 4	✓	✓	$9,950
	400 div/μs	30 min minimum	Fast bistable						
	3 div/μs	30 s*2	Variable persistence						
	0.2 div/μs	30 min minimum	Bistable						
7623A	150 div/μs	30 s*2	Fast variable persistence	100 MHz	5 mV/div at BW; 10 μVdiv; 1 mA/div	Up to 4	✓	✓	$8,055
	50 div/μs	20 min minimum	Fast bistable						
	0.5 div/μs	30 s*2	Variable persistence						
	0.003 div/μs	30 min minimum	Bistable						
5441	5 div/μs	1 hr	Variable persistence	50 MHz	5 mV/div at BW; 10 μV/div; 0.5 mA/div	Up to 8	✓	✓	$6,675
5111A Opt 03	0.8 div/μs	10 hr	Bistable split screen	2 MHz	1 mV/div at BW; 10 μV/div; 0.5 mA/div	Up to 8	✓	✓	$3,645
5111A	0.05 div/μs								$3,440
5113	0.02 div/μs	10 hr	Bistable split screen	2 MHz	1 mV/div at BW; 10 μV/div; 0.5 mA/div	Up to 8 dual-beam	✓	✓	$4,815

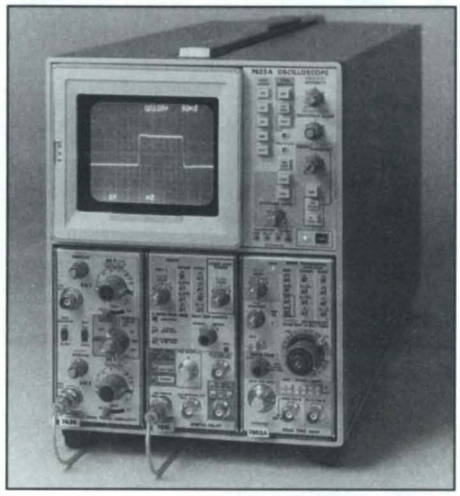
*1 *Bandwidths are real time. Sampling plug-ins that extend bandwidth to 14 GHz are available for most 7000-series mainframes.*
*2 *View times are at full stored display intensity. They may be increased by using reduced intensity in the save display mode.*
*3 *Save intensity at minimum.*

7000-SERIES CRT STORAGE OSCILLOSCOPES

7934



7633



7623A

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A Selection of Storage Modes

7000-Series CRT-storage mainframes offer a selection of storage modes and features:

- Bistable—For long view time
- Fast Bistable—Captures fast single or multiple events
- Variable Persistence—High-contrast displays
- Fast Variable Persistence—Provides maximum stored writing rate

Selection of Writing Speeds

CRT-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 4 cm/ns for capturing fast single events such as high-speed digital logic.

7000-SERIES CRT-STORAGE OSCILLOSCOPE SELECTION GUIDE

Features	7934	7633/R7633	7623A/R7623A
Bandwidth	500 MHz	100 MHz	100 MHz
Maximum Sweep Rate	500 ps/div	5 ns/div	5 ns/div
Rise Time	700 ps	3.5 ns	3.5 ns
Stored Writing Speed	4000 cm/μs	1000 cm/μs	135 cm/μs
Storage Mode			
Bistable	✓	✓	✓
Fast Bistable	✓	✓	✓
Variable Persistence	✓	✓	✓
Fast Variable Persistence	✓	✓	✓
Prices Begin At*[1]	$13,620	$9,950/$10,550	$8,055/$8,550

*[1] *Price does not include plug-in.*

7934 Storage Oscilloscope

TYPICAL APPLICATIONS

- **Laser Research**
- **High Speed Logic**
- **ESD Testing**
- **Data Base Analysis**

BENEFITS

- **Wide Selection of Versitile Plug-Ins**
- **View Low Rep Rate Signals**
- **Real Time Storage of Fast Transients for Later Analysis**

FEATURES

- **DC to 500-MHz Bandwidth**
- **700-ps Single-Shot Rise-Time Storage Capability**
- **4000-cm/μs Stored Writing Speed**
- **500-ps/Div Fastest Calibrated Sweep Rate**
- **Multimode Storage Flexibility**
- **Wide Selection of Plug-In Amplifiers and Time Bases**

The 7934 Storage Oscilloscope is designed for fast single-shot, low-repetition rate, and high-speed pulse analysis. The 7934 captures the most difficult types of signals for stored viewing and analysis. Capabilities include storing unexpected transient pulses common in power-generation and nuclear-test studies, high-frequency bursts occurring at low-repetition rates, and fast pulses in applications ranging from lasers to high-speed ECL design.

A 4000-cm/μs storage writing rate, 700-ps rise time, and 500-MHz bandwidth ensure undistorted capture and clear display of the fastest waveform details.

The 7934 stores single-shot rise times to 700 ps, 3.6-cm high, at eight-divisions amplitude, in the reduced-scan mode. The 7934's mainframe bandwidth is 500 MHz. The system bandwidth may vary from 80 MHz to 500 MHz, depending on the plug-in selected.*1

*1 *High-gain differential amplifiers offer very high gain at lower bandwidths.*

The instrument has four storage modes: Bistable, Variable Persistence, Fast Bistable, and Fast Variable Persistence.

Bistable provides stored displays with long (30 minute) view time.

Variable Persistence gives high-contrast displays of both single-shot and repetitive phenomena. When viewing changing waveshapes, variable persistence provides continuous bright displays of new information as old information fades from the CRT.

Fast Bistable increases bistable writing speed to 350 cm/μs (reduced scan).

Fast Variable Persistence provides the maximum stored writing speed of 4000 cm/μs (reduced scan). View time is at least 30 seconds.

The 7934 also offers Store Off for conventional oscilloscope use. . . Multitrace Delay to adjust view time before the next stored trace in Fast transfer. . . Storage Level for adjustable writing speed. . . Save to prevent display erasure and provide up to 30-times extension of viewing time in the variable persistence modes. . . Auto Erase with time interval selection to more than 10 seconds between erasures.

The 7934 has four plug-in compartments with pushbutton selection of active compartments and trigger sources. There is also a choice of over 30 Tektronix 7000-Series plug-in amplifiers, time bases, and special-purpose plug-ins. This provides the flexibility to design a complete measurement system to fit a specific need, and quickly change it when measurement needs change.

CHARACTERISTICS

VERTICAL SYSTEM

Channels—Two left-hand plug-in compartments. Compatible with all 7000-Series plug-ins.
Bandwidth—500 MHz with 7A29 Amplifier plug-in.
Rise Time—700 ps or less with 7A29 Amplifier plug-in (1.1 ns at 10 mV).
Bandwidth, Rise Time, and Deflection Factor—Determined by plug-in unit. See 7000-Series Vertical System Specifications.
Display Modes—Left, Alt, Add, Chop, Right. Chopped-mode repetition rate is ≈1 MHz.
Trace Separation—In dual-sweep modes, positions B trace at least four divisions above or below the A trace.
Delay Line—Permits viewing leading edge of displayed waveform (not recommended for use with 7B50 Series time bases).

HORIZONTAL SYSTEM

Channels—Two right-hand plug-in compartments. Compatible with most 7000-Series plug-ins. 7000-Series vertical amplifiers and special plug-ins may also be used.
Bandwidth—DC to at least 1 MHz.
Display Modes—A, Alt, Chop, B. Chopped-mode repetition rate is ≈200 kHz.
Fastest Calibrated Sweep Rate—500 ps/div.
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

CRT—Internal variable illuminated graticule. 8×10 division (0.9 cm/div) graticule in full scan and 8×10 division (0.45 cm/div) in reduced scan. Accelerating potential is ≈10 kV full-scan mode, and 12 kV in reduced scan-mode. GH (P31) phosphor standard.
Auto Focus—Maintains CRT focus following changes in display intensity after focus control has been set.
Beam Finder—Aids in locating an off-screen signal.
CRT Display Modes—Store Off, Bistable, Variable Persistence, Fast Bistable and Fast Variable Persistence (full and reduced scan).
Auto Erase—Continuously variable from <1 s to >10 s.
Multitrace Delay—Adjusts the transfer cycle time in the fast transfer modes. Continuously variable from <1 s to >4 s.
Persistence—(Variable-Persistence Mode only) Controls rate of continuous erasure of the variable-persistence and fast variable-persistence stored displays.
Save—Prevents display from being accidentally erased, and provides up to 30 times longer viewing times in variable-persistence modes.
External Z-Axis Input—2 V p-p for full intensity range from dc to 1 MHz. Positive signal blanks the trace. Maximum input voltage is 15 V (dc plus peak ac).

CALIBRATOR

Voltage Output—Square wave, positive going from ground.
Voltage Range—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 0.25%.
Current Output—40-mA square wave with optional current-loop accessory (012-0341-00) connected to calibrator output. Output R is 450 Ω.

OUTPUTS/INPUTS

+Sawtooth—Starts 1 V or less from ground into 1 MΩ. Output voltage is 1 V/div (±10%) into 1 MΩ, 50 mV/div (±15%) into 50 Ω. Output R is ≈950 Ω.
Bandwidth—Determined by vertical plug-in. See 7000-Series Reference section.
Vertical-Signal Out—Selected by B Trigger Source switch. Output voltage is 0.5 V (±10%) into 1 MΩ, 25 mV (±10%) into 50 Ω. Output R is ≈950 Ω.

Storage Writing Speed

Full Scan (Center 6×8 div at 0.9 cm/div)

Display Mode	Fast Variable Persistence	Fast Bistable	Variable Persistence	Bistable
Stored 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 (0.03 div/μs)
View Time	30 s*1	30 min	30 s*1	30 min
≈Erase Time	1.4 s	1.4 s	0.9 s	0.9 s

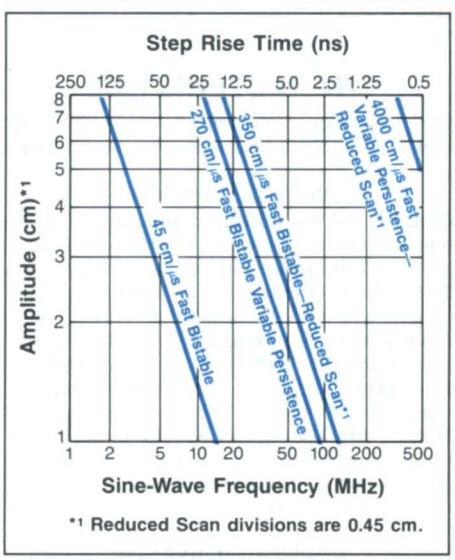
Reduced Scan (Center 8×10 div at 0.45 cm/div)

Display Mode	Fast Variable Persistence	Fast Bistable	Variable Persistence	Bistable
Stored Writing Speed	4000 cm/μs (8800 div/μs)	350 cm/μs (776 div/μs)	5.4 cm/μs (12 div/μs)	0.09 cm/μs (0.2 div/μs)
View Time*1	30 s*1	30 min	30 s*1	30 min
≈Erase Time	1.4 s	1.4 s	0.9 s	0.9 s

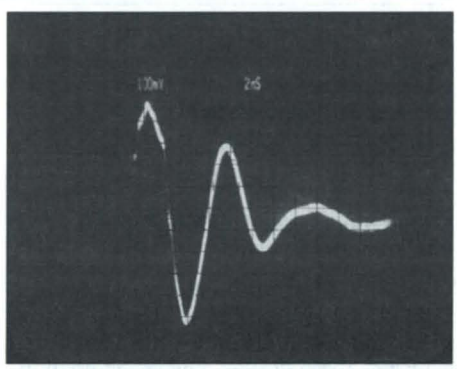
*1 *View times are at full stored display intensity. They may be increased more than 30 times by using reduced intensity in the Save display mode.*

Fast Variable Persistence Writing Speed

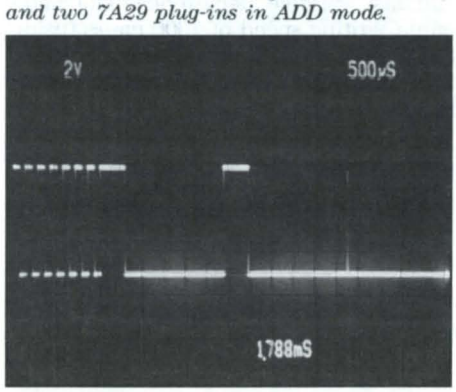
Scan Mode	Sweep Speed	Peak-to-Peak Sine Wave	Step Response
Reduced Scan 8,800 div/μs (0.45 cm/div	≥1 ns/div	7.1 div 325 MHz	7.7 div 1.07 ns
		8 div 290 MHz	8 div 1.2 ns
Full Scan 300 div/μs (0.9 cm/div)	≥ 10 ns/div	3.2 div 30 MHz	3 div 10 ns
		6.4 div 15 MHz	5 div 16.6 ns



Graph showing the stored writing speed needed to display a given sine wave or step rise time at a given amplitude.



In laser research—The 7934 captures a laser primary and reflected pulse using Fast Variable-Persistence storage (reduced scan) and two 7A29 plug-ins in ADD mode.



Glitch Capture—The 7934 captures a glitch (near the 8th) using a 7A29 plug-in and variable-persistence storage.

+Gate—Positive pulse of the same duration and coincident with sweep selectable from A Gate, B Gate, or A Delayed Gate. Output voltage is 10 V (±10%) into 1 MΩ, 0.5 V (±10%) into 50 Ω. Output R is ≈950 Ω.

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—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 for two active probes.

POWER REQUIREMENTS

Line-Voltage Ranges—90 to 132 V ac and 180 to 250 V ac.

Line Frequency—48 to 440 Hz.

Maximum Power Consumption—230 W.

ENVIRONMENTAL AND SAFETY

Ambient Temperature—Operating: 0 to +50°C. Nonoperating: −55 to +75°C.

Altitude—Operating: 5000 m (15,000 ft). Nonoperating: 15 000 m (50,000 ft).

Vibration—Operating: 15 minutes along each of the three major axes. 0.04 cm (0.015 in.) p-p displacement 10 to 55 to 10 Hz in one minute cycles. Held for three minutes at 55 Hz, referenced to MIL-T 28800C.

Humidity—Operating/Nonoperating: 95%, 5 cycles (120 hours), referenced to MIL-E-16400F.

Shock—Nonoperating: 30 g's, ½ sine, 11-ms duration in each direction along each major axis. Total of six shocks, referenced to MIL-T-28800C.

EMC Capabilty—Meets MIL-STD-461B requirements when tested in accordance with certain test methods of MIL-STD-462. Contact your Tektronix representative for more information.

Safety—UL listed (UL 1244) and CSA certified (CSA 556B); meets VDE 0871 Class B.

PHYSICAL CHARACTERISTICS

	Cabinet	Rackmount
Dimensions	**mm**	**in.**
Width	305	12.0
Height	345	13.6
Depth	622.5	24.5
Weight ≈	**kg**	**lb**
Net, without plug-ins	17.2	37.8
Shipping, without plug-ins	21.6	47.6

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

7934 Storage Oscilloscope **$13,620**
Includes: Installed gray CRT filter (378-0625-02); green CRT filter (378-0625-08); power cord (161-0066-00); operator's manual (070-5879-00).

OPTIONS

Option 02—X-Y Mode Phase Correction. Adds X-Y delay compensation network to equalize the signal delay between either vertical compartment and the B horizontal compartment. **+ $260**

Option 03—EMC capability. Adds special shielding for protection to the instrument when operated in severe EMC environments. **+ $395**

CONVERSION KITS

X-Y Mode Phase Correction—
Order 040-0942-01 **$210**

EMC Capability—
Order 040-1195-00 **$375**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

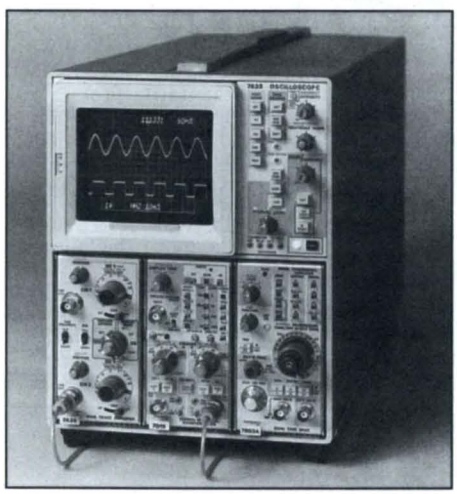
OPTIONAL ACCESSORIES

Service Manual—
Order 070-5880-00 **$30**

Cradle Mount Adaptor—For rack-mounting. Order 040-0560-00 **$535**

Recommended Plug-Ins, Probes, and Cameras—See 7000-Series Analog Reference section, page 201.

Recommended Cart—K213 Option 12, see Instrument/Cart Compatibility chart in Cart section.



7600 Series

FEATURES

- **DC to 100-MHz Bandwidth**
- **3.5-ns Rise Time**
- **5-ns/Div Fastest Calibrated Sweep Rate**
- **5.25-Inch Rackmount Height**
- **Long View Time**

BENEFITS

- **Large Selection of Plug-Ins**
- **Able to Capture and Store Fast Transients and Low Rep Rate Signals**

7633/R7633 Features

TYPICAL APPLICATIONS

- **Digital Design**
- **Destructive Testing**
- **Communications**

FEATURES

- **1000-cm/μs Stored Writing Speed**
- **Multimode Storage**

7623A/R7623A Features

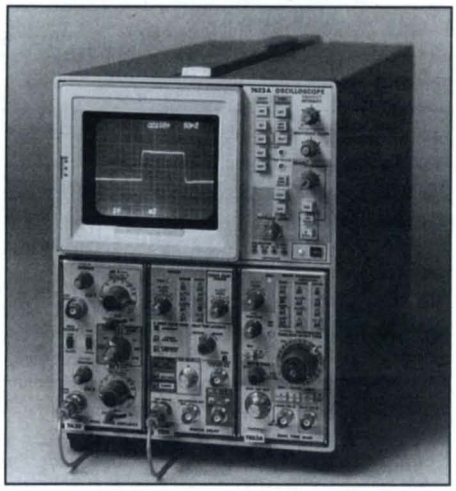
TYPICAL APPLICATIONS

- **Ultrasonics**
- **Power-Supply Design**
- **Component Testing**

FEATURES

- **135-cm/μs Stored Writing Speed**
- **Multimode Storage**

The 7633 Storage Oscilloscope provides 2200-div/μs (1000 cm/μs) stored writing speed and 100-MHz bandwidth. The instrument has three display modes— store, non-store, and save—and four storage modes—bistable, variable persistence, fast bistable, and fast variable persistence. The maximum writing speed of 1000 cm/μs (using the center 8×10 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 7623A/R7623A Storage Oscilloscopes have all the features and performance of the 7633/R7633 except the reduced-scan mode.

The R7633/R7623A require only 5.25 inches of rack height in a standard 19-inch rack. They are fan cooled and come complete with slide-out chassis tracks.

CHARACTERISTICS

Characteristics are common to the 7633/R7633 and 7623A/R7623A unless otherwise noted.

VERTICAL SYSTEM

Channels—Two left-hand plug-in compartments. Compatible with all 7000-Series plug-ins. See 7000-Series Reference section.
Bandwidth—Determined by mainframe and plug-in unit. See 7000-Series Reference section.
Rise Time—Determined by mainframe and plug-in unit. See 7000-Series Reference section.
Deflection Factor—Determined by plug-in unit. See 7000-Series Reference section.
Display Modes—Left, Alt, Add, Chop, Right. Chopped-mode repetition rate is ≈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. See 7000-Series Reference section.
Bandwidth—DC to at least 2 MHz.
Fastest Calibrated Sweep Rate—5 ns/div.
X-Y Mode—Phase shift <2° from dc to 35 kHz.

CRT AND DISPLAY FEATURES

CRT—Internal 8×10-division (0.9 cm/div) graticule with variable illumination. 7633/R7633 have additional (0.45 cm/div) graticule used in the reduced-scan mode. Accelerating potential is 8.5 kV (10 kV for 7633/R7633 in reduced-scan mode). GH (P31) phosphor is standard.

Autofocus—Reduces the need for additional manual focusing with changes in intensity after focus control has been set.

Beam Finder—Aids in locating an offscreen signal.

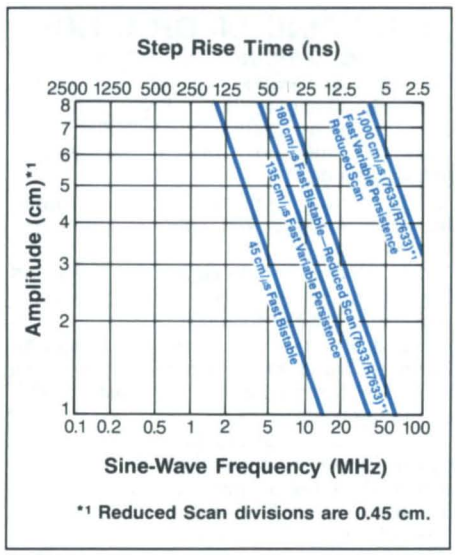
CRT Display Modes—Nonstore, Bistable, Variable Persistence, Fast Bistable, Fast Variable Persistence. Full or reduced scan may be selected on the 7633/R7633 in all display modes. Select normal scan to view the entire CRT; select reduced scan for the fastest writing rate.

Auto Erase—Continuously variable to >10s.

Save—Prevents accidental erasure of display and extends view time up to 30 times longer in all modes.

Persistence—(Variable) Controls rate of continuous erasure of stored displays.

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. Positive signal blanks the trace. Maximum input voltage is 10 V (dc + peak ac) and p-p ac.



Graph showing the stored writing speed needed to display a given sine wave or step rise time at a given amplitude.
*1 *Reduced Scan divisions are 0.45 cm.*

Storage Writing Speed

Full Scan

Display Mode	Fast Variable Persistence	Fast Bistable	Variable Persistence	Bistable
Stored Writing Speed	135 cm/μs	45 cm/μs	0.45 cm/μs	0.03 cm/μs
View Time	30 s*1	30 min minimum	30 s*1	30 min minimum
≈Erase Time	1.4 s	1.4 s	0.9 s	0.9 s

Reduced Scan

Display Mode	Fast Variable Persistence	Fast Bistable	Variable Persistence	Bistable
Stored Writing Speed	1000 cm/μs	180 cm/μs	1.35 cm/μs	0.09 cm/μs
View Time*1	30 s*1	30 min minimum	30 s*1	30 min minimum
≈Erase Time	1.4 s	1.4 s	0.9 s	0.9 s

*1 *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.*

Fast Variable Persistence Writing Speed

Scan Mode	Sweep Speed	Peak-to-Peak Sine Wave	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

CALIBRATOR

Voltage Output—Rectangular waveshape, positive going from ground (dc voltage available when selected by internal jumper).

Voltage Ranges—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 to 35°C); within 2% (0 to 50°C). Repetition rate is ≈1 kHz.

Current Output—40-mA rectangular waveshape with optional current-loop accessory (012-0259-00) connected between 4 V and ground-pin jacks. Output R is ≈450 Ω.

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-going waveform of the same duration and coincident with sweep selectable from main, delay, or auxiliary gate. 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%.

Vertical Signal Out—Selected by Trigger Source switch. Output voltage is 25 mV/div into 50 Ω, 0.5 V/div into 1 MΩ. Output R is 950 Ω within 2%. Bandwidth is determined by vertical plug-in. See 7000-Series Reference section.

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.

External Single-Sweep Reset—Ground closure; rear panel BNC input to reset sweep.

Remote Erase—Rear-panel BNC connector inputs, ground-closure activated.

POWER REQUIREMENTS

Line-Voltage Ranges—100, 110, 120, 200, 220, and 240 V ac ±10%; internally selectable with quick change jumpers.

Line Frequency—50 to 400 Hz.

Maximum Power Consumption—180 W, 2.0 A at 115-V line, 60 Hz. Fan cooling is provided for all models.

ENVIRONMENTAL AND SAFETY

Ambient Temperature—Operating: 0 to +50°C. Nonoperating: −55 to +75°C.
Altitude—Operating: 5000 m (15,000 ft). Nonoperating: 15 000 m (50,000 ft).
Vibration—Operating: 15 minutes along each of the three major axes. 0.04 cm (0.015 in.) p-p displacement 10 to 55 to 10 Hz in one minute cycles. Held for three minutes at 55 Hz (MIL-T-28800B).
Humidity—Operating and Nonoperating: 95%, five cycles (120 hours), referenced to MIL-E-16400F.
Shock—Nonoperating: 30 g's, ½ sine, 11-ms duration in each direction along each major axis. Total of six shocks (MIL-T-28800C).
EMC Capability—Meets MIL-STD-461B requirements when tested in accordance with certain test methods of MIL-STD-462. Contact your Tektronix representative for more information.
Safety—UL listed (UL 1244) and CSA certified (CSA 556B).

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	221	8.7	483	19.0
Height	305	12.0	135	5.3
Depth	597	23.5	566	22.3
Weights ≈	**kg**	**lb**	**kg**	**lb**
Net	13.6	30.0	14.5	32.0
Shipping	19.0	42.0	28.2	62.0

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

7633 Storage Oscilloscope **$9,950**
Includes: 20-in. two-pin-to-BNC cable (175-1178-00); green CRT filter (378-0625-08); power cord (161-0066-00); instruction manual (070-1767-00).
R7633 Storage Oscilloscope **$10,550**
Includes: Same as 7633 plus rackmounting hardware.
7623A Storage Oscilloscope **$8,055**
Includes: Same as 7633, instruction manual replaced with 070-1685-00.
R7623A Storage Oscilloscope **$8,550**
Includes: Same as 7633 plus rackmounting hardware, instruction manual replaced with 070-1685-00.

OPTIONS

Option 03—EMC capability. Adds special shielding for protection to the instrument when operated in severe EMI environments.
(7633/7623A) **+$395**
(R7633/R7623A) **+$375**
Option 08—(7633/7623A only) Protective Panel Cover. **+$115**
Option 23—(7633/7623A only) VDE RPM Mark. **+$50**

CONVERSION KITS

CRT Readout—
(7633/7623A) Order 040-0748-06 **$585**
(R7633/R7623A) Order 040-0759-06.*1
EMC Capability—
(7633/7623A) Order 040-0663-01 **$485**
(R7633/R7623A) Order 040-0678-01 **$395**
Power Supply—To light plug-in pushbuttons. Order 040-0686-01 **$90**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

*1 *Contact your local sales office.*

OPTIONAL ACCESSORIES

Recommended Plug-Ins—See Oscilloscope Plug-in section, page 277.
Recommended Probes—See Signal Acquisition section.

RECOMMENDED CARTS

K213 Opt 12—(7633/7623A) See Instrument/Cart Compatibility chart in Cart section. **$625**
K217—(R7633/R7623A) See Instrument/Cart Compatibility chart in Cart section. **$510**

K213 cart shown with optional plug-in storage and keyboard drawer (Option 22).

RECOMMENDED CAMERAS

C-53P—General purpose. See 7000 Series Analog Reference section and Instrumentation Documentation Devices Reference section. **$2,090**
C-5C—Option 01—Low cost. See 7000-Series Analog Reference section and Instrumentation Documentation Devices Reference section. **$495**
A6902B—
Allows high CMRR differential, floating, and high-voltage measurements safely. See Accessories section. **$1,980**

5000-SERIES CRT STORAGE OSCILLOSCOPES

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5441 50 MHz Storage Oscilloscope 274
R5441 50 MHz Rackmount Storage Oscilloscope 274
5111A 2 MHz Storage Oscilloscope 275
R5111A 2 MHz Rackmount Storage Oscilloscope 275
5113 2 MHz Storage Oscilloscope 275
R5113 2 MHz Rackmount Storage Oscilloscope 275
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Cameras/Video Copier/Plotter . 501
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The 5000-Series plug-in oscilloscope family is designed to provide maximum versatility and performance at the lowest possible price.

The 5100 Series mainframes provide real-time bandwidth to 2 MHz, sensitivity to 10 microvolts per division, CRT and digital storage, dual-sweep operation, and more.

The 5223 digitizing mainframe with the 5B25N time base provides digitization of signals to 10 MHz with optional GPIB interface.

The 5400-Series mainframes provide all of the capabilities of the 5100-Series mainframes plus 50-MHz bandwidth, variable-persistence storage, and CRT readout of vertical and horizontal scale factors.

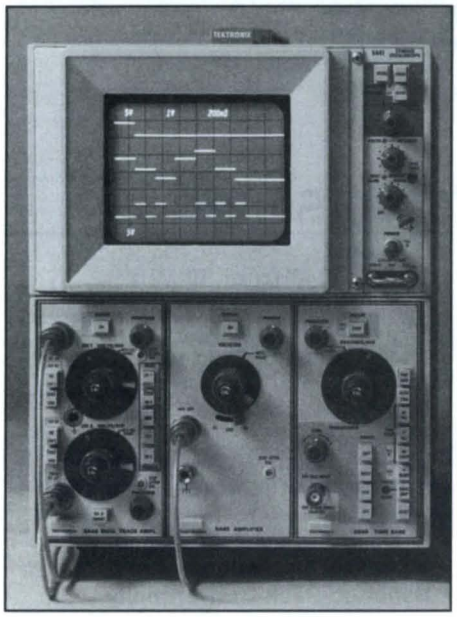
5000 Series

- **Low Cost**
- **2-MHz, 10-MHz, or 50-MHz Bandwidth**
- **10-μV/Div Sensitivity**
- **Wide Choice of Plug-Ins**
- **One- to Eight-Trace Capability**
- **Digital, Dual-Beam, & Storage Displays**
- **Large 6.5-Inch CRT (8×10 Div)**
- **CRT Readout (5400 Series and 5D10)**
- **Delayed-Sweep Time Bases**
- **Y-T or X-Y Operation**
- **Bench-to-Rack Convertibility**

5000-SERIES SELECTION GUIDE

Features	5441/R5441 Variable-Persistence Storage W/Readout	5111A/R5111A Bistable Storage	5113/R5113 Dual-Beam Bistable Storage
Bandwidth	50 MHz	2 MHz	2 MHz
Minimum Deflection Factor	5 mV/div at BW 10 μV/div 0.5 mA/div	1 mV/div at BW 10 μV/div 0.5 mA/div	1 mV/div at BW 10 μV/div 0.5 mA/div
Maximum Sweep Rate	10 ns/div	100 ns/div	100 ns/div
Eight Traces	✓	✓	✓Dual Beam
Delayed Sweep	✓	✓	✓
Prices*1 begin at	$6,675/$6,580	$3,440/$3,430	$4,815/$5,005

*1 *Price does not include plug-ins.*



5441/R5441

Storage Oscilloscope

TYPICAL APPLICATIONS

- **Ultrasonics**
- **Low-Power Laser**
- **Fiber Optics**

FEATURES

- **DC to 50 MHz**
- **CRT Readout**
- **Three Plug-In Flexibility**
- **Wide Choice of Plug-Ins**
- **Bench-to-Rack Convertibility**
- **Low Cost**
- **5-Div/μs Stored Writing Speed**
- **Variable-Persistence Storage**

The 5441 combines versatility and low cost in a 50-MHz general-purpose, plug-in oscilloscope. This oscilloscope features CRT readout of plug-in scale factors, sensitivities to 10 microvolts per division, display of up to eight different signals at two different sweep rates, a three plug-in mainframe, a wide choice of plug-ins, and bench-to-rack convertibility.

Plug-in scale factors are displayed on the CRT, so measurement time and operator errors are reduced by taking into account magnifiers and probe attenuators. The CRT readout can also be accessed externally to allow the display of dates, times, test numbers, etc., along with displayed waveforms. (Order Option 03, User Addressable CRT Readout.)

The variable persistence of the 5441 provides the ideal means of viewing hard-to-observe signals such as fast single-shot transients and very-low-frequency phenomena that require a very slowly moving trace on the CRT. Variable-persistence storage may be used to completely eliminate the flicker inherent in low-rep-rate traces. The viewing time at normal intensity for any trace can be varied from a fraction of a second to more than five minutes. At lowered intensity (SAVE mode), signals may be viewed for up to an hour.

In addition to permitting viewing of single-shot and low-frequency phenomena, the variable persistence of the 5441 may also be used to suppress the random noise that obscures the true waveform in signals with low signal-to-noise ratio.

The wide variety of plug-ins allows an oscilloscope/plug-in configuration to meet your current and future needs. All of the plug-ins in the 5000 Series are compatible with the 5441.*[1]

*[1] *Plug-ins with a suffix N (5B12N, etc.) do not provide CRT readout. The 5B10N and 5B12N Time Bases do not permit viewing the leading edge of a triggered waveform when used in the 5400 Series.*

CHARACTERISTICS

VERTICAL SYSTEM

Channels—Left and center plug-in compartments. Compatible with all 5000-Series plug-ins. CRT readout is not available with plug-ins having a suffix N (5A18N, etc.).
Bandwidth—Up to 50 MHz, determined by plug-in unit. See 5000-Series Reference section.
Deflection Factor—Determined by plug-in unit. See 5000-Series Reference section.
Chopped Mode—The oscilloscope will chop between channels at ≈ 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 switching to the second amplifier.

HORIZONTAL SYSTEM

Channel—Right plug-in compartment. Compatible with all 5000-Series plug-ins. CRT readout is not available for plug-ins with a Suffix N (5B10N, etc.).
Internal Trigger Mode—Left vertical, right vertical.
Fastest Calibrated Sweep Rate—10 ns/div, determined by plug-in.
X-Y Mode—Phase shift is within 2° from dc to 20 kHz.

CRT AND DISPLAY FEATURES

CRT—Internal, parallax-free, 8×10 div (0.9 cm/div) illuminated graticule. Accelerating potential is 8.5 kV. GH (P31) phosphor standard.
Autofocus—Reduces the need for manual focusing with changes in intensity after focus control has been set.
External Intensity Input—+5 V turns beam on from off condition. −5 V turns beam off from on condition. Frequency range is dc to 2 MHz. Input R and C is ≈10 kΩ paralleled by ≈40 pF. Maximum input is ±50 V (dc + peak ac).
Beam Finder—Brings offscreen trace into graticule area.
Persistence—Continuously variable, may be turned off when not needed, thus producing high-contrast stored displays without the characteristic fading of variable persistence.

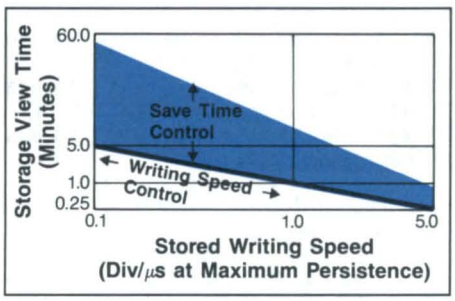
PHOTOGRAPHIC WRITING SPEED

Writing Speed cm/μs				Camera	Lens
GH (P31) Phosphor		BE (P11) Phosphor			
20,000 ASA	3000 ASA	20,000 ASA	3000 ASA		
180	90	245	125	C-59P	f/2.8 0.67 mag
330	160	450	230	C-50P*[1]	f/2.8 0.7 mag

*[1] *Slight cropping of the graticule corners.*

Maximum Stored Writing Speed—Writing speed >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 maximum writing speed, the view time is 15 seconds 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 five minutes (refer to chart below).
Save Mode—Extends view time of stored displays up to one hour; prevents erasure of stored display and storage of unwanted displays.
Erase Time—0.5 s ±10%.



STORED WRITING SPEED (Div/μs at Maximum Persistence)

CALIBRATOR

Voltage—400 mV within 1%.
Current Output—4 mA within 1%. Frequency is two times the power-line frequency.

POWER REQUIREMENTS

Line Voltage Ranges—100, 110, 120, 200, 220, and 240 V ac ±10% (except that maximum input should not exceed 250 V ac), internally selected with quick-change jumpers.
Line Frequency—48 to 440 Hz.
Maximum Power Consumption—100 W at 120 V ac, 60 Hz.

ENVIRONMENTAL

Ambient Temperature—Operating: 0 to +50°C. Nonoperating: −40 to +70°C.
Altitude—Operating: 5000 m (15,000 ft). Nonoperating: 15 000 m (50,000 ft).

ORDERING INFORMATION

(Plug-ins not included)

5441 Storage Oscilloscope **$6,675**
Includes: Instruction manual (070-2140-01).
R5441 Rackmount Oscilloscope **$6,580**
Includes: Same as 5441.

OPTIONS

Option 01—Without CRT Readout. **NC**
Option 03—User-Addressable CRT Readout. Up to 20 user-selected characters may be displayed in the CRT readout for additional test information such as time, date, device tested, test number, etc. Especially useful for documenting photographs. Programming of characters is done by external resistors and switches. **+$150**
Option 04—Protective Panel Cover. **+$40**

CONVERSION KITS

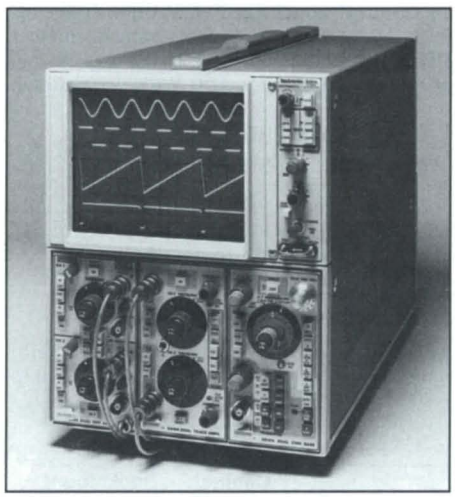
CRT Readout—Order 040-0691-02 **$580**
Cabinet-to-Rackmount—Order 040-0583-03 **$250**
Rackmount-to-Cabinet—Order 040-0584-04 **$225**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.

OPTIONAL ACCESSORIES

Recommended Plug-Ins—See page 277.
Recommended Probes—See page 277.
Recommended Cameras—See Instrumentation Documentation Devices section.
Recommended Cart—K213
Option 12. See Cart section. **$625**



5111A/R5111A

TYPICAL APPLICATIONS

- **Electromechanical Design and Test**
- **Vibration Analysis**

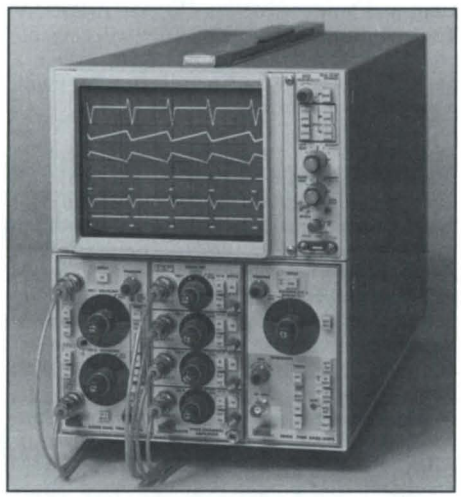
FEATURES

- **Single-Beam Bistable-Storage Oscilloscope**
- **Split-Screen Display**
- **Stored Writing Speed to 800 Div/ms in Enhanced Mode (Option 03)**

The 5111A is a single-beam, split-screen, bistable-storage oscilloscope with a large 6½-inch diagonal display. The 5111A extends measurement capability into areas requiring retention of single and multitrace displays for long-term examination and/or photography. It is particularly useful for recording low- and medium-frequency signals.

The standard 5111A provides writing speeds to 50 div/ms; Option 03 extends the writing speed to 800 div/ms, suitable for capturing a single-shot display of a 60-kHz sine wave four divisions in amplitude.

Up to eight traces can be displayed and stored simultaneously with two 5A14N amplifier plug-in units. When using two amplifiers and the 5B12N dual time base in the dual-sweep mode, the two sweeps are slaved individually to the two amplifiers.



5113/R5113

TYPICAL APPLICATIONS

- **Biomedical Research**
- **Low-Repetition Rate Observation**

FEATURES

- **Dual-Beam Bistable-Storage Oscilloscope**
- **Split-Screen Display**
- **Two Independent Vertical Systems**
- **Two Single-Shot Display Signals**
- **Display Without Time-Sharing**
- **Stored Writing Speed ≥20 Div/ms**

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. View time is at least one hour at normal intensity and can be increased to ten hours 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 simultaneously observed and recorded.

CHARACTERISTICS

Characteristics are the same for the 5111A/R5111A and 5113/R5113 unless otherwise indicated.

VERTICAL SYSTEM

Channels—Left and center plug-in compartments. Compatible with all 5000-Series plug-ins. See 5000-Series Reference section.

Deflection Factor and Bandwidth—Determined by plug-in. See 5000-Series Reference section.

Chopped Mode—(5110/R5110, 5111A/R5111A) The mainframe vertical amplifier will chop between left and center plug-in compartments, and/or between two or more amplifier channels. The total time segment per channel is ≈5 μs, consisting of ≈4 μs displayed, ≈1 μs blanked. Chop or alternate mode is selected at the time-base unit.

Chopped Mode—(5113/R5113) The left and right mainframe vertical amplifiers are dedicated to the left and center plug-in compartments, respectively. Each mainframe vertical amplifier will chop between two or more channels in their associated plug-in compartments. No channel switching is necessary between left and center plug-in compartments. The total time segment per channel is ≈5 μs, consisting of 4 μs displayed, ≈1 μs blanked. Chop or alternate mode is selected at the time-base unit.

Alternate Mode—(5110/R5110, 5111A/R5111A) Each amplifier plug-in is swept twice before switching to the next. Single-trace amplifiers are swept twice. Each channel of a dual-trace amplifier is swept once before switching to the second amplifier.

Alternate Mode—(5113/R5113) 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 plug-in compartment. Compatible with all 5100-Series plug-ins. See 5000-Series Reference section.

Fastest Calibrated Sweep Rate—0.1 μs/div (X10 mag) with 5B10N or 5B12N.

X-Y Mode—Phase shift is within 1° from dc to 100 kHz.

CRT AND DISPLAY FEATURES

CRT—Internal 8 x 10 div (1.27 cm/div) parallax-free, nonilluminated graticule. Illuminated graticule available at extra cost.

Accelerating Potential—5110/R5110, 5111A/R5111A, 5113/R5113: 3.5 kV.

Standard Phosphor—5110/R5110: GH (P31). 5111A/R5111A, 5113/R5113: Equivalent to GJ (P1).

Optional Phosphors (Specify)—(5110/R5110 only) GM (P7) or BE (P11).

Beam Finder—Aids in locating an off-screen signal.

Maximum Stored Writing Speed—(5111A and 5113 only) 5111A/R5111A: At least 20 div/ms in the Normal Mode and 50 div/ms in the Enhanced Mode. 5113/R5113: At least 20 div/ms.

With Option 03, Fast-Writing-Speed CRT—(5111A and 5113 only) At least 200 div/ms (center 6 x 8 div) in the Normal Mode and 800 div/ms (center 6 x 8 div) in the Enhanced Mode.

Storage View Time—(5111A and 5113 only) At least one hour at normal intensity; up to ten hours at reduced intensity, after which time it may be increased to original level.

Erase Time—(5111A and 5113 only) ≈250 ms.

CALIBRATOR

Voltage Output—Square wave, positive going from ground.

Voltage Range—400 mV within 1%.

Current Output—4 mA with current loop. Frequency is two times the line frequency.

OUTPUTS/INPUTS

External Intensity Input—+5 V turns beam on from off condition. −5 V turns beam off from on condition. Frequency range is dc to 1 MHz. Input R and C is ≈10 kΩ paralleled by ≈40 pF. Maximum input is ±50 V (dc + peak ac).

POWER REQUIREMENTS

Line-Voltage Ranges—100, 110, 120, 200, 220, and 240 V ac ±10% (except that maximum input should not exceed 250 V ac). Internally selected with quick-change jumpers.

Line Frequency—48 to 440 Hz.

Maximum Power Consumption—110 W.

ENVIRONMENTAL

Ambient Temperature—5110/5111A/5113: Operating, 0 to +50°C; nonoperating, −40 to +70°C.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	213	8.4	483	19.0
Height	302	11.9	135	5.3
Depth	518	20.4	483	19.0
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	10.4	23.0	10.9	24.0
Shipping	14.5	32.0	19.5	43.0

OPTION 07

Rear-Panel Signal Outputs

CHARACTERISTICS

Left and Center Compartments—Two BNC connectors provide access to the CRT-related signals from the left and center plug-in amplifiers. Sensitivity: 0.5 V/CRT division. Output impedance: 1 kΩ.

Right Compartment—Sweep: One BNC connector provides access to the CRT-related sweep waveform. Sensitivity is 0.5 V/CRT division; positive going sawtooth, ≥ 5 V. Output Impedance is 1 kΩ. Gate: One BNC connector provides access to TTL-compatible gate. Positive going, coincident with displayed sweep.

X-Y Mode—CRT-related X-Y signals are available at the appropriate rear-panel connectors when amplifier plug-ins are used in either the left or center compartment and the right compartment to display X-Y information. Sensitivity (X-Y): 0.5 V/CRT division.

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

Ordering information is common to all units unless otherwise noted.

5111A Storage Oscilloscope **$3,440**
Includes: Power cord (161-0066-00); instruction manual (070-3934-00).

R5111A Storage Oscilloscope **$3,430**
Includes: Same as 5111A.

5113 Storage Oscilloscope **$4,815**
Includes: Instruction manual (070-2137-01).

R5113 Storage Oscilloscope **$5,005**
Includes: Same as 5113.

OPTIONS

Option 02—(5110, 5111A, 5113 only) Protective Panel Cover. The cover protects the front panel and knobs during transportation and storage. **+$40**

Option 03—Fast Write CRT increases stored writing speed to 200 div/ms (center 6×8 div).
(5111A/R5111A/R5113A). **+$205**
(5113). **+$150**

Option 07—Add Rear-Panel Signals Out. **+$130**

CONVERSION KITS

Cabinet-to-Rackmount Conversion Kit—Order 040-0583-03. **$250**

Rackmount-to-Cabinet Conversion Kit—Order 040-0584-04. **$225**

Protective Panel Cover Kit—(5111A, 5113 only) Order 040-0620-00. **$45**

Rear Panel Signal Outputs—Order 040-0915-02. **$400**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

OPTIONAL ACCESSORIES

Recommended Plug-Ins and Probes—See Plug-In section and Signal Acquisition section.

Recommended Cart—K213
Option 12. See Cart section. **$625**

Recommended Cameras—See Instrumentation Documentation Devices section.

C-5C—Low cost. **$495**

C-59AP—General purpose for 5100 Series. **$1,475**

C-7—AutoFilm Eject. **$610**

OSCILLOSCOPE PLUG-INS

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11000-SERIES PLUG-INS

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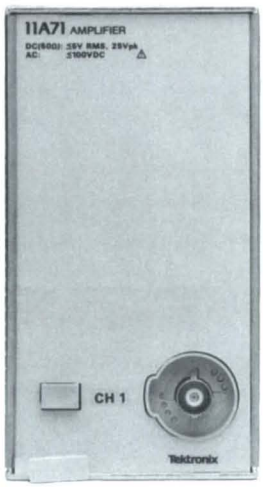
11000 -Series Plug-Ins

- **Single Trace (11A71)**
- **Dual Trace (11A32, 11A52)**
- **Differential (11A33)**
- **Four Channel (11A34)**
- **Up to 500-MHz Bandwidth (With 11302)**
- **Up to 1-GHz Bandwidth (With 11402)**
- **1-mV/Div Deflection Factor**
- **Calibrated Offset With Fast Overdrive Recovery**
- **Switchable Input Impedances**

Wide bandwidth, unsurpassed accuracy, clean response, low noise, and calibrated dc offset with fast overdrive recovery characterize the amplifier plug-in units available for use with the Tektronix 11000-Series Plug-in Oscilloscopes. The 11A71 provides 1-GHz bandwidth in the 11402 digitizing mainframe and up to 500-MHz bandwidth in the 11302A and 11401 mainframes. The 11000-Series Maximum Bandwidth Matrix at the start of this section shows the bandwidth of each of the amplifier plug-in units in each of the four 11000-Series mainframes.

Control of the 11000-Series plug-ins is accomplished through the mainframe controls, either manually or over the IEEE-488 or RS-232C bus. The only control on the amplifier plug-ins is a single pushbutton for each channel. This button is used only to turn the display of the associated channel on and off; it has no effect on the availability of the input signal to the triggering system.

Each of the input channels on all amplifier plug-ins uses the new TEKPROBE™ interface. This interface allows the mainframe to supply power to active probes, to sense the type (and, with some probes, the serial number) of the probe, to supply offset voltage to probes so equipped, to detect activation of the probe's ID pushbutton, and to provide other communication between probe and oscilloscope as appropriate to the type of probe. A serial data line in the TEKPROBE™ interface provides the means for a high level of communication with current and future special-purpose probes.



11A71 Amplifier

11A71

- **DC to 1 GHz Bandwidth (in 11402)**
- **Single Trace**
- **10-mV to 1-V/Div Calibrated Deflection Factors**
- **±10-Div Offset**
- **50-Ω Input Impedance**

The single-channel 11A71 is the highest bandwidth amplifier currently available for the Tektronix 11000-Series mainframes. It provides 1-GHz bandwidth in the 11402 digitizing mainframe and 500-MHz bandwidth in the 11401 digitizing mainframe and 11302 analog mainframe.

DC offset can be set to 40 steps per division over a range of ±10 div at all sensitivities.

CHARACTERISTICS

Number of Channels—One.

Bandwidth—All Deflection Factors

11301A	11302A	11401/11402
400 MHz	500 MHz	500 MHz/1 GHz

Deflection Factor—10 mV to 1 V/div in 1-2-5 sequence.

Accuracy—
ΔVolts dc accuracy:
With 11301/11302: ±(0.9% +0.05 div).
With 11401/11402: ±(0.7% +0.03 div).
DC Balance: ±0.2 div.

Input Impedance—50 Ω ±2%; VSWR ≤1.45:1 @ 10 mV/div. DC to 1 GHz.
VSWR ≤1.25: @ 20 mV/div. to 1 V/div., dc to 1 GHz.

Input Coupling Modes—AC, DC, OFF.

Offset Range—±10 divisions, 0.025 division resolution, all deflection factors.

Max Input Voltage—50-Ω input automatically disconnects when the signal exceeds safe limits. Manual reset.

Typical Noise (RMS)—0.01 div.

ORDERING INFORMATION

11A71 Single-Channel Vertical Amplifier **$2,700**
Includes: Operator manual supplement.
Option 26—Includes one P6231 probe. **+$410**

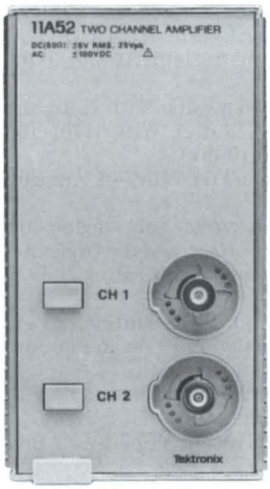
OPTIONAL ACCESSORIES

Service Manual—
Order 070-6787-00. **$50**
Recommended Probe—P6231 10X 1.5 GHz active probe. See other recommended probes on page 282. **$410**
Optical to Electrical Converters—
P6701 **$1,900**
P6702 **$2,095**
Spatial Input Head—
P6751 **$310**

See Signal Acquisition section for complete description.

11000 SERIES SCOPE/PLUG-IN MAXIMUM BANDWIDTH MATRIX

Scope/Plug-in	11A71	11A52	11A32	11A34	11A33
11401A/	500 MHz	500 MHz	350 MHz	300 MHz	150 MHz
11402A	1 GHz	600 MHz	400 MHz	300 MHz	150 MHz
11601	1 GHz	600 MHz	400 MHz	300 MHz	150 MHz
11602	1 GHz	600 MHz	400 MHz	300 MHz	150 MHz



11A52 Two-Channel Amplifier

11A52

- **DC to 600-MHz Bandwidth (in 11402)**
- **Dual Trace**
- **1-mV to 10-V/Div Calibrated Deflection Factors in 1% Increments**
- **50-Ω Input Impedance**
- **High-Resolution Calibrated DC Offset**
- **Fast Overdrive Recovery**

The 11A52 is a high bandwidth dual-trace amplifier plug-in available for the 11000-Series mainframes.

The 11A52 provides 600-MHz bandwidth in the 11402 digitizing mainframe and 400-MHz bandwidth in the 11302 analog mainframe. Two built-in four-pole bandwidth-limiting filters (100 and 20 MHz) may be activated to reduce unwanted high-frequency noise at 24 dB/octave.

Both coarse and fine deflection-factor steps are fully calibrated. At 1 mV/div, the high-resolution calibrated dc offset has a setability of 25 μV and a range of ±1 V (equivalent to 16 bits), giving an effective screen height of 2000 divisions and permitting absolute dc measurement accuracies to ±0.3%.

CHARACTERISTICS

Number of Channels—Two.

Bandwidth (MHz)

Volts/ div	11301A	11302A	11401/ 11402
>10 mV	350	400	500/600
5 to 9.95 mV	300	350	350/400
2 to 4.98 mV	250	250	250
1 to 1.99 mV	200	200	200

Calibrated Deflection Factors—Coarse: 1 mV to 10 V/div in 1-2-5 steps. Fine: between coarse steps in 1% increments of next more sensitive coarse step.

Accuracy—
ΔVolts dc accuracy:
With 11301/11302: ±(1.0% +0.04 div).
With 11401/11402: ±(0.8% +0.01 div).
DC Balance, 1 to 99.5 mV/div: With 11301 and 11302: ±(0.2 mV+0.13 div). With 11401 and 11402: ±(0.2 mV+0.10 div).
Offset Accuracy, 1 to 99.5 mV/div (±1 V range): ±(0.15% +0.4 mV).
For absolute dc accuracy of single-point measurements using offset, add the Offset Accuracy and DC Balance terms.

Offset Range—
1 to 99.5 mV/div: ±1 V; Resolution: 25 μV. 100 mV to 0.995 V/div: ±10 V; Resolution: 250 μV. 1 to 10 V/div: ±100 V; Resolution: 2.5 mV.

Overdrive Recovery—1 to 99.5 mV/div: To within ±(0.1% +0.2 div) within 20 ns from ±2 V step.

Typical Noise (RMS)—
1 to 1.99 mV/div: 0.087 div.
2 to 4.98 mV/div: 0.04 div.
5 to 9.95 mV/div: 0.02 div.
10 mV to 10 V/div: 0.012 div.

Input Impedance—50 Ω ±0.5%; VSWR: <1.3:1 dc to 500 MHz.

Input Coupling Modes—AC, DC, and OFF.

Maximum Input Voltage—Input automatically disconnects when the input signal exceeds safe limits. Manual reset.

ORDERING INFORMATION

11A52 Two-Channel Vertical Amplifier **$2,405**
Includes: Operator manual supplement.

OPTION

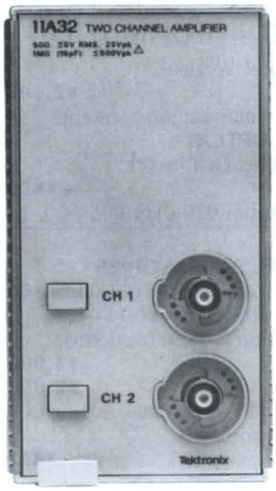
Option 25—Includes two P6231 probes. **+$820**
Includes: User manual 070-6114-00.

OPTIONAL ACCESSORIES

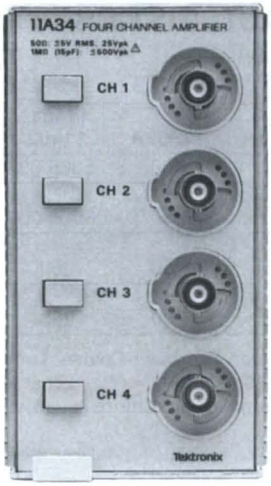
Service Manual—Order 070-6786-00. **$50**

Optical to Electrical Converters—
See Signal Acquisition section for description.
P6701 **$1,900**
P6702 **$2,095**

Spatial Input Head—See Signal Acquisition section for description.
P6751 **$310**



11A32 Two-Channel Amplifier



11A34 Four-Channel Amplifier

11A32/11A34

- **DC to 400-MHz Bandwidth (11A32 in 11402 Mainframe)**
- **Dual Trace (11A32) or Four Trace (11A34)**
- **1-mV to 10-V/Div Calibrated Deflection Factors in 1% Increments**
- **Switchable 50-Ω or 1-MΩ Input Impedance**
- **High-Resolution Calibrated DC Offset**
- **Fast Overdrive Recovery**

The 11A32 and 11A34 amplifier plug-in units are virtually identical to one another except for the number of channels. The 11A32 is a dual-trace unit, and the 11A34 is a four-trace unit. The bandwidth of the 11A32 is slightly higher than that of the 11A34 in each of the 11000-Series mainframes.

Two built-in four-pole bandwidth-limit filters (100 and 20 MHz) may be activated to reduce unwanted high-frequency noise at 24 dB/octave for each channel.

Both coarse and fine deflection-factor steps are fully calibrated. At 1 mV/div, the high-resolution calibrated dc offset has a setability of 25 μV and a range of ±1 V (equivalent to 16 bits), giving an effective screen height of 2000 div and permitting absolute dc measurement accuracies to ±0.4%.

CHARACTERISTICS

Number of Channels—11A32: Two; 11A34: Four.

Calibrated Deflection Factors—Coarse steps: 1 mV to 10 V/div in 1-2-5 sequence. Fine steps: Between coarse steps in 1% increments of next more-sensitive coarse step.

Bandwidth—11A32

Volts/div	11301A	11302A	11401	11402
>10 mV	300 MHz	350 MHz	350 MHz	400 MHz
5 to 9.95 mV	250 MHz	250 MHz	300 MHz	350 MHz
2 to 4.98 mV	200 MHz	200 MHz	250 MHz	250 MHz
1 to 1.99 mV	200 MHz	200 MHz	200 MHz	200 MHz

Bandwidth—11A34

Volts/div	11301	11302	11401	11402
>10 mV	250 MHz	250 MHz	300 MHz	300 MHz
5 to 9.95 mV	250 MHz	250 MHz	250 MHz	250 MHz
2 to 4.98 mV	200 MHz	200 MHz	200 MHz	200 MHz
1 to 1.99 mV	150 MHz	150 MHz	150 MHz	150 MHz

Accuracy—
ΔVolts dc accuracy: With 11301A/11302A: ±(1.0% +0.04 div). With 11401/11402: ±(0.9% +0.012 div).
DC Balance, 1 to 99.5 mV/div: With 11301 and 11302: ±(1.0 mV+0.13 div). With 11401 and 11402: ±(1.0 mV+0.10 div).
Offset Accuracy, 1 to 99.5 mV/div (±1 V range): ±(0.2% +0.5 mV).
For absolute dc accuracy of single-point measurements using offset, add the Offset Accuracy and DC Balance terms.
Offset Range—
1 to 99.5 mV/div: ±1 V; Resolution: 25 μV.
100 mV to 0.995 V/div: ±10 V; Resolution: 250 μV.
1 to 10 V/div: ±100 V; Resolution: 2.5 mV.
Overdrive Recovery—
1 to 99.5 mV/div: To within ±(0.3% +0.2 div) within 50 ns from ±2 V step.
100 to 995 mV/div: To within ±1% within 50 ns from ± 20 V step.
1 to 10 V/div: To within ±1% within 50 ns from ±200 V step.
Typical Noise (RMS)—
1 to 1.99 mV/div: 0.12 div.
2 to 4.98 mV/div: 0.06 div.
4 to 9.95 mV/div: 0.025 div.
10 mV to 10 V/div: 0.014 div.
Input Impedance—Switchable 1 MΩ in parallel with 15 pF, or 50 Ω ±0.5%.
Input Coupling Modes—AC, DC, and OFF.
Maximum Input Voltage—1 MΩ: 500 V (dc + peak ac). 50 Ω: Input automatically disconnects when the input signal exceeds safe limits. Manual reset.

ORDERING INFORMATION

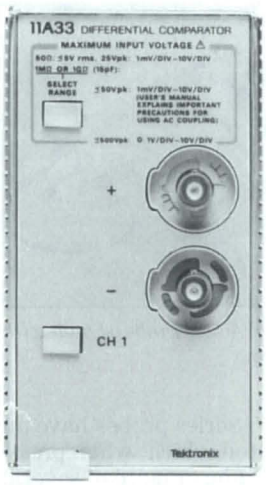
11A32 Two-Channel Vertical Amplifier **$2,025**
Includes: Operator manual supplement.
11A34 Four-Channel Vertical Amplifier **$3,525**
Includes: Operator manual supplement.

OPTIONS

Option 22—(11A32) Includes two P6134 probes. **+$340**
Option 23—(11A34) Includes four P6134 probes. **+$680**

OPTIONAL ACCESSORY

Service Manual—
(11A32) Order 070-6782-01. **$50**
(11A34) Order 070-6785-01. **$50**



11A33 Differential Comparator

11A33

- **Differential Comparator**
- **DC to 150-MHz Bandwidth**
- **1-mV to 10-V/Div Calibrated Deflection Factors in 1% Increments**
- **Very-High-Resolution Calibrated DC Offset**
- **16000-Division Effective Screen Height**
- **High Common-Mode Rejection**
- **Fast Overdrive Recovery From Large Input Signals**
- **Selectable 50-Ω, 1-MΩ, or 1-GΩ Input Impedance**

The 11A33 Differential Comparator plug-in is a single-channel differential amplifier with high common-mode-rejection ratio and fast overdrive recovery from large signals. As a differential amplifier, common-mode input-voltage range is ±8 V at 1 mV/div. As a comparator, the built-in comparison voltage (Vc) is used to measure the fine structure of very large signals with unprecedented accuracy and resolution.

Maximum bandwidth in the 11301A, 11302A, 11401, and 11402 mainframes is 150 MHz. Two built-in four-pole bandwidth-limit filters (100 and 20 MHz) may be activated to reduce unwanted high-frequency noise at 24 dB/octave for each channel.

Both coarse and fine deflection factors are fully calibrated. At 1 mV/div, the high-resolution comparison voltage has a setability of 25 μV throughout its ±8 V range (equivalent to 19 bits), giving an effective screen height of 16,000 div and permitting absolute dc measurement accuracies of ±0.2%.

CHARACTERISTICS

Number of Channels—One.
Bandwidth—DC to 150 MHz in 11301A, 11302A, 11401, and 11402 mainframes. (DC to 120 MHz at 1 mV/div.)
Calibrated Deflection Factors—Coarse steps: 1 mV to 10 V/div in 1-2-5 sequence. Fine steps: Between coarse steps in 1% increments of next more-sensitive coarse step.
Accuracy—ΔVolts dc accuracy: With 11301A/11302A: ±(1.0% +0.04 div). With 11401/11402: ±(0.9% +0.01 div).
DC Balance, 1 to 99.5 mV/div: With 11301A and 11302A: ±(0.5 mV+0.13 div). With 11401 and 11402: ±(0.5 mV+0.10 div).
Vc Accuracy, 1 to 99.5 mV/div (8 V range): ±(0.15% +0.6 mV).
For absolute dc accuracy of single point measurements using Vc, add the Vc Accuracy and dc balance terms.
Vc Range—
1 to 99.5 mV/div: ±8 V; Resolution: 25 μV. 100 mV to 0.995 V/div: ±80 V; Resolution: 250 μV. 1 to 10 V/div: ±500 V; Resolution: 2.5 mV.
Overdrive Recovery—Recovers to within 0.25% of overdriving signal within 40 ns; to within 2 mV in 100 μs; to within 1 mV in 300 μs. Conditions: 1 to 99.5 V/div; Overdriving signal steps to 0.0 V from ±8.0 Volts; Slew rate ≤0.5 V/ns.
Typical Noise (RMS)—
1 to 1.99 mV: 0.24 div.
2 to 4.98 mV: 0.12 div.
5 to 9.95 mV/div: 0.05 div.
10 mV to 10 V/div: 0.03 div.
Common-Mode-Rejection Ratio—1 to 99.5 mV/div: 10,000:1 dc to 1 MHz; 2000:1 at 5 MHz (8 V p-p signal).
100 mV to 0.995 V/div: 1000:1 dc to 1 MHz; 100:1 at 10 to 20 MHz (30 V p-p signal).
1 to 10 V/div: 500:1 dc to 250 kHz (100 V p-p signal).
Input Impedance—50 Ω, 1 MΩ in parallel with 15 pF, or 1 GΩ in parallel with 15 pF from 1 to 99.5 mV/div.
Input Coupling Modes—AC, DC, and OFF (each input).
Max Input Voltage—1-MΩ mode: 1 to 99.5 mV/div: 40 V (dc + peak ac); 100 mV to 0.995 V/div: 400 V (dc + peak ac); 1 to 10 V/div: 500 V (dc + peak ac). (At 1 to 99.5 mV/div, derate max input voltage at 20 dB/decade above 3 MHz; at 100 mV to 10 V/div, derate max input voltage at 20 dB/decade above 1 MHz.)
50 Ω: Input automatically disconnects when the input signal exceeds safe limits. Manual reset.

ORDERING INFORMATION

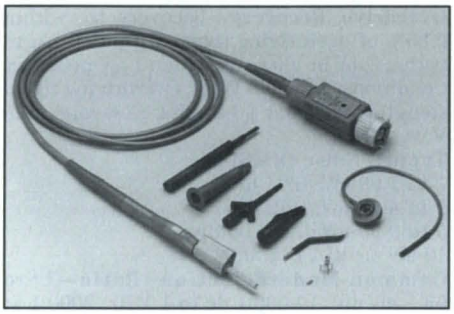
11A33 Differential Comparator **$3,000**
Includes: Operator manual supplement.

OPTION

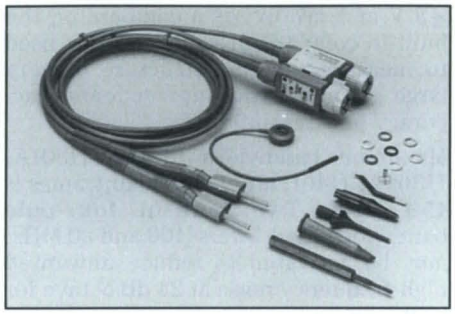
Option 24—Includes a P6135 probe pair. **+$495**

OPTIONAL ACCESSORY

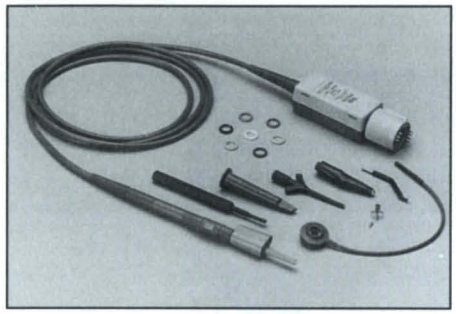
Service Manual—Order 070-6784-00. **$50**



P6134 10X, 10-Megohm Passive Probe (shown with typical accessories).



P6135 10X, Matched Pair of 1-Megohm Differential Passive Probes (shown with typical accessories).



P6231 10X, 450-ohm Active Probe (shown with typical accessories).

P6134 10X, 10-MΩ Passive Probe

P6135 10X, Matched Pair of 1-MΩ Differential Passive Probes

NEW P6156 10X, 3.5 GHz Passive Probe

NEW P6203 10X, >10-KΩ Active (Bipolar) Probe

NEW P6204 10X, 10-MΩ Active (FET) Probe

P6231 10X, 450-Ω Active Probe

Six high-performance probes round out the capabilities of the 11000-Series oscilloscopes and plug-ins.

The P6134 is a 10X, 300 MHz passive voltage probe that is intended primarily for use with the 11A32 and 11A34, with their one megohm input impedances.

The P6135 is actually a matched pair of probes clipped together at the scope input end. The P6135 has dc attenuation and ac compensation adjustments that allows matching of one probe-oscilloscope amplifier input (probe plus scope) to the other probe-oscilloscope amplifier input. This probe-oscilloscope input matching provides high common-mode rejection at the probe tip with minimal loss to the 11A33 Differential Comparator plug-in common mode performance.

The P6156 3.5 GHz, low impedance probe (low input R, low input C) comes standard with a 10X (500 ohm) attenuator tip. Attenuation values of 1X, 20X, and 100X are available as options to the standard products. Standard accessories include a probe carrying case and a probe tip holder for storing the optional attenuator tips.

The P6203 is a 10X, 1 GHz, medium impedance (medium input R, low input C), miniature size active (Bipolar) probe intended for use in testing high-speed logic and analog circuitry. The P6203 provides a variable (±10 V) is adjustable via mainframe controls, allowing offset of any dc component within the range of the control. This allows signals with dc components to be brought into the probes' dynamic range.

Although primarily designed for the 11A52 and 11A71 plug-ins, the P6203 and P6204 active probes may be used with other 11000 Series plug-ins.

The P6231 is a 1.5 GHz, low impedance, subminiature, 10X active probe intended primarily for use with high-speed logic circuits. The P6231 provides a *nulling voltage*, adjustable via the mainframe controls over a ±5 V range. This nulling voltage reduces the dc loading effects of the probe when it is used to measure signals whose mid-voltage is other than ground level.

The 50-ohm termination required by the P6203, P6204, and P6231 at the plug-in input is automatically accommodated by the 11000 Series mainframe. When an 11000 Series active probe is connected to an input connector of an 11A32, 11A33, or 11A34 Amplifier plug-in unit, the plug-in input impedance is automatically switched to 50 ohm. The 11A52 and 11A71 Amplifier plug-ins have fixed 50-ohm input impedances.

Each of the 11000 Series probes have an "IDENTIFY" button which, when pressed, will cause any one or more of several actions to be taken by the mainframe-autoset: recall the next in a series of stored setups, invoke the automatic-measurement function, or issue an SRQ. These actions are selectable via the mainframe UTILITY major menu.

All of the 11000 Series probes make use of the probe interface of the 11000 Series plug-ins. Each of the probes communicates its attenuation ratio to the mainframe. Power for the P6231 active probe comes through that interface, eliminating the need for a special power cable or power source. The bias voltage for the P6231 is applied through that interface. The P6231 also communicates its type and serial number through the serial-data communication lines in the interface connector. Sensing of the pressing of the ID buttons on the probes is done through the interface.

All of the probes are compatible with the subminiature accessories shown in the Signal Acquisition section, including the KLIPKIT.

Other voltage probes described in this catalog (that can be compensated to 1 Megohm and 15 pF or to 50 ohm) can be used with the 11000 Series plug-in units, including the operation of the ID button on probes so equipped. Refer to the Signal Acquisition section (page 518) for compatibility and full descriptions of all available Tektronix signal probes and other accessories.

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7000 SERIES VERTICAL SYSTEM SPECIFICATIONS

Plug-in		7A13	7A18A	7A19	7A22	7A24	7A26	7A29	7A42	7F10A
Features		Differential dc offset, high-freq CMRR amplifier	Dual-channel amplifier	Wide band-width 50-Ω input amplifier	DC-coupled high-gain differential amplifier	Dual-channel 50-Ω amplifier	Dual-channel amplifier	Widest bandwidth single channel	Four-channel logic triggered	Optical/ Electrical converter w/built-in amplifier
Minimum Deflection Factor		1 mV/div	5 mV/div	10 mV/div	10 μV/div	5 mV/div	5 mV/div	10 mV/div	20 mV/div	2 μW/div
Accuracy*1 Without Probe		1.5%	2%	2%	3%	2%	2%	2%	3%	—
7104										
R7103	BW	105 MHz	75 MHz	600 MHz	1 MHz ±10%	400 MHz	200 MHz	1000 MHz	350 MHz	750 MHz
0 to 35°C	T_r	3.4 ns	4.7 ns	0.6 ns	350 ns ±9%	0.9 ns	1.8 ns	0.35 ns	1.0 ns	
7904A										
R7903	BW	105 MHz	75 MHz	500 MHz	1 MHz ±10%	350 MHz	200 MHz	500 MHz	300 MHz	400 MHz
7934	T_r	3.4 ns	4.7 ns	0.8 ns	350 ns ±9%	1.0 ns	1.8 ns	0.7 ns*5	1.2 ns	
0 to 30°C	SIG OUT	100 MHz	90 MHz	300 MHz	1 MHz ±9%	140 MHz	140 MHz	300 MHz	NA	300 MHz
7912HB*4	BW	105 MHz	75 MHz	500 MHz	1 MHz ±10%	350 MHz	200 MHz	700 MHz	300 MHz	400 MHz
0 to 30°C	T_r	3.4 ns	4.7 ns	0.8 ns	350 ns ±9%	1.0 ns	1.8 ns	0.525 ns	1.2 ns	
R7844	BW	100 MHz	75 MHz	400 MHz*2	1 MHz ±10%	300 MHz	180 MHz	400 MHz	275 MHz	300 MHz
0 to 35°C	T_r	3.5 ns	4.7 ns	0.9 ns	350 ns ±9%	1.2 ns	1.9 ns	0.9 ns	1.3 ns	
7854*3	BW	100 MHz	75 MHz	400 MHz*2	1 MHz ±10%	300 MHz	180 MHz	400 MHz	275 MHz	300 MHz
0 to 35°C	T_r	3.5 ns	4.7 ns	0.9 ns	350 ns ±9%	1.2 ns	1.9 ns	0.9 ns	1.3 ns	
7603/R	BW	75 MHz	75 MHz	100 MHz	1 MHz ±10%	100 MHz	100 MHz	100 MHz	100 MHz	100 MHz
	T_r	4.8 ns	4.7 ns	3.5 ns	350 ns ±9%	3.5 ns	3.5 ns	3.5 ns	3.5 ns	
0 to 50°C	SIG OUT	55 MHz	50 MHz	65 MHz	1 MHz ±10%	60 MHz	60 MHz	65 MHz	NA	65 MHz
7633/R	BW	75 MHz	75 MHz	100 MHz	1 MHz ±10%	100 MHz	100 MHz	100 MHz	100 MHz	100 MHz
7623A/R	T_r	4.8 ns	4.7 ns	3.5 ns	350 ns ±9%	3.5 ns	3.5 ns	3.5 ns	3.5 ns	
0 to 50°C	SIG OUT	55 MHz	50 MHz	65 MHz	1 MHz ±10%	60 MHz	60 MHz	65 MHz	NA	65 MHz
	BW									
7612D	T_r	65 MHz	65 MHz	80 MHz	1 MHz ±10%	80 MHz	80 MHz	80 MHz	80 MHz	80 MHz
0 to 40°C	SIG OUT	6.0 ns	6.0 ns	5.0 ns	350 ns ±9%	5.0 ns	5.0 ns	5.0 ns	5.0 ns	
Price		$3,655	$1,620	$3,010	$2,040	$2,760	$2,470	$3,540	$5,950	*6

*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 *Bandwidth is 325 MHz at 10 mV/div.*

*3 *Bandwidth with equivalent time sampling and time display only.*

*4 *Fully programmable mainframe. 7A29P Programmable Amplifier recommended for 750-MHz bandwidth.*

*5 *R7903 with 7A29 T_r is 0.8 ns.*

*6 *Contact your local sales office.*

7000 SERIES OSCILLOSCOPE SYSTEMS/PROBE SELECTION GUIDE*1
(All bandwidths given in MHz.)

This selection guide lists the most popular combinations for optimum performance, but is not all inclusive. Current probes and other compatible probes are listed in the Probes section.

		Passive 1-MΩ Input								Passive 50-Ω Input		Active 50-Ω/1-MΩ Inputs			
Probe		P6101A 1 m	P6105A 2 m	P6130 1.5 m P6106A 1 m	P6131 1.3 m	P6055*2 3.5 ft	P6062B*5 6 ft	P6009 9 ft	P6015 10 ft	P6056 1.5 m	P6057 6 ft	P6201*4 6 ft	P6202A*4 2 m	P6230*4 1.5 m	P6046 6 ft
7100 Family	7A19	NC	NC	NC	NC	NC	NC	NC	NC	500	480	430	300	480	100
	7A24	NC	NC	NC	NC	NC	NC	NC	NC	350	350	310	300	350	100
	7A26	34	100	175	NC			125	75			195	185	200	90
	7A29	NC	NC	NC	NC	NC	NC	NC	NC	950	800	660	450	800	100
	7A42	34	100	250	300			130	80	350	350	300	280	350	100
7900 Family	7A13	34	75	105	NC	65		85		65		105	105	105	70
	7A18A	34	75	75	NC		75	70	60		75	75	75	75	60
	7A19	NC	NC	NC	NC	NC	NC	NC	NC	500	480	430	300	480	95
	7A22	1	NC	NC	NC	1	1								
	7A24	NC	NC	NC	NC	NC	NC	NC	NC	350	350	310	290	350	90
	7A26	34	100	175	NC			125	75			185	185	290	85
	7A42	34	100	250	300			130	80	300	300	300	300	300	90
7800 Family	7A13	34	100	100	NC	65		85	60			100	100	100	70
	7A18A	34	85	85	NC		85	80	60			90	75	90	65
	7A19	NC	NC	NC	NC	NC	NC	NC	NC	400	400	360	320	400	95
	7A22	1	1	NC	NC	1	1	1	1						
	7A24	NC	NC	NC	NC	NC	NC	NC	NC	300	300	280	270	300	90
	7A26	34	100	145	NC			105	75			155	150	180	85
	7A42	34	100	200	275			110	75	275	275	260	260	275	90
7600 Family	7A13	34	70	75	NC	55	70	60	55			75	75	75	55
	7A18A	34	70	70	NC		70	65	55			75	75	75	55
	7A22	1	1	NC	NC	1	1								
	7A26	34	95	95	NC		95	85	65			100	100	100	70
	7A42	34	95	95	100		95	85	65			100	100	100	70

*1 *The values in the above table represent the approximate useful frequency response for the measurement systems at the probe tip.*

*2 *Matched pair recommended.*

*3 *Option 09 Mainframe. Requires 1101/1101A Power Supply or other external source of power when used with 7854, 7603, 7633, or 7623.*

*4 *Bandwidths given for 10X switch position. NC = Not Compatible. If there is no bandwidth specified, the probe/plug-in combination is compatible but not recommended.*

PROBE FEATURES

Passive Voltage 1-MΩ Compatible
P6101A and P6105A—Miniature, 1X
P6130 and P6106A—Miniature, fast rise time, 10X
P6131—Subminiature, fast rise time, 10X
P6055—Adjustable attenuation, 10X High CMRR
P6062B—Selectable 1X, 10X attenuation
P6009—100X, 1.5 kV
P6015—1000X, 40-kV peak

Passive Voltage 50-Ω Input Compatible
P6056—Fastest 10X passive probe
P6057—Fastest 100X passive probe

Active 50-Ω/1-MΩ Input Compatible
P6201—Low capacitive loading, AC coupling, DC offset
P6202A—10-MΩ input impedance,DC offset
P6230—ECL bias/offset 10X
P6046—Differential, high CMRR

7000-SERIES MAINFRAME/TIME BASE/CAMERA SELECTION GUIDE

	Time Bases						Cameras					
Plug-In	**7B53A**	**7B80**	**7B85**	**7B92A**	**7B10**	**7B15**	**C-51**	**C-53**	**C-59**	**C-5C**	**C-7**	**C-4 Opt 02**
Features*1	**Dual Time Base with Mixed Sweep**	**Single Time Base**	**Single Time Base with Delaying Δ Delay**	**Dual Time Base with Display Switching**	**Single Time Base**	**Single Time Base with Delaying Δ Delay**	**High Writing Rate**	**General Purpose**	**General Purpose**	**Low Cost**	**Low Cost**	**Low Cost**
7104/R7103				✓	✓	✓		✓		✓	✓	✓
7904A/R7903		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
7934		✓	✓	✓	✓	✓		✓		✓	✓	✓
R7844		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
7854	Opt 05*2	✓	✓*2	✓*2	✓	✓*2	✓	✓		✓	✓	✓
7603/R7603	✓								✓	✓	✓	✓
7633 7623A/R7623	✓							✓		✓	✓	✓
Prices begin at	$2,290	$1,885	$2,140	$3,870	$2,800	$3,000	$2,510	$2,090	$1,475	$495	$610	$410

*1 *Camera/time base recommendation the same for rack mount version of scope.*
*2 *Single-sweep mode operable for real time only.*

7000 SERIES MAINFRAMES AND PLUG-INS DIMENSIONS AND WEIGHTS

ANALOG SCOPES

Dimensions		**7104**	**R7103**	**7904A**	**R7903**	**7934**	**R7844**	**7603**	**R7603**	**7633, 7623A**	**R7633, R7623A**
Width	mm	305	483	305	483	305	483	221	483	221	483
	in.	12.0	19.0	12.0	19.0	12.0	19.0	8.7	19.0	8.7	19.0
Height	mm	345	178	345	135	345	178	290	133	305	133
	in.	13.6	7.0	13.6	5.3	13.6	7.0	11.4	5.3	12.0	5.3
Depth	mm	592	704	577	579	622	630	610	627	597	566
	in.	23.3	27.7	22.7	22.8	24.5	24.8	24.0	24.7	23.5	22.3
Weights ≈											
Net	kg	19.8	20.0	16.9	12.3	17.2	15.0	13.6	13.6	13.6	14.5
	lb	45.0	44.0	37.2	27.0	37.8	33.0	30.0	30.0	30.0	32.0
Shipping	kg	25.4	30.9	21.4	23.6	21.6	28.5	20.8	19.0	19.0	28.2
	lb	56.0	68.0	52.0	47.6	47.0	63.0	46.0	42.0	42.0	62.0

DIGITAL SCOPES/DIGITIZERS/PLUG-INS

				Plug-Ins	
Dimensions		**7912HB**	**7854***	**Single**	**Double**
Width	mm	483	305	71	140
	in.	19.0	12.0	2.8	5.5
Height	mm	178	348	127	127
	in.	7.0	13.7	5.0	5.0
Depth	mm	679	627	368	368
	in.	26.8	24.7	14.5	14.5
Weights ≈					
Net	kg	24.7	20.4	0.9	4.1
	lb	54.6	45.0	2.0	9.0
Shipping	kg	32.6	28.1	2.3	5.4
	lb	72.0	62.0	5.0	12.0

* *Calculator dimensions and weights, width 277 mm (10.9 in), height 69 mm (2.7 in), depth 165 mm (6.5 in).*

7A29 DC to 1-GHz Amplifier

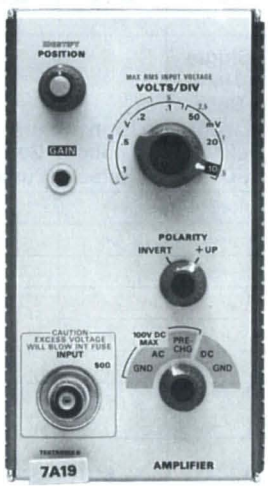
7A29

- **DC to 1-GHz Bandwidth**
- **10-mV to 1-V/Div Calibrated Deflection Factors**
- **50-Ω Input**
- **±500-ps Variable Delay Line (Option 04)**

The 7A29 is a high-performance, wideband, single-trace amplifier that provides a bandwidth of 1 GHz in the 7100-Series mainframes. Bandwidth is constant over the entire range of calibrated deflection sensitivities of 10 mV to 1 V/div. Input impedance is 50 Ω. Manually resettable input-protection circuitry protects the input against most common overloads. Polarity of the display is selectable by a front-panel switch. An optional variable delay line (front-panel adjustable) permits matching the transit time of two 7A29s and/or probes to better than 10 ps.

CHARACTERISTICS

Bandwidth—DC Coupled: 1 GHz (10 mV to 1 V/div).
Deflection Factor—Calibrated: 10 mV to 1 V/div in seven steps (1 2-5 sequence). Accuracy is within 2% with gain adjusted at 0.1 V/div. Uncalibrated: Variable continuously between steps and a maximum of at least 2.5 V/div (with some bandwidth reduction).
Input Z—50 Ω.
AC Coupling—−3 dB at 1 kHz or less from a 50-Ω source.



7A19 DC to 600-MHz Amplifier

Option 04, Variable Signal Delay—Permits matching the transit time of two preamps and probes to better than 10 ps. Range is ±500 ps.
Maximum Input Voltage—DC Coupled: 50 or 10 V RMS (whichever is less). AC Coupled: 100 V additional.
DC Stability—Drift with Ambient Temperature (Line Voltage Constant): 0.04 div/°C or less.
Input 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.

ORDERING INFORMATION

7A29 Amplifier **$3,540**
Includes: Instruction manual (070-2320-00).
Option 04—Variable Signal Delay. **+$435**

7A19

- **DC to 600-MHz Bandwidth**
- **10-mV to 1-V/Div Calibrated Deflection Factors**
- **50-Ω Input**
- **±500-ps Variable Delay Line (Option 04)**

The 7A19 is a high-performance, wideband, single-trace amplifier that provides a bandwidth of 600 MHz in the 7100-Series mainframes. Bandwidth is constant over the entire range of calibrated deflection sensitivities of 10 mV to 1 V/div. Input impedance is 50 Ω. An optional variable delay line (front-panel adjustable) permits matching the transit time of two 7A19s and/or probes to better than 50 ps.

CHARACTERISTICS

Bandwidth—DC Coupled: 600 MHz (10 mV to 1 V/div).
Deflection Factor—Calibrated: 10 mV to 1 V/div in seven steps (1-2-5 sequence). Accuracy is within 3%.
Input Z—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.
Maximum Input Voltage—DC Coupled: 50 or 10 V RMS (whichever is less). AC Coupled: 100 V additional.
DC Stability—Drift with Ambient Temperature (Line Voltage Constant): 100 μV/°C or less.

ORDERING INFORMATION

7A19 Amplifier **$3,010**
Includes: Instruction manual (070-2129-00).
Option 04—Variable Signal Delay. **+$435**

7A24 DC to 400-MHz Amplifier

7A24

- **DC to 400-MHz Bandwidth**
- **5-mV to 1-V/Div Calibrated Deflection Factors**
- **50-Ω Input**

The 7A24 is a high-performance, wide-band, dual-trace amplifier that provides 400-MHz bandwidth in the 7100-Series mainframes. Bandwidth is constant over the entire range of deflection sensitivities from 5 mV to 1 V/div. Input impedance is 50 Ω. The 7A24 features five operating modes, trigger-source selectability, and trace identify.

CHARACTERISTICS

Bandwidth—DC Coupled: 400 MHz (5 mV to 1 V/div).
Deflection Factor—Calibrated: 5 mV to 1 V/div in eight steps (1-2-5 sequence). Accuracy is within 2% with gain adjusted at 5 mV/div. Uncalibrated: Variable continuously between steps to a maximum of at least 2.5 V/div.
Input Z—50 Ω within 0.5%;

VSWR

	≤1.25	DC to 350 MHz
5 mV–20 mV	≤1.40	350 to 400 MHz
50 mV–1 V	≤1.20	DC to 400 MHz

Maximum Input Voltage—DC Coupled: 5 V RMS.
DC Stability—Drift with Ambient Temperature (Line Voltage Constant): 0.02 div/°C. Drift with Time (Ambient Temperature and Line Voltage Constant): 0.02 div in any one minute after one-hour warm-up.
Displayed Noise—0.7 div or less at 5 mV/div (with a 7900 Series mainframe).
Common-Mode Rejection Ratio—At least 10:1, dc to 50 MHz.

ORDERING INFORMATION

7A24 Amplifier **$2,760**
Includes: Instruction manual (070-1485-00).

7A26

- **DC to 200-MHz Bandwidth**
- **5-mV to 5-V/Div Calibrated Deflection Factors**
- **1-MΩ Input**

The 7A26 is a dual-trace amplifier that provides a bandwidth of 200 MHz in the 7900- and 7100-Series mainframes. Bandwidth is constant over the entire range of deflection sensitivities of 5 mV to 5 V/div. Bandwidth may be limited to 20 MHz to reduce displayed noise in lower-frequency applications. The 7A26 features five operating modes, trigger-source selectability, and trace-identify.

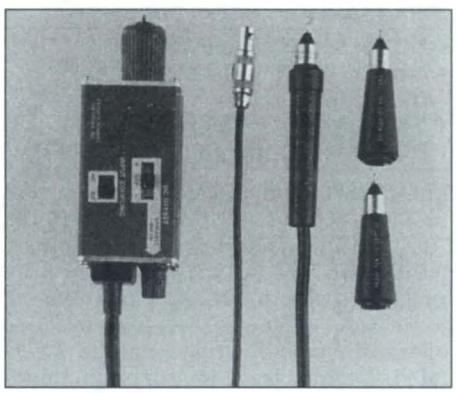
CHARACTERISITICS

Bandwidth—DC Coupled: 200 MHz (5 mV to 5 V/div). AC Coupled: 10 Hz or less to 200 MHz (5 mV to 5 V/div).
Deflection Factor—Calibrated: 5 mV to 5 V/div in ten steps (1-2 5 sequence). Accuracy is within 2% with gain adjusted at 10 mV/div. Uncalibrated: Variable continuously between steps to a maximum of at least 12.5 V/div.
Input R and C—1 MΩ within 2%; ≈20 pF.
Maximum Input Voltage—DC Coupled: 250 V (dc + peak ac), ac component 500 V p-p maximum, 1 kHz or less. AC Coupled: 500 V (dc + peak ac), ac component 500 V p-p maximum, 1 kHz or less.
DC Stability—Drift with Ambient Temperature (Line Voltage Constant): 0.02 div/°C. Drift with Time (Ambient Temperature and Line Voltage Constant): 0.02 division in any one minute after one-hour warm up.
Displayed Noise—0.1 div or less at 5 mV/div (with a 7900-Series mainframe).
Common-Mode Rejection Ratio (Add, CH 2 Invert)—At least 10:1, dc to 50 MHz.

ORDERING INFORMATION

7A26 Amplifier **$2,470**
Includes: Instruction manual (070-1484-01).

7A26 DC to 200-MHz Amplifier



P6201 FET Probe

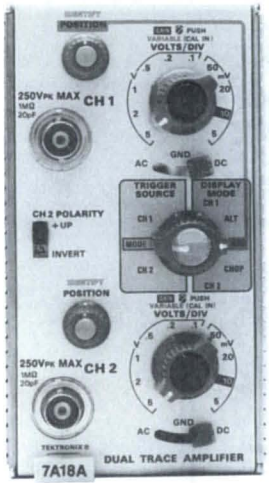
- **DC to 900-MHz Bandwidth**
- **50-Ω or 1-MΩ Inputs**

The P6201 is an active FET probe that provides unity gain and dc to 900-MHz bandwidth. The low probe-tip capacitance permits coupling of high-frequency signals to an oscilloscope with minimum loading on the circuit being tested. Plug-in attenuator heads provide higher input resistance and reduced input capacitance. Refer to the Accessories section for additional characteristics.

ORDERING INFORMATION

P6201 1X, FET Probe **$1,280**

For recommended probes, see 7000-Series Analog Oscilloscopes Reference section and the Signal Acquisition section.
See 7000-Series Vertical-System Specifications chart in 7000-Series Analog Oscilloscopes Reference section.



7A18A DC to 75-MHz Amplifier.

7A18A

- **DC to 75-MHz Bandwidth**
- **5-mV to 5-V/Div Calibrated Deflection Factors**
- **1-MΩ Input**
- **DC Offset (Option 06)**

The 7A18A is a dual-trace amplifier that provides a bandwidth of 75 MHz in the 7800-, 7900-, and 7100-Series mainframes. Bandwidth is constant over the entire range of deflection sensitivities of 5 mV to 5 V/div. The 7A18A features five operating modes, trigger-source selectability, and a trace-identify function.

CHARACTERISTICS

Bandwidth—DC Coupled: 75 MHz; AC Coupled: 10 Hz or less to 75 MHz.
Deflection Factor—Calibrated: 5 mV to 5 V/div in ten steps (1-2-5 sequence). Accuracy is within 2% with gain adjusted to 10 mV/div. Uncalibrated: Variable continuously between steps to a maximum of at least 12.5 V/div.
Input R and C—1 MΩ within 2%; ≈20 pF.
Maximum Input Voltage—DC Coupled: 250 V (dc + peak ac), ac component 500 V p-p maximum, 1 kHz or less. AC Coupled: 500 V (dc + peak ac), ac component 500 V p-p maximum, 1 kHz or less.
DC Stability—Drift with Ambient Temperature (Line Voltage Constant): 0.01 div/°C. Drift with Time (Ambient Temperature and Line Voltage Constant): 0.02 div in any one minute after one-hour warm-up.
Displayed Noise—0.06 div or less.
Common-Mode Rejection Ratio (Add, CH 2 Invert)—At least 10:1, dc to 50 MHz.

DC OFFSET OPTION

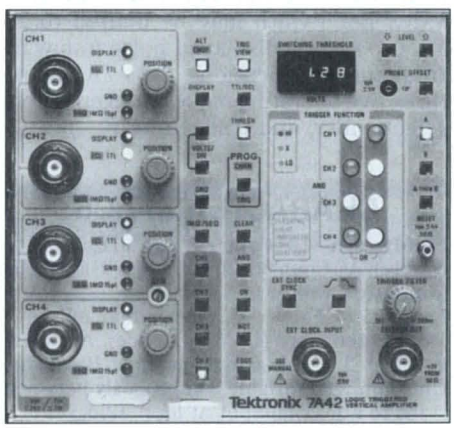
Option 06, DC Offset—Allows small signals riding on larger signals, such as power-supply ripple, to be analyzed. Separate Channel 1 and Channel 2 variable offset controls are concentric with the position controls replacing the identify pushbuttons of the standard 7A18A. The ac-dc-ground switch of each channel is expanded to accommodate a fourth position for dc offset.
Offset Range Display—±200 division maximum, equivalent to ±1 V at 5 mV/div.
Accuracy—When in dc Offset, the deflection accuracy is derated by 1%.

ORDERING INFORMATION

7A18A Amplifier **$1,620**
Includes: Instruction manual (070-4329-00).
Option 06—DC Offset. **+$210**

ISOLATOR

A6902B—For floating and differential measurements. See Accessories section. **$1,980**



7A42 Logic Triggered Amplifier

7A42

- **Up to 350-MHz Bandwidth (7100 Family)**
- **Four Input Channels**
- **Boolean-Logic Triggering**
- **Nested Trigger Functions**
- **Variable Switching Thresholds**
- **Precise Amplitude and Timing Measurements**
- **External Clock Synchronization**
- **1-MΩ/50-Ω Switchable Inputs**
- **Variable/Bias Offset Probe Compatibility**
- **7000-Series Mainframe Compatible**

The 7A42 Four-Channel Logic-Triggered Vertical Amplifier is a combination of amplifier and triggering technologies.

High-Resolution Analog Display of Digital Signals

Accurate analog representations of digital signals are displayed. A 1-ns rise time with 200-ps or less delay difference between the input channels provides precise, high-resolution timing measurements.

Advanced Triggering

Triggers are generated by the 7A42 upon recognition of user-programmed Boolean combinations of logic levels and transitions at any or all of its input channels. Triggers may be generated on event "A," event "B," or on "A then B."

Trigger-View trace shows where the trigger event occurred and how long it lasted. A trigger filter eliminates requirements that a trigger function remain true longer than the Trigger Filter setting.

External Clock Synchronization

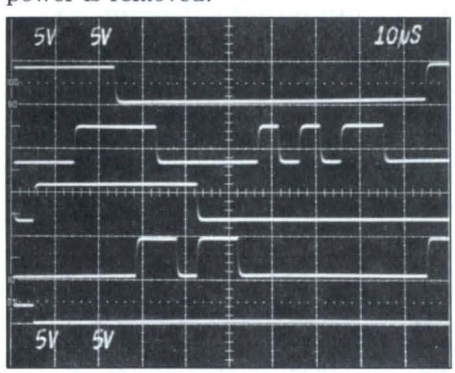
A triggering event can coincide with either a positive or negative transition of an external clock signal.

Special Probe Features

The P6230 is a 1.5-GHz, 450-Ω probe with the ability to place bias voltage at its tip. The P6131 10X high-impedance probe is the recommended probe for TTL, high-speed TTL, and CMOS logic families.

Easy Set-Up

CRT readout of attenuator settings, the display of error messages, and use of multicolored LEDs communicate the status of other 7A42 functions at a glance. A battery backup system preserves the current settings when power is removed.



Up to four logic signals can be displayed by the 7A42 in true analog form. Additionally, the Trigger-View trace provides the ability to view exactly when the programmed Trigger Function is satisfied.

For recommended probes:, see 7000-Series Analog Oscilloscopes Reference section and the Signal Acquisition section.
See 7000-Series Vertical-System Specifications chart in 7000-Series Analog Oscilloscopes Reference section.

CHARACTERISTICS

VERTICAL SYSTEM

Input—Four channels, BNC connectors.
Bandwidth—To 350 MHz maximum. See 7000-Series Reference section.
Input Impedance—Selectable between 1 MΩ and 50 Ω.
Maximum Input Voltage—1 MΩ: 25 V (dc + peak ac). 50 Ω: 5 V RMS during any 1-ms time interval. Active internal protection opens all inputs if overvoltage is applied to any channel.
Differential Delay—200 ps maximum between the four input channels.
Trigger View or External Clock View—Time Coincidence with Channel Display: Trigger View is within 3 ns. External Clock View is within 5 ns.

TRIGGER SYSTEM

External Clock Input—Maximum Voltage Range: +5 to −5 V (dc + peak ac). Pulse Width: TTL level is 20 ns minimum, either pulse transition selected. ECL level is 5 ns minimum, leading edge or 10 ns minimum, trailing edge.
Channel-Edge Sensitivity—Set-Up Time, Channel-to-Channel: 5 ns minimum (time that level-sensitive portion of trigger function must be true before Edge Sensitive Channel transition). Hold Time, Channel-to-Channel: 5 ns minimum (time that level-sensitive portion of trigger function must remain true after Edge Sensitive Channel transition). Set-Up Time, Edge Sensitive Channel: 10 ns minimum (time that level of Edge Sensitive Channel must be stable before transition). Hold Time, Edge Sensitive Channel: 5 ns minimum (time that level of Edge Sensitive Channel must remain stable after transition).
Trigger Out Connector—Output Voltage: 1 V into 50 Ω. Output Impedance: ≈50 Ω. Toggle Frequency: 125 MHz maximum.
Reset Input—Maximum Input Voltage: +5 to −5 V (dc + peak ac). Input Impedance: ≈50 Ω. Logic Zero Level: ≤0.2 V. Logic One Level: ≥0.8 V. Pulse Width: 100 ns minimum. Timing (Post-Reset Inhibit Time to Next Trigger): 10 ns minimum (time from falling edge of Reset to next recognizable event).

Response Time: Reset pulse must lead or be coincident with event recognition to inhibit trigger output. Event recognition must lead the Reset pulse by 10 ns to guarantee trigger output.

BATTERY BACK-UP

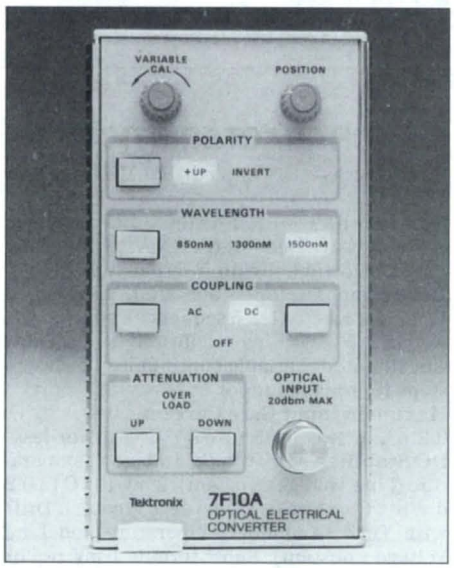
Ni-Cad Battery (3.75 V)—Provides power to preserve front-panel control status a minimum of 200 hours while main power is off. Battery requires about 24 hours to fully charge from discharged condition.

ORDERING INFORMATION

7A42 Logic-Triggered Vertical Amplifier **$5,950**
Includes: Instruction manual (070-4285-00).

OPTIONAL ACCESSORIES

P6230—10X Variable Bias/Offset **$420**
P6131—10X Passive **$145**
KLIPKIT—Provides hands-free connection to integrated circuits. See Other Accessories section for complete description. Order 013-0197-00. **$46**



7F10A Optical-Electrical Converter

- **Single-Mode/Multimode Fiber Optical Input**
- **700- to 1550-Nanometer Wavelength**
- **DC to 1 GHz Frequency Response**
- **Built-In Optical Attenuator**
- **CRT Readout of Deflection Factor**

The 7F10A single-wide plug-in module is an optical-to-electrical converter for use with either single-mode or multimode fibers. It offers dc to 1 GHz frequency response and covers the 700- to 1550-nanometer spectrum with a choice of three calibrated wavelengths: 825, 1300, and 1500 nanometers. It is designed for use in the vertical compartments of 7000-Series Oscilloscopes.

The optically coupled 7F10A input goes through a built-in attenuator that provides sixteen calibrated settings for controlling the input-signal level. On the front panel there is an optical overload indicator and pushbuttons to vary the attenuation level. Readout for deflection factor, uncalibrated indication, and polarity invert appears on the CRT.

CHARACTERISTICS

CONVERTER-AMPLIFIER

Wavelength—Operates from 700 to 1550 nm continuously with selectable calibrated settings at 825, 1300, and 1500 nm.
Photo Element—Ge-APD.
Maximum Linear Input—+10-mW optical carrier, 70% modulation.
Deflection Factor—9 selectable 5-dB steps. Calibrated 1500-nm Wavelength: 2.5 μW/div ±30% at 0-dB attenuation setting. Calibrated 1300-nm Wavelength: 2 μW/div ±30% at 0-dB attenuation setting. Calibrated 850-nm Wavelength: 4 μW/div ± 30% at 0-dB attenuation setting.
Variable Range—At least 4 dB.

Frequency Response

7104/R7103	dc to 1 GHz, ±3 dB
7900 Series	dc to 400 MHz, ±3 dB
7800 Series	dc to 300 MHz, ±3 dB

Position Range—9 divisions each direction from graticule center, within 1 division.

ENVIRONMENTAL

Temperature—Calibration: 20 to 30°C. Operating: 0 to 50°C, to 95%. Nonoperating: −55 to +75°C to 95% humidity.
Altitude—Operating: To 4500 m (15,000 ft). Nonoperating: To 15 000 m (50,000 ft).

ORDERING INFORMATION

7F10A Optical-Electrical Converter.*1
Includes: Instruction manual (070-6277-00).

OPTIONS

Option 01—Diamond 85μ/125μ connector.*1
Option 02—SMA 85μ/125μ connector.*1
Option 03—BICONIC 85μ/125μ connector.*1
Option 04—FC 85/125μ connector.*1

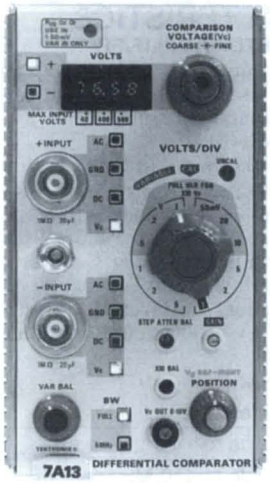
*1 *Contact your local sales office.*

OPTIONAL ACCESSORIES

1-m Optical-Fiber Interface Cables*1—
(Diamond 3.5 to Diamond 3.5)
Order 174-0045-01 **$235**
(Diamond 3.5 to SMA)
Order 174-0524-01 **$180**
(Diamond 3.5 to FC)
Order 174-0527-01 **$200**
(Diamond 3.5 to D4)
Order 174-0528-01 **$235**
(Diamond 3.5 to AT&T Biconic)
Order 174-0530-01 **$215**

*1 *3-m cables are also available. To order, contact your local Tektronix Sales Office.*

For recommended probes: See 7000-Series Analog Oscilloscopes Reference section and the Signal Acquisition section.
See 7000-Series Vertical-System Specifications chart in 7000-Series Analog Oscilloscopes Reference section.



7A13

- **DC to 105-MHz Bandwidth**
- **1-mV to 5-V/Div Calibrated Deflection Factors**
- **1-MΩ Input Switchable to ∞**
- **20,000:1 CMRR**
- **10,000 cm Effective Screen Height**

The 7A13 is a differential-comparator amplifier that provides dc to 105-MHz bandwidth in all the 7100- and 7900-Family instruments. It incorporates a number of features that make it particularly versatile, especially in multitrace combination with other 7000-Series vertical plug-ins.

The 7A13 has constant bandwidth over the 1-mV 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 at 10 mV/div (X10 Vc pulled) and 500 V at 0.1 V/div.

As a comparator amplifier, the 7A13 provides an accurate (0.1%) positive or negative internal offsetting voltage of up to 10 V. This precision offset voltage effectively provides a screen height of 10,000 div at 1 mV/div. The offset voltage is also available as an output for external monitoring.

Signal Range

Deflection-Factor Settings	1 mV to 50 mV/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	±10 V	±100 V	±500 V
Maximum DC Coupled Input (dc + peak ac at 1 kHz or less)	±40 V	±400 V	±500 V
Maximum AC Coupled Input (dc voltage)		±500 V	

CHARACTERISTICS

Bandwidth—DC Coupled: 105 MHz (1 mV to 5 V/div).

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—Calibrated: 1 mV to 5 V/div in 12 steps (1-2-5 sequence). Accuracy is within 1.5% with gain adjusted at 1 mV/div. Uncalibrated: Variable continuously between steps to a maximum of at least 12.5 V/div.

Maximum Input Gate Current—0 to +35 °C: 0.2 nA or less. +35 to +50 °C: 2 nA or less.

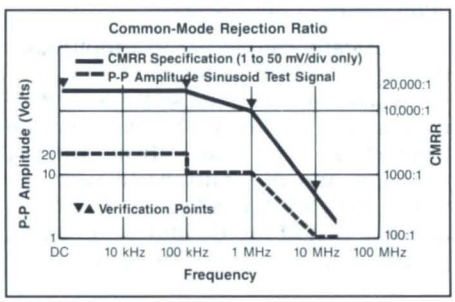
DC Stability—Drift with Ambient Temperature (Line Voltage Constant): 2 mV/10° C to 0.2 div/10° C or less (whichever is greater). Drift with Time (Ambient Temperature and Line Voltage Constant): Short term is 1 mV p-p or 0.1 div or less (whichever is greater) over any one-minute interval after 20-minute warm-up. Long term is 1 mV p-p or 0.1 division or less (whichever is greater) during any one-hour interval after 20-minute warm-up.

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 at 1 mV/div only, regardless of pulse duration.

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 to 5 mV/div; 0.05 div or less at 10 mV to 5 V/div. With X10 Vc Out: 0.4 div or less at 10 mV to 0.5 V/div.

Internal Comparison Voltage—Range: 0 to ±10 V. Accuracy: ±(0.1% of setting +3 mV). Vc Output R: ≈15 kΩ.

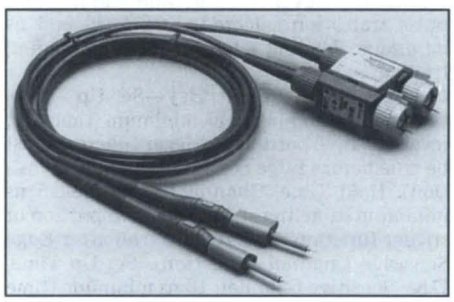
Common-Mode Rejection Ratio—At least 2000:1, 10 mV to 50 mV/div (X10 Vc out) and 0.1 to 5 V/div. AC coupled input at least 500:1 at 60 Hz.



ORDERING INFORMATION

7A13 Amplifier **$3,655**
Includes: Instruction manual (070-1948-00).

For floating measurements, order A6902B Isolator. See Signal Acquisition section for complete description.



P6135 10,000:1 CMRR, 10X (Adjustable) with Readout

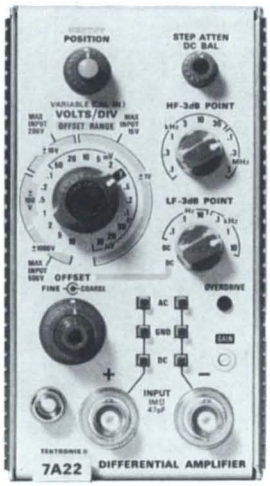
- **DC to 150-MHz Bandwidth**
- **Low Capacitance**
- **High CMRR**
- **Matched Pair**

Refer to the Signal Acquisition section for additional information.

ORDERING INFORMATION

P6135 Matched Pair of 10X, 1.5-m Differential Probes. **$495**

For recommended probes: See 7000-Series Analog Oscilloscopes Reference section and the Signal Acquisition section.
See 7000-Series Vertical-System Specifications chart in 7000-Series Analog Oscilloscopes Reference section.



7A22 Differential Amplifier

7A22

- **DC to 1-MHz Bandwidth**
- **10-μV to 10-V/Div Calibrated Deflection Factors**
- **1-MΩ Input**
- **100,000:1 CMRR**
- **Selectable Upper and Lower −3 dB Points**
- **DC Offset**
- **10-μV/Hour DC Drift*1**

*1 *With constant temperature. See dc stability specifications.*

The 7A22 is a high-gain differential amplifier well suited for difficult low-amplitude, low-frequency measurements. Selectable high- and low-pass filters help eliminate unwanted noise and drift from the display and from the triggering signal.

CHARACTERISTICS

Bandwidth—HF: −3 dB point selectable in nine steps (1-3 sequence) from 100 Hz to 3 kHz. Accuracy is within 10% of selected frequency. Rise time is 350 ns ±9% in 1-MHz position. LF: −3 dB point selectable in six steps (1-10 sequence) from 0.1 Hz to 10 kHz. Accuracy is within 12% of selected frequency. The switch also contains dc and dc with Offset positions. AC coupled at input, 2 Hz or less.

Deflection Factor—Calibrated: 10 μV to 10 V/div in 19 steps (1-2-5 sequence). Accuracy is within 2% with gain adjusted at 1 mV/div. Uncalibrated: Variable continuously between steps to a maximum of at least 25 V/div.

Input R and C—1 MΩ within 1%; ≈47 pF.

Maximum Input-Gate Current (Differentially Measured)—10 μV to 10 mV/div: 40 pA at +25°C; 200 pA at +50° C. 20 mV to 10 V/div: 10 pA at +25°C; 20 pA at +50°C.

Single ended, one-half the differential measurement. Display shift (10 μV/div, ac coupled) is ±4 divisions at +25°C; ±20 divisions at +50°C.

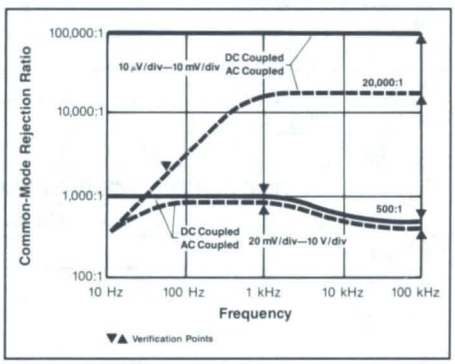
Signal and Offset Range

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	±10 V	±100 V	±500 V	
Maximum DC Coupled Input (dc + peak ac at 1 kHz or less)	±15 V	±200 V	±500 V	
Maximum AC Coupled Input (dc voltage)	±500 V dc rejection, at least 4×10^5:1			
DC Offset	+1 to −1 V	+10 to −10 V	+100 to −100 V	+100 to −100 V

DC Stability—(Line Voltage Constant): 50 μV/°C or less. Drift with Time (Ambient Temperature and Line Voltage Constant): Short term is 5 μV p-p or 0.1 div (whichever is greater) over any one-minute interval after one-hour warm-up. Long term is 10 μV p-p or 0.1 div (whichever is greater) in any one-hour interval after one-hour warm-up.

Displayed Noise—16 μV or 0.1 div (whichever is greater) at maximum bandwidth. Source resistance, 25 Ω or less measured tangentially.

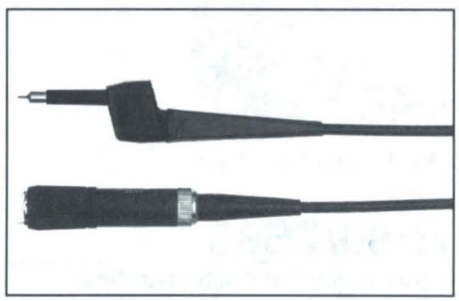
Overdrive Recovery—10 μs or less to recover within 0.5% of zero level after removal of a test signal applied for 1 s (signal amplitude not to exceed differential dynamic range). Front-panel Overdrive light indicates that an overdrive condition is being approached.



Common-Mode Rejection Ratio (for signals not exceeding common-mode signal range)

ORDERING INFORMATION

7A22 Amplifier **$2,040**
Includes: Instruction manual (070-0931-00).
High CMRR Differential Probes
P6055—Matched pair of probes for maximum CMRR. (See Signal Acquisition section for complete P6055 description.) **$555**



P6055

20,000:1 CMRR, 10X With Readout

- **DC to 60 MHz**
- **Low Capacitance**
- **High CMRR**
- **Compact Size**

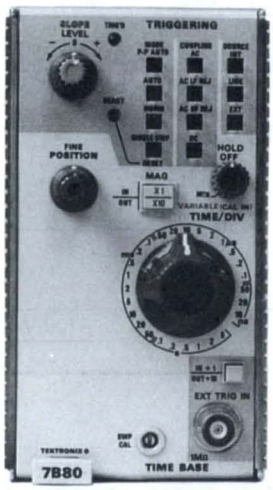
The P6055 is a miniature, low-capacitance, 10X probe designed for use with Tektronix differential amplifiers with nominal input capacitances from 20 to 47 pF. The attenuation ratio is adjustable to compensate for differences in input resistance of the amplifier (the amplifier input resistance must be 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. The use of a matched pair of P6055 differential probes provides the best possible system CMRR.

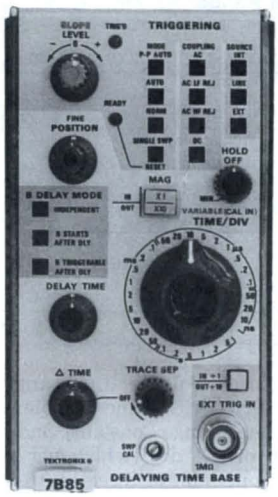
ORDERING INFORMATION

P6055 Matched pair of 10X, 3.5 ft Differential Probes **$555**
Option 01—Single probe with accessories. **−$260**

For recommended probes: See 7000-Series Analog Oscilloscopes Reference section and the Signal Acquisition section.
See 7000-Series Vertical-System Specifications chart in 7000-Series Analog Oscilloscopes Reference section.



7B80 Delayed Time Base



7B85 ΔDelaying Time Base

7B80/7B85

- **1-ns to 5-s/Div Calibrated Time Bases**
- **Triggering to 400 MHz**
- **Variable Trigger Holdoff**
- **Peak-to-Peak Auto Triggering**

7B85 Features:

- **ΔTime Measurements With CRT Readout**
- **Delayed-Time Measurements With CRT Readout**
- **Vertical Trace Separation Between Two Delayed Sweeps**

The 7B80 and 7B85 are horizontal time bases recommended for use with the 7800- or 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.)

Each plug-in can be used separately as an independent single time base, or combined in any mainframe with two horizontal compartments for delaying and delayed operation.

Option 02 is appropriate where the user is making Y-T and X-Y measurements, and changing the amplifier frequently from the vertical to the horizontal compartment is not acceptable.

7000-SERIES TIME-BASE SELECTION GUIDE

Performance Feature	7B50A	7B53A	7B80	7B85	7B92A	7B10	7B15
Single time base	✓		✓	✓		✓	✓
Dual time base		✓			✓		
With mixed sweep		✓					
TV Sync Triggering		Opt 05					
Used also as delayed time base			✓			✓	
Delaying sweep				✓			✓
ΔDelay sweep				✓			✓
Display switching					✓		
Prices begin at	$1,320	$2,290	$1,885	$2,140	$3,870	$2,800	$3,000

7000-SERIES TIME-BASE/MAINFRAME RECOMMENDATION

Mainframe	7B50A	7B53A	7B80	7B85	7B92A	7B10	7B15
7104/R7103					✓	✓	✓
7904A/R7903			✓	✓	✓	✓	✓
7844/R7844			✓	✓	✓	✓	✓
7934			✓	✓	✓	✓	✓
7854			✓	✓*1	✓*1	✓	✓*1
7603/R7603	✓	✓					
7633/R7633 7623A/R7623A	✓	✓					

*1 *Single-sweep mode operable for real time only.*

CHARACTERISTICS

Characteristics are common to both units unless otherwise noted.

MAIN SWEEP

Sweep Rates—Calibrated: 5 s to 10 ns/div in 27 steps (1-2-5 sequence). X10 Magnifier extends fastest calibrated sweep rate to 1 ns/div. Uncalibrated: Variable is continuous to at least 2.5 times the calibrated sweep rate.

Sweep Accuracy—Measured over the center eight divisions, +15 to +35 °C, in the 7800- or 7900-Series mainframe. Derate accuracies by an additional 1% for 0 to +50 °C.

Time/Div*1	Unmagnified	Magnified
5 to 1 s/div	4.0%	Unspecified
0.5 s to 50 ns/div	1.5%	2.5%
20 to 10 ns/div	2.5%	4.0%

*1 *Fastest calibrated sweep rate is limited by 7600-Series Mainframes.*

Trigger Holdoff Time—Minimum holdoff setting: 2 times Time/Div setting or less for sweep rates 5 s to 1 μs/div; 2 μs or less for sweep rates 0.5 μs to 10 ns/div. Variable extends holdoff through at least 2 sweep lengths for 20-ms/div or faster sweep rates.

ΔTime Range—(7B85 only) 0 to at least 9.0 times Time/Div setting.

ΔTime Accuracy (+15 to +35 °C)—(7B85 only) 0.5 s to 50 ms/div: Within (0.5% of reading +0.1% full scale +1 count)*1. 20 ms to 100 ns/div: Within (0.5% of reading +0.03% full scale +1 count)*1.

*1 *Full scale equals ten times the Time/Div switch setting.*

Trace Separation Range—Functional only in ΔDelay Time mode when alternating or chopping between time-base units. The second delayed sweep display can be vertically positioned at least three divisions below the first delayed-sweep display.

Delay Time Range—0.2 or less to at least 9.0 times Time/Div setting.

Delay Time Jitter—0.02% or less of Time/Div setting plus 0.1 ns.

TRIGGERING

External Trigger Input—Maximum Input Voltage: 250 V (dc + peak ac). Input R and C: 1 MΩ within 5% and 20 pF within 10%. Level Range (Excluding P-P Auto): At least ±1.5 V in Ext÷1, at least ±15 V in Ext÷10.

7B80 Option 02, X-Y Display Capability—A front-panel switch selects either normal-sweep displays or X-Y displays. In the X-Y mode, the X and Y signals are applied to the inputs of a dual-trace vertical amplifier or two single-trace vertical amplifiers. The X signal is routed via the amplifier/mainframe trigger path to the 7B80 Option 02, and then to the mainframe horizontal amplifier for display.

Single Sweep—Requirements are same as for repetitive signals.

Internal Trigger Jitter—0.1 ns or less at 400 MHz.

Triggering Sensitivity From Repetitive Signals (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 to 400 MHz	1.5 div	250 mV
AC LF Rej*2	30 kHz to 50 MHz	0.3 div	50 mV
	50 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 to 400 MHz	1.5 div	250 mV

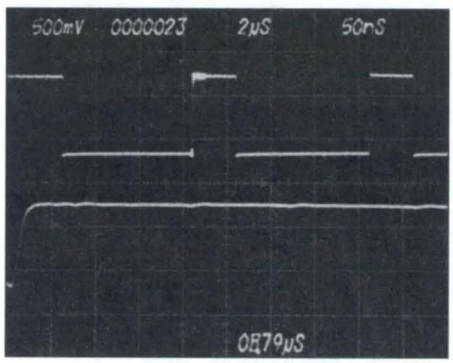
*1 *Triggering frequency ranges are limited to the frequency of the vertical system when operating in the Internal mode.*

*2 *Will not trigger on sine waves of less than eight divisions Internal, or 3 V External, at or below 60 Hz.*

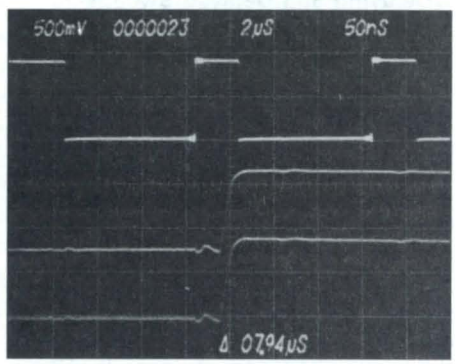
*3 *Triggering Frequency Range for dc coupling applies to frequencies above 30 Hz when operating in the Auto Triggering mode.*

Triggering Sensitivity in P-P Auto Mode

Coupling	Triggering Frequency Range	Min Signal Required Int	Min Signal Required Ext
AC or DC	Low Frequency Response: At least 50 Hz	2.0 div	500 mV
AC or DC	200 Hz to 50 MHz	0.5 div	125 mV
AC or DC	50 to 400 MHz	1.5 div	375 mV



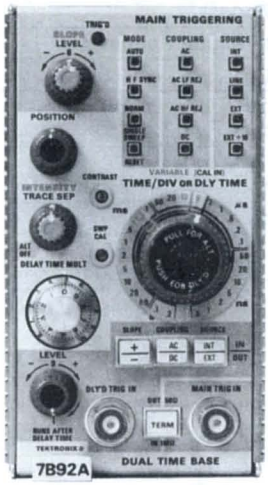
Delaying and delayed sweeps are shown with the mainframe selecting Alt sweep modes. The delay time to the start of the delayed sweep is digitally presented on the lower edge of the CRT.



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 three divisions of separation.

ORDERING INFORMATION

7B80 Time Base **$1,885**
Includes: Instruction manual (070-1959-00).
Option 02—X-Y Display Capability. **+$105**
7B85 Delaying Time Base **$2,140**
Includes: Instruction manual (070-1961-01).



7B92A Dual Time Base

7B92A

- **0.5 ns 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**

The 7B92A Dual Time Base is recommended for use in the 7100-, 7800-, and 7900-Series mainframes. (The 7B92A may be used in all other mainframes at slower sweep speeds. See the selection guides at the front of the 7000-Series Time Base section.)

There are four display modes: normal sweep, intensified delaying sweep, delayed sweep, and alternate sweep. When operating in the Auto mode of main triggering, a bright base line is displayed in the absence of a trigger signal.

CHARACTERISTICS

MAIN AND DELAYED SWEEP

Sweep Rate—Calibrated: 0.2 s to 0.5 ns/div in 27 steps (1-2-5 sequence). Uncalibrated: Variable continuously between steps to at least 2.5 times the calibrated sweep rate. The variable control is internally switchable between delaying and delayed sweeps.

Sweep Accuracy—Measured over the center eight divisions in a 7900-Series mainframe:

Time/Div	+15 to +35°C	0 to +50°C
0.2 s to 20 ns/div	Within 2%	Within 3%
10 ns/div	Within 3%	Within 4%
2 to 1 ns/div	Within 4%	Within 5%
0.5 ns/div	Within 5%	Within 6%

Differential Delay-Time Measurement Accuracy*1
Sweep Speed

0.2 s to 0.1 μs/div	Both Delay Time Mult dial settings at 0.5 or greater	±(0.75% of reading +0.25% or greater of full scale*2)
	One or both Delay Time Mult dial settings at less than 0.5	±(0.75% of reading +0.5% of full scale*2 +5 ns)
50 to 10 ns/div	Both Delay Times equal to or greater than 25 ns	±(1% of reading +0.5% of full scale*2)
	One or both Delay Times less than 25 ns	±(1% of reading +1% of full scale*2 +5 ns)

*1 *+15 to +35°C.*

*2 *Full scale is ten times the Time/Div or Delay Time setting. Accuracy applies over the center eight divisions from +15 to +35°C.*

Delay Time Multiplier Range—0 to 9.8 times the Delay Time/Div setting from 0.2 s to 10 ns/div (0 to 1.96 s).

TRIGGERING

Triggering Sensitivity
Auto and Norm Modes

Coupling	Triggering Frequency Range	Min Signal Required Int	Min Signal Required Ext
AC	30 Hz to 20 MHz	0.5 div	100 mV
	20 to 500 MHz	1.0 div	500 mV
AC LF Rej*1	30 kHz to 20 MHz	0.5 div	100 mV
	20 to 500 MHz	1.0 div	500 mV
AC HF Rej*1	30 Hz to 50 kHz	0.5 div	100 mV
DC	DC to 20 MHz	0.5 div	100 mV
	20 to 500 MHz	1.0 div	500 mV

*1 *Not applicable in Delayed Sweep mode.*

HF Sync—Triggering sensitivity is 0.5 div Int or 100 mV Ext, from 100 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.

Delay Time Multiplier Range—0 to 9.8 times the Delay Time/Div setting from 0.2 s to 10 ns/div (0 to 1.96 s).

Delay Time Jitter*1

0.2 to 50 μs/div	0.2% of main sweep time/div switch setting or less
20 μs tp 10 ns/div	0.3% of the main sweep time/div switch setting or less

*1 *Not applicable for the first 2% of maximum available delay time (Delay Time Mult dial setting <0.2). Maximum available delay time is ten times the Time/Div or Delay Time switch setting.*

Internal Trigger Jitter—50 ps or less at 500 MHz.

External Trigger Input—Selectable 50-Ω or 1-MΩ inputs (1MΩ is paralleled by ≈20 pF). Maximum Input Voltage: 250 V (dc + peak ac) for 1-MΩ input and 1 W average for 50-Ω input. Level Range: At least ±35 V in Ext÷10.

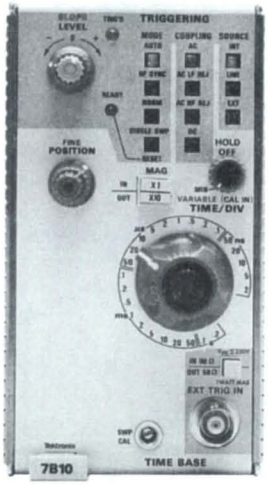
Internal Trigger Jitter—50 ps or less at 500 MHz.

DELAYED SWEEP

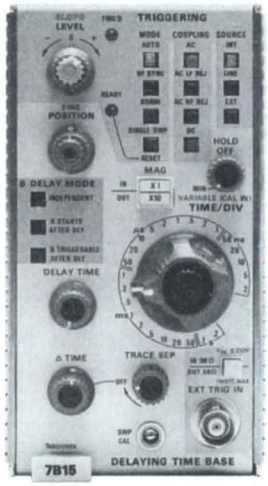
Coupling	Triggering Frequency Range	Min Signal Required Int	Min Signal Required Ext
AC	30 Hz to 20 MHz	0.5 div	100 mV
	20 to 500 MHz	1.0 div	500 mV
DC	DC to 20 MHz	0.5 div	100 mV
	20 to 500 MHz	1.0 div	500 mV

ORDERING INFORMATION

7B92A Dual Time Base **$3,870**
Includes: Instruction manual (070-1751-02).



7B10 Time Base



7B15 ΔDelaying Time Base

7B10/7B15

Features:

- **0.2 ns to 0.2 s/Div Calibrated Time Bases**
- **Triggering to 1 GHz**
- **Variable Trigger Holdoff**
- **Auto Triggering**
- **ΔTime Measurements With CRT Readout (7B15)**
- **Delayed Time Measurements With CRT Readout (7B15)**
- **Vertical Trace Separation Between Two Delayed Sweeps (7B15)**

The 7B10 and 7B15 are horizontal time bases designed for use with the 7100-Series mainframes to provide optimum bandwidth/sweep-speed compatibility, but may also be used with the 7800- and 7900-Series mainframes. (Each may be used in any slower 7000-Series mainframe with some reduction in sweep accuracy at the fastest sweep speed. See Oscilloscope Reference section.)

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.

The 7B10 and 7B15 provide Δtime measurement in addition to the standard delay-time display.

Delta time measurement is accomplished simply by manually positioning two intensified zones on the waveform. The time difference between the two zones is displayed in the CRT readout. (See waveform photos in the description of the 7B80/7B85 time bases.) Expansion and overlapping of the two intensified zones is possible to allow very precise setting of the zones to the desired points on the displayed waveform.

CHARACTERISTICS

MAIN SWEEP

Sweep Rates—Calibrated: 2 ns to 0.2 s/div in 25 steps (1-2-5 sequence). X10 Magnifier extends fastest calibrated sweep rate to 0.2 ns/div. Uncalibrated: Variable is continuous to at least 2.5 times the calibrated sweep.

Sweep Accuracy—Measured over the center eight divisions, +15 to +35 °C, in a 7100-, 7800-, or 7900-Series mainframe. Derate accuracies by an additional 1% for 0 to +50 °C.

Time/Div*1	Unmagnified	Magnified
0.2 s to 10 ns/div	2%	3%
5 and 2 ns/div	3%	4%

*1 *Fastest calibrated sweep rate is limited by 7900-, 7800-, and 7600-Series mainframes.*

Trigger Holdoff Time

	Minimum	Maximum With Variable
0.2 s to 50 ms/div	40 ms	400 ms
20 ms to 2 μs/div	2 times Time/Div Setting	20 times Time/Div Setting
1 to 0.5 μs/div	2 μs	20 μs
0.2 μs to 2 ns/div	2 μs	6 μs

Delay Time Range—(7B15 only) 0.2 or less to at least 9.0 times Time/Div setting.

Delay Time Jitter—(7B15 only) 0.02% of Time/Div setting up through 50 μs/div. 0.03% of Time/Div setting plus 0.1 ns for sweep speeds of 20 μs through 100 ns/div.

ΔTime Range—(7B15 only) 0 to at least 9.0 times Time/Div setting.

ΔTime Accuracy—20 ms to 100 ns/div. Within 0.5% of reading +3 counts.

Trace Separation Range—(7B15 only) Functional only in ΔDelay Time mode when alternating or chopping between time-base units. The second delayed-sweep display can be vertically positioned at least three divisions below the first delayed-sweep display.

Single Sweep—Requirements are the same as for repetitive signals.

Internal Trigger Jitter—30 ps or less at 1 GHz.

HF Sync Mode—250 MHz to 1 GHz, 0.3 div Internal and 0.75 mV External.

External Trigger Input—Maximum Input Voltage: 250 V (dc + peak ac) for 1-MΩ input, 1 W average for 50-Ω input. Input R and C: 1 MΩ within 5% and 20 pF within 10%; for 50-Ω input, 50 Ω within 2%. Level Range: At least ±3.5 V in Ext÷1.

TRIGGERING

Triggering Sensitivity for Repetitive Signals

Coupling	Triggering Frequency Range*1	Min Signal Required Int	Min Signal Required Ext
AC	30 Hz to 250 MHz	0.5 div	50 mV
	250 MHz to 1 GHz	1.5 div	150 mV
AC LF Rej*2	50 kHz to 250 MHz	0.5 div	50 mV
	250 MHz to 1 GHz	1.5 div	150 mV
AC HF Rej	30 Hz to 40 kHz	0.5 div	50 mV
DC*3	DC to 250 MHz	0.5 div	50 mV
	250 MHz to 1 GHz	1.5 div	150 mV

*1 *The triggering frequency ranges given here are limited to the −3-dB frequency of the oscilloscope vertical system when operating in the Internal mode.*

*2 *Will not trigger on sine waves at or below 60 Hz when amplitudes are less than eight division Internal or 3 V External.*

*3 *The Triggering Frequency Range for DC Coupling applies to frequencies above 30 Hz when operating in the Auto Triggering Mode.*

ORDERING INFORMATION

7B10 Time Base **$2,800**
Includes: Instruction manual (070-2316-00).

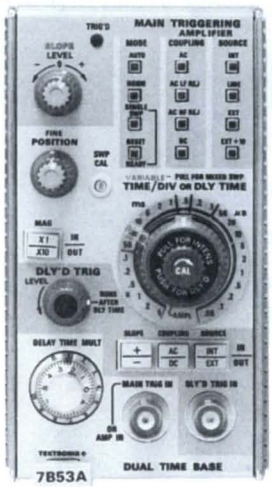
7B15 Delaying Time Base **$3,000**
Includes: Instruction manual (070-2318-00).

7B53A

- **5 ns to 5 s/Div Calibrated Time Base**
- **Triggering to 100 MHz**
- **Single-Sweep Operation**
- **Calibrated Mixed Sweep**
- **TV Sync Separator Triggering (Option 05)**

The easy-to-use 7B53A Time Base is recommended for use with 7600-Series mainframes to provide optimum bandwidth/sweep speed compatibility. It may, however, be used in any 7000-Series mainframe to provide sweep rates to 5 ns/div. See Oscilloscope Reference section.

The 7B53A provides normal, intensified delaying, delayed, and mixed sweeps.



7B53A Dual Time Base

CHARACTERISTICS

DELAYING SWEEP

Sweep Rate—Calibrated: 50 ns 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. Uncalibrated: Variable continuously between steps to at least 2.5 times the calibrated sweep rate.

Delay Time Multiplier Range—0 to 10 times the Delay Time/Div setting from 5 s to 1 μs/div.

Differential Delay-Time Measurement Accuracy—5 to 1 s/div: ±1.4% of measurement +0.3% of full scale. 0.5 s to 1 μs/div: ±0.7% of measurement +0.3% of full scale. Full scale is ten times the Delay Time/Div setting. Accuracy applies over the center 8 DTM div from +15 to +35 °C.

Delay Time Jitter—0.05% or less of Time/Div setting.

Single Sweep—When triggered, sweep generator produces one sweep only, until reset.

Internal Trigger Jitter—1 ns or less at 75 MHz.

Sweep Accuracy—Measured over center eight divisions, +15 to +35 °C, with any 7000-Series mainframe. Derate accuracies by an additional 1% each for 0 to +50 °C; 1.5% in magnified mode.

External Trigger Input—Maximum Input Voltage: 500 V (dc + peak ac), 500 V p-p ac at 1 kHz or less. Input R and C: 1 MΩ within 2% and 20 pF within 2 pF. Level Range: At least +1.5 to −1.5 V in Ext, at least +15 to −15 V in Ext÷10.

Sweep Accuracy	Delaying Sweep		Delayed Sweep	
Time/Div	**Unmagnified**	**Magnified**	**Unmagnified**	**Magnified**
5 to 1s/div	3%	N/A	4%	4.5%
50 ms to 0.5 μsec	2%	2.5%	3%	3.5%
0.2 to 0.05 μsec/div	3%	3.5%		

External Trigger Input—Maximum Input Voltage: 500 V (dc + peak ac), 500 V p-p ac at 1 kHz or less. Input R and C: 1 MΩ within 2% and 20 pF within 2 pF. Level Range: At least +1.5 to −1.5 V in Ext, at least +15 to −15 V in Ext÷10.

DELAYED SWEEP

Sweep Rate—Calibrated: 0.05 μs 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. Uncalibrated: Variable continuously between steps to at least 2.5 times the calibrated sweep rate. The variable control is internally switchable between main, delayed sweep, and variable main sweep holdoff.

Internal Trigger Jitter—1 ns or less at 75 MHz.

Delayed Sweep Gate—Output Voltage: ≈ +3.5 V into at least 10 kΩ shunted by 100 pF or less, or 0.5 V into 50 Ω. Rise time: 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.

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.

TV SYNC

TV Sync Separator Triggering—Available as Option 05.

ORDERING INFORMATION

7B53A Dual Time Base **$2,290**
Includes: Instruction manual (070-1342-01).
Option 05—TV Triggering. **+$170**
Includes: Instruction manual (070-1471-00).

7CT1N Curve Tracer

7CT1N

- **Tests Semiconductor Devices to 0.5 Watts**
- **10-nA to 20-mA/Div Vertical-Deflection Factors**
- **0.5-V to 20-V/Div Horizontal-Deflection Factors**
- **Easy to Operate**

The 7CT1N converts your 7000-Series oscilloscope into a semiconductor curve tracer capable of displaying characteristics of small-signal devices to power levels up to 0.5 W. The 7CT1N operates in either the horizontal or vertical compartments of any 7000-Series mainframe. It may be used in conjunction with standard amplifier and time-base plug-in units to display signal waveforms along with characteristic curve families.

CHARACTERISTICS

COLLECTOR/DRAIN SUPPLY

	X1		X10	
Horizontal Volts/Div	0.5	2	5	20
Voltage Range (V)	0 to 7.5	0 to 30	0 to 75	0 to 300
Maximum Current (mA)	240	60	24	6

Maximum Open-Circuit Voltage—Within 20%. Maximum short-circuit current within 30%.

Series Resistance—Automatically selected with horizontal V/div switches. Peak Power: 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: 1 μA to 1 mA/step, 1-2-5 sequence. Maximum Current (Steps Plus Aiding Offset): X15 amplitude setting. Maximum Voltage (Steps Plus Aiding Offset): At least 13 V. Maximum Opposing Offset Current: At least X5 amplitude setting.

FET Mode—Step-Amplitude Range: 1 mV to 1 V/step, 1-2-5 sequence. Voltage Amplitude (Steps Plus Aiding Offset): X15 amplitude setting, 13 V maximum. Source Impedance: 1 kΩ ±1%.

Accuracy—Incremental: Within 3% between steps. Absolute: Within (3□+0.3X 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 to 20 μA/div with the 1000 control activated. 10 μA 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.

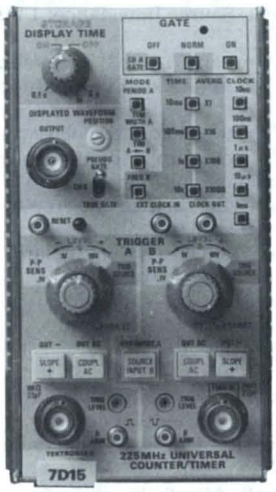
Horizontal-Deflection Factors—Selectable, 0.5, 2, 5, or 20 V.

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 a 7000-Series oscilloscope mainframe.

ORDERING INFORMATION

7CT1N Curve Tracer **$1,870**

Includes: Test adapter with two sets of test terminals, one with TO5 basing and the other with TO18 basing (013-0128-00); instruction manual (070-1247-00).



7D15 225-MHz Counter/Timer

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**

For Measurement Applications Guide order 42-W-5017-1.

The 7D15 Universal Counter/Timer is designed for use in all 7000-Series oscilloscope mainframes having CRT readout. The 7D15 can 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, measurements can be made between any two points on the CRT display (see Figure 1).

The 7D15 offers all the measurement capabilities of a Universal Counter/Timer, such as time interval, period, period and time interval averaging, frequency, frequency ratio, totalize, and manual stop watch.

The 7D15 may be used in vertical or horizontal compartments of 7000-Series mainframes. It provides a full eight-digit CRT display with leading-zero suppression and positioned decimal. Legend and averaging information appear at the bottom of the CRT display.

Modes	Range	Accuracy
Frequency Mode	DC to 225 MHz, Resolution is 0.1 Hz max.	$\epsilon_{Freq\ (Hz)} = \pm TB \cdot f_{in} \pm \frac{1}{T}$
Period and Multi-Period Mode	10 ns to 10^5 seconds with selected averaging of 1 to 1000 events in decade steps. Resolution to 10 ps.	$\epsilon_{Period\ (s)} = \pm TB \cdot P_{in} \pm \frac{10^{-9}}{N} \pm \frac{2E_{npk}}{\frac{dv}{dt} \cdot N} \pm \frac{P_{ck}}{N}$
Time Interval (TI) and TI Average Mode	6 ns to 10 seconds with selected averaging of 1 to 1000 in decade steps. Resolution is 0.1 ns.	$\epsilon_{TI\ (s)} = \pm TB \cdot P_{in} \pm \frac{P_{ck}}{\sqrt{N}} \pm 10^{-9} \pm \frac{2E_{npk}}{\frac{dv}{dt}}$
Frequency Ratio, CH B/Ext Clock	10^{-7} to 10^4	
Manual Stop Watch	0 to 10^5 seconds	
Totalize, CH B	0 to 10^8 counts	

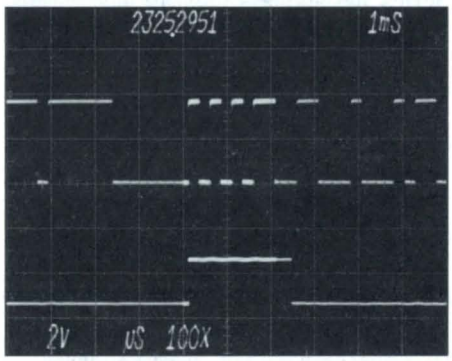


Figure 1. Oscilloscope-controlled digital measurements using the delayed B gate as the arming input logic allow user to make precise time-interval measurement from third to seventh pulse on CRT display. Counter CH A is "armed" with leading edge of B gate while CH B Counter is "armed" with falling edge of B gate. Lower trace is pseudo gate of 7D15. CRT readout displays the result of 2325.295 μs.

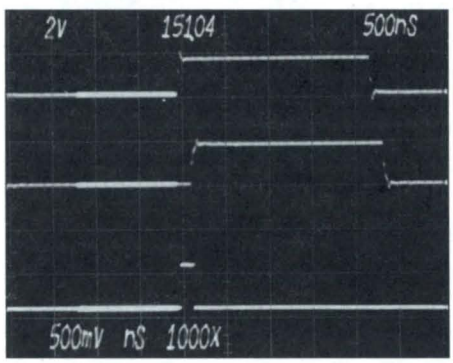


Figure 2. The propagation delay time between the input of a delay line (upper trace) and the output of the delay line (middle trace) is measured digitally. Lower trace is 7D15 pseudo gate display. CRT readout displays the result of 151.0 ns.

CHARACTERISTICS

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—Readies the instrument. All counters are affected, including averaging circuits.

INTERNAL TIME BASE

Crystal Oscillator—Accuracy: Within 0.5 ppm (0 to +50 °C ambient). Long-Term Drift: 1 part or less in 10^7 per month. Oscillator: 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 screwdriver controlled selects true gate, pseudo gate, or CH B signal out.

External Display—Same as internal except position control has no effect.

Display-Mode Switch—0.1 s to 5 s; also a preset position for infinite display time. Allows selection of readout "follow or store."

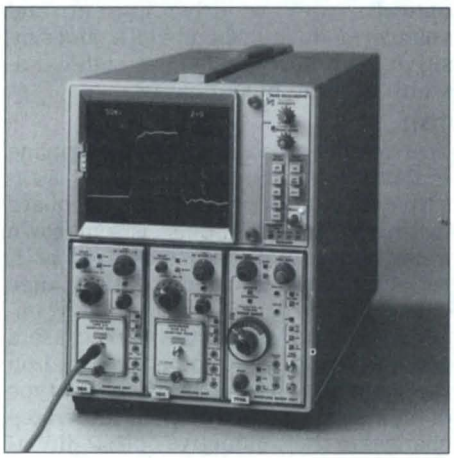
Readout—Eight-digit display; the four most significant have zero suppression. Overflow indicated by a greater than symbol.

ORDERING INFORMATION

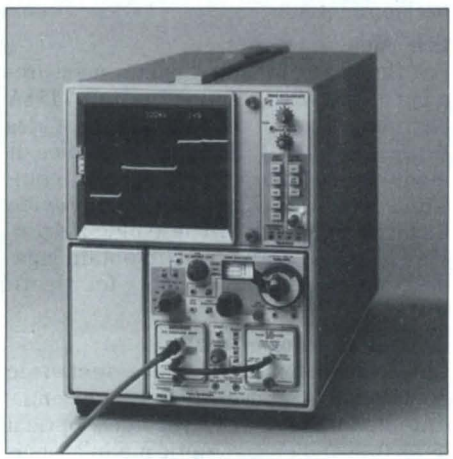
7D15 Universal Counter/Timer **$3,960**
Includes: Two 44-inch Sealectro-to-BNC connector cables (012-0403-00); instruction manual (070-1433-00).

For recommended probes: See 7000-Series Analog Oscilloscopes Reference section and the Signal Acquisition section.
See 7000-Series Vertical-System Specifications chart in 7000-Series Analog Oscilloscopes Reference section.

7603SMP AND 7603TDR MEASUREMENT SYSTEMS



7603SMP Sampling System



7603TDR Measurement System

7603SMP
Sampling System

TYPICAL APPLICATIONS

- **Fiber Optics**
- **High-Speed Logic**
- **Digital Signal Processing**
- **Microwave Communication**

FEATURES

- **Low Cost Sampling System**
- **Two High Bandwidth Channels**
- **25 ps Rise Time**
- **6.5 Inch CRT with Readout**

The Tektronix 7603SMP Sampling System is a low cost, two-channel, high-bandwidth sampling system. It is designed for users wanting a low cost solution for measuring subnanosecond rise times and very short propagation delays.

CHARACTERISTICS

The 7603SMP includes:
(1) 7603 Oscilloscope
(2) 7S11 Sampling Units
(2) S-4 Sampling Heads
(1) 7T11A Sampling Sweep Unit plus manuals and accessories.

Refer to individual product sections for more complete information.

7603TDR
Measurement System

TYPICAL APPLICATIONS

- **Circuit Board Testing**
- **Microwave Stripline Evaluation**
- **Cable Testing**

FEATURES

- **Low Cost TDR System**
- **One High-Resolution TDR Channel**
- **45 ps System Rise Time**
- **6.5 Inch CRT with Readout**

The Tektronix 7603TDR oscilloscope system is a low cost, one channel, TDR system. It is designed for customers desiring a low cost solution for their TDR measurement needs. This system can be expanded to allow general-purpose sampling by adding a S-53 Trigger Recognizer Head.

CHARACTERISTICS

The 7603TDR includes:
(1) 7603 Oscilloscope
(1) 7S12 TDR/Sampler
(1) S-6 Sampling Head
(1) S-52 Pulse Generator Head plus manuals and accessories.

Refer to individual product sections for more complete information.

ORDERING INFORMATION

(System price represents substantial discount over individual instrument prices).

7603SMP Sampling System **$15,995**
7603TDR System **$9,995**

OPTIONS

Option 03—Tape Dial Change (Meters) 7603TDR only.*[1]

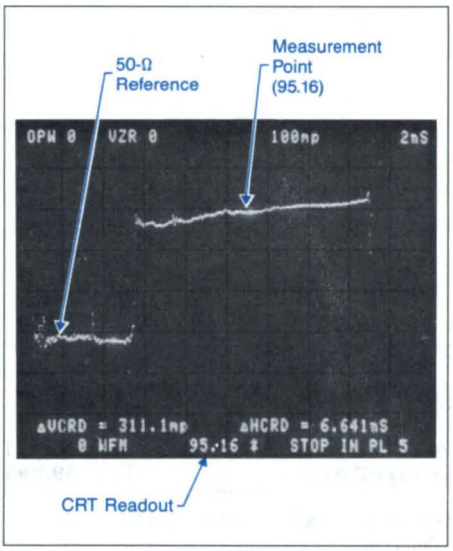
INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.

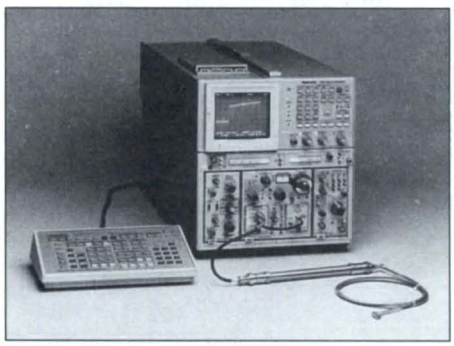
*[1] *Contact your local sales office.*

Sampling Plug-ins

7000-Series sampling plug-ins can increase the versatility of your mainframe by providing measurement capabilities up to 14 GHz on repetitive signals. The sampling family consists of three plug-ins, one external delay line, eight specially-designed sampling heads, and various supporting accessories that provide maximum configurability for numerous applications.



CRT photo shows an automated impedance measurement on a four-foot length of 93-Ω coax. An easy-to use program allows the operator to obtain a direct readout in ohms (bottom center) after positioning cursors on selected points on the display.



The 7854/7S12 combination is ideally suited for making a wide variety of automated sampling measurements. Examples of easy-to-program measurements are: measuring propagation delay through active or passive devices; measuring distance to faults in coax cables; and measuring impedance in EC boards and other controlled-impedance devices. Programs can be entered into the 7854 via the calculator keyboard for simple operator-controlled measurements, or tests can be computer-controlled via a remote terminal on the GPIB for production applications.

Specific uses for samplers include general UHF measurement, optical waveform analysis and TDR (Time-Domain Reflectometry.)

UHF Measurements

For flexibility in time-domain measurements, the 7S11 Sampling Unit/7T11A Sampling Sweep combination provides triggering to 12.4 GHz and the choice of modular heads for optimum signal acquisition. Two 7S11s and one 7T11A provide dual-trace capability. These plug-ins provide a cost-effective way to obtain gigahertz measurement capability for repetitive signals.

Optical Waveform Analysis

Characterization of optoelectronic devices such as laser diodes, light emitting diodes, optical waveguides, optical detectors and electro-optic modulators is becoming more important as applications for fiber optics in telecommunications and data communications expand. The S-42 optical sampling head allows researchers to display and measure optical waveforms from DC to 6.4 GHz in the 1000 to 1700 nm wavelength range. Measurements such as risetime, aberration, optical power vs drive current and voltage, modulation bandwidth, and sensitivity can now be made at high bandwidth accurately and easily.

TDR

TDR is widely used in microwave stripline evaluation, computer backplane measurements, and printed circuit board testing. With TDR, a pulse is sent down a conductive path and measured as it reflects back from any impedance changes in the device under test. Any impedance variations in the path cause a corresponding signal to be displayed on the scope. The precise location and type of impedance anomaly (open, short, step change) in the conductive path is directly readable on the display. The fast rise times of samplers make them well-suited for these measurements. The high-resolution 7S12 TDR Sampler provides maximum versatility in addition to general-purpose applications.

SAMPLING-HEAD CHARACTERISTICS

	Calculated Bandwidth	Rise Time	Input Impedance	Noise	Connector
S-1	DC to 1 GHz	≤ 350 ps	50 Ω	≤1 mV*1 ≤2 mV*2	GR
S-2	DC to 4.6 GHz	≤75 ps	50 Ω	≤3 mV*1 ≤6 mV*2	GR
S-3A	DC to 1 GHz	≤350 ps	— 100 kΩ	≤3 mV at probe tip*2	Probe
S-4	DC to 14 GHz	≤25 ps	50 Ω	≤2.5 mV*1 ≤5 mV*2	SMA (3 mm)
S-6	DC to 11.5 GHz	≤30 ps	50 Ω feed thru	— ≤5 mV*2	SMA (3 mm)
S-42	DC to 6.4 GHz	≤55 ps	N/A	≤125 μW	FC (Fiber Optic)

*1 *Smoothed* *2 *Unsmoothed*

ACCESSORY PROBES FOR 50-Ω SAMPLERS

Passive

Type	Attenuation	Length*1	Loading		Rise Time (ns)	Bandwidth	Package Number*2
P6056	10X	6.0	500 Ω	1 pF	<0.1	DC to 3.5 GHz	P6056
P6057	100X	6.0	5 kΩ	1 pF	<0.25	DC to 1.4 GHz	P6057
Active—FET*3							
P6201	1X	6.0	100 kΩ	3 pF	<0.4	DC to 900 MHz	P6201 (includes attenuators)
	10X	6.0	1 MΩ	1.5 pF	<0.4	DC to 900 MHz	
	100X	6.0	1 MΩ	1.5 pF	<0.4	DC to 900 MHz	
P6202A	10X	2 m	10 MΩ	2 pF	<0.7	DC to 500 MHz	P6202A plus 010-0384-00 to provide 100X
	100X	2 m	10 MΩ	2 pF	<0.7	DC to 500 MHz	
Active—Variable Bias/Offset*3							
P6230	10X	1.6	450 Ω	1.6 pF	≤0.23 ps	DC to 1.5 GHz	P6230

*1 *Length in feet except where specified.*
*2 *Refer to probe section for additional information.*
*3 *Requires power source: Most four-compartment mainframes provide probe power. See Signal Acquisition section for Probe Power Supplies.*

7S12 TDR/Sampler

7S12

- **45-ps TDR or General-Purpose Sampler**
- **5 Sampling Heads Available**
- **1 Optical Sampling Head Available**
- **1 Pulse Source Available**
- **1 Trigger-Recognizer 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 250 feet in any cable. Its vertical scale is calibrated in reflection coefficient (ρ) from 2 to 500 mρ/div and in voltage from 2 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.

General-purpose measurements may be made by using a S-1, S-2, S-3A, S-4, or S-6 Sampling Head with a S-53 Trigger-Recognizer Head. Optical signals can be measured by using an S-42 optical sampling head with a S-53 Trigger Recognizer Head. For dual-trace sampling displays, use a 7S11 Sampling Unit with a 7S12.

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.

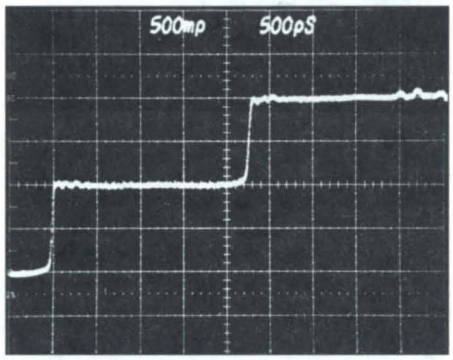
Time and Distance Ranges—Direct-reading tape dial gives calibrated one-way distance to at least 375 ft (air line). Time range is at least 0.75 μs round trip. Both ranges are limited by the duration of the pulse from the S-52.

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—<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.



The 7S12 displays reflection coefficient (ρ) versus distance on a device-under-test. Here the 7S12 measures a reflection caused by a crack (open) in a PCB under test. Distance can be read directly from the 7S12 front panel or calculated from the time-base settings.

OTHER 7S12 CHARACTERISTICS

Vertical Scale—Calibrated in mρ (reflection coefficient$\times 10^{-3}$) and mV from 2 to 500 units/division in eight 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 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: Accurate within 1%. Distance calibration may be preset for dielectric having propagation factors from 0.6 to 1.

Time/Div—20 ps 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.

ORDERING INFORMATION

7S12 TDR/Sampler Without Sampling Heads (Tape Dial in Feet) **$3,715**
Includes: 750-ps rigid "U" delay line (015-1017-01); short-circuit termination (015-1021-00); TDR graticule overlay (331-0296-00); TDR slide rule (003-0700-00); TDR graticule overlay (331-0297-00); instruction manual (070-1244-00).

Option 03—Tape Dial Change (Meters). **+ $25**

RECOMMENDED MAINFRAMES

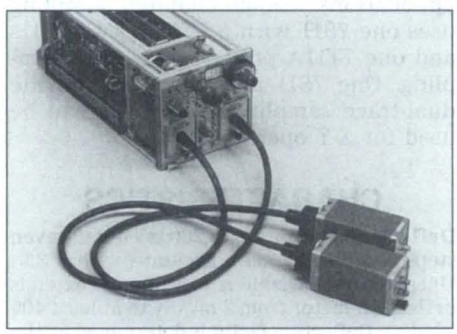
7603 Oscilloscope Mainframe **$3,995**
7854 Waveform Processing Oscilloscope **$15,275**

OPTIONAL EQUIPMENT

7M11—75 ns Delay Line. **$1,730**

OPTIONAL ACCESSORIES

Sampling-Head Extender—
(3 ft) Order 012-0124-00 **$500**
(6 ft) Order 012-0125-00 **$570**



Extenders allow the user to locate the sampling head directly in a test fixture, avoiding potential signal degradation by cables.

TRAINING

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. Information is in the Customer Training section. For further information, or to enroll, call us at 1-800-835-9433 ext. 430. In Oregon, call collect 629-1017.

For sampling heads, see later in this section. See 1502 and 1503 Portable TDR Cable Testers on pages 66–67.

7S11 Sampling Unit

7T11A Sampling Sweep Unit

7S11

- **2- to 200-mV/Div Calibrated Deflection Factors**
- **Plug-In Sampling Heads**

The 7S11 single-channel sampling unit employs the sampling plug-in head concept. The heads, which mount in the 7S11, range in bandwidth from 1 to 14 GHz. The 7S11 is used for a variety of applications. Single-channel sampling uses one 7S11 with a 7T11A. Two 7S11s and one 7T11A 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 to 200 mV/div in seven steps (1-2-5 sequence), accurate within 3%. Uncalibrated variable is continuous (extends deflection factor from 2 mV/div to at least 400 mV/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 to −1 V or more. Offset out is 10X 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 to +50°C.

ORDERING INFORMATION

7S11 Sampling Unit Without Sampling Head **$1,995**
Includes: Instruction manual (070-0985-00).

7T11A

- **10-ps to 5-ms/Div Calib Time Base**
- **Random or Sequential Sampling**
- **Equivalent- or Real-Time Sampling**
- **No Pretrigger Required**

The 7T11A Sampling Time Base provides equivalent- and real-time horizontal deflection for single- or dual-trace sampling. Timing accuracy is within 3% and nonlinearity is below 1%. Triggering range is from approximately 10 Hz (sequential mode) to above 12.4 GHz. The 7T11A works with all 7000-Series instruments and is a companion unit to the 7S11.

CHARACTERISTICS

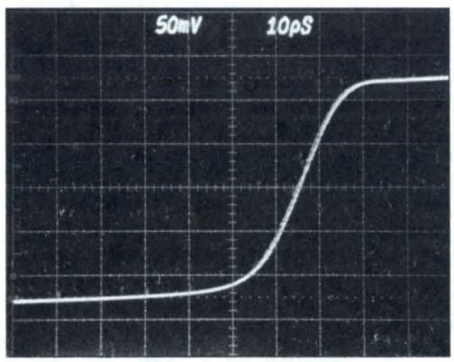
Time/Division Range—10 ps to 5 ms/div (1-2-5 sequence) directly related to time position ranges. Uncalibrated variable is continuous between steps to at least 4 ps/div.
Time Position Range—Equivalent time is 50 ns to 50 μs in four steps; real time is 0.05 ms to 50 ms in three steps.
Time/Division Accuracy—Within 3% for all time/division settings over center 8 cm.

TRIGGERING

External 50-Ω Input—Frequency range: dc to 1 GHz in X1 Trig Amp mode. Sensitivity range: 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: 50 Ω within 10%. Max input voltage: 2 V (dc + peak ac).
External 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%. Maximum input voltage is 100 V p-p to 1 kHz (derating 6 dB per octave to a minimum 5 V p-p).
External HF Sync—Frequency range: 1 to 12.4 GHz. Sensitivity range: 10 to 500 mV p-p. Input R: 1 MΩ. Max input voltage: 2 V p-p.
Internal Trigger Source (Sine Wave Triggering)*1—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.
*1 *Trigger circuits will operate to dc with pulse triggering, except for HF Sync.*
Random Mode Trigger Rate—1 kHz min.
Display Jitter*1

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

*1 *Measured under optimum trigger conditions with Time/Division switch clockwise.*
Pulse Out—Positive pulse amplitude at least 400 mV (into 50 Ω) with 2.5-ns rise time or less.
Trigger Kickout—2 mV or less into 50 Ω (except HF Sync).
Display Scan Rate—Continuously selectable from at least 40 sweeps/s to <2 sweeps/s.
External Scan—Deflection factor is continuously variable from 1 to 10 V/div. Input R is 100 kΩ within 10%. Maximum 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 to +50°C.



7S11/7T11A provide accurate measurements on repetitive signals. Pulse rise time of 21 ps shown.

ORDERING INFORMATION

7T11A Sampling Sweep Unit **$4,880**
Includes: 42-inch BNC 50-Ω cable (012-0057-01); 3-mm SMA male to BNC adaptor (015-1018-00); 3-mm SMA male to GR874 adaptor (015-1007-00); 10X 50-Ω attenuator (011-0059-02); instruction manual (070-0986-00).

OPTIONAL EQUIPMENT

7M11—75 ns Delay Line **$1,730**

TRAINING

Tektronix Instrument Group Customer Training offers operation and application training to help you get full value out of your instrumentation investment. Information is in the Customer Training section. For further information, or to enroll, call us at 1-800-835-9433 ext. 430. In Oregon, call collect 629-1017.

S-1

- **DC to 1-GHz Bandwidth**
- **Clean Transient Response**
- **Internal Trigger Pickoff**

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% or less, total of 1% or less p-p after 5 ns.
Displayed Noise—Smoothed: 1 mV. Unsmoothed: 2 mV or less.
Signal Range—Variable dc offset allows signals between +1 and −1 V limits to be displayed at 2 mV/div. Signals between +2 and −2 V limits may be displayed at 200 mV/div. For best dot response with random-sampling sweep unit, signal amplitude should be <500 mV p-p.
Input Characteristics—Nominally 50 Ω. Safe overload is ±5 V. GR874 input connectors.
Weights—Net: 0.5 kg (1.0 lb). Shipping: 1.4 kg (3.0 lb).

ORDERING INFORMATION

S-1 Sampling Head **$1,695**
Includes: 5-ns, 50-Ω RG58 A/U cable (017-0512-00); 10X, 50-Ω GR attenuator (017-0078-00); instruction manual (070-0763-00).

S-2

- **DC to 4.6-GHz Bandwidth**
- **Displayed Noise <6 mV (Unsmoothed)**
- **Internal Trigger Pickoff**

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—Smoothed: 3 mV. Unsmoothed: 6 mV or less.
Signal Range—Variable dc offset allows signals between +1 and −1 V limits to be displayed at 2 mV/div. Signals between +2 and −2 V limits may be displayed at 200 mV/div. For best dot response with random-sampling sweep unit, signal amplitude should be <200 mV p-p.
Input Characteristics—Nominally 50 Ω. Safe overload is ±5 V. GR874 input connectors.
Weights—Net: 0.5 kg (1.0 lb). Shipping: 1.4 kg (3.0 lb).

ORDERING INFORMATION

S-2 Sampling Head **$1,695**
Includes: 10X 50-Ω GR attenuator (017-0078-00); 5-ns, 50-Ω RG213/U Cable (017-0502-00); instruction manual (070-0764-00).

S-3A

- **Displayed Noise <3 mV (Unsmoothed)**
- **DC to 1-GHz Bandwidth**
- **Compact, 4.5-ft, 100-kΩ, 2.3-pF Probe**

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 and −1 V, 1X range, or +2 and −2 V, 2X range, to be displayed at 2 mV/div. The signal range may be increased 10X or 100X with the probe attenuators.
Weight—Net: 1.4 kg (3.0 lb). Shipping: 2.3 kg (5.0 lb).

ORDERING INFORMATION

S-3A Sampling Head **$2,280**
Includes: 10X attenuator head (010-0364-00); 100X attenuator head (010-0365-00); two test-point jacks (131-0258-00); coupling capacitor (011-0098-00); probe tip (206-0114-00); tip ground adaptor (013-0085-00); 5½-inch ground lead (175-1017-00); 12½-inch ground lead (175-1018-00); 3-inch cable assembly (195-6176-00); end cap (200-0834-00); three ground clips (344-0046-00); two end caps (200-0835 00); probe holder (352-0090-00); carrying case (016-0121-01); 6-inch elec lead (175-0849-00); 3-inch elec lead (175-0849-00); retractable hook tip (013-0097-01); 50-Ω voltage pickoff (017-0077-01); instruction manual (070-1148-01).

S-4

- **Displayed Noise <5 mV (Unsmoothed)**
- **25-ps Rise Time**
- **Internal Trigger Pickoff**

The S-4 Sampling Head is a 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 an 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—Smoothed: 2.5 mV. Unsmoothed: 5 mV or less.
Signal Range—Variable dc offset allows signals between +1 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 is ±5 V. SMA (3 mm) input connector.
Weight—Net: 0.5 kg (1.0 lb). Shipping: 0.9 kg (2.0 lb).

ORDERING INFORMATION

S-4 Sampling Head **$2,500**
Includes: 10X, 50-Ω SMA attenuator (015-1003-00); 2-ns cable with SMA connectors (015-1005-00); GR874 to SMA male adaptor (015-1007-00); SMA male-to-male adaptor (015-1011-00); $^5/_{16}$ inch wrench (003-0247-00); instruction manual (070-0896-01).

S-6

- **30-ps Rise Time**
- **Displayed Noise <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 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. Safe overload is ±5 V.
Weight—Net: 0.5 kg (1.0 lb). Shipping: 0.9 kg (2.0 lb).

ORDERING INFORMATION

S-6 Sampling Head **$1,900**
Includes: 50-Ω termination (015-1022-00); 1-ns 50-Ω cable (015-1019-00); SMA (3 mm) female-to-female adaptor (015-1012-00); combination wrench (003-0247-00); SMA male-to-GR874 adaptor (015-1007-00); instruction manual (070-1128-01).

TIMING AND PULSE-GENERATOR HEAD CHARACTERISTICS

	Bandwidth	Rise Time	Application
S-52	—	≤25 ps	High-Resolution TDR
S-53	DC to 1 GHz trigger recognizer	—	General-Purpose Sampling

NEW S-42

Optical Sampling Head

- **55-ps (FWHM) Optical Pulse Response (max FWHM)**
- **DC 6.4 GHz Equiivalent Bandwidth (0.35/55 ps)**
- **1000–1700 nm Spectral Response**
- **Mean Optical Power Monitor Function**

The S-42 is an optical to electrical sampling head for use with Tektronix 7000 Series oscilloscopes equipped with 7S11 sampling or 7S12 sampling plug-in. The optical-to-electrical converson is linear up to 25 mW peak input with a calibrated deflection factor from 50 μW/div to 5 mW/div at 1300 nm.

The S-42 also has a Mean-Power meter function with selectable 1 V/mW and 1 V/μW ranges.

The S-42 can be plugged into the sampling unit or attached by a sampling head extender for remote use.

Optical signal input is through a standard FC fiber optic connector, other connector types can be accommodated by use of fiber optic jumper cables (See page 491).

Pulse Response—55 ps max FWHM (Full Width Half Maximum).
Bandwidth (Equivalent)—6.4 GHz (0.35/55 ps).
Spectral Response—1000 to 1700 nm.
Noise Equivalent Power—125 μW or less.
Pulse Response Aberrations (first 400 ps following setup)—≤30% p-to-p.
Linear Response—Linear up to 25 mW peak, 5 mW mean-optical-power input.
Mean-Power Meter Dynamic Range—1 nW to 5 mW (60 dB).
Weight—Net: 0.4 kg (14 oz). Shipping= 0.9 kg (2.0 lbs).

ORDERING INFORMATION

S-42 Optical Sampling Head.*[1]
Includes: 2 multimeter connection cables (012-1286-00 and 012-1287-00); instruction manual (070-7191-00).

*[1] *Contact your local sales office.*

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 TDR (Time-Domain Reflectometer). For TDR applications, it 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 250 ft in any cable. A pretrigger output allows operation 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 when used with the 7S12 in the TDR mode is typically 750 ns. Pulse duration when powered by the 7S11 is >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.

Weight—Net: 0.3 kg (0.8 lb). Shipping: 0.5 kg (1.0 lb).

ORDERING INFORMATION

S-52 Pulse-Generator Head **$1,500**
Includes: 1-ns, 50-Ω semirigid coax delay line (015-1023-00); instruction manual (070-1101-01).

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.

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.

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.

Weight—Net: 0.3 kg (0.8 lb). Shipping: 0.5 kg (1.0 lb).

ORDERING INFORMATION

S-53 Trigger-Recognizer Head **$1,530**
Includes: 42-inch, 50-Ω cable (012-0057-01); 10X 50-Ω attenuator (011-0059-02); instruction manual (070-1147-00).

OPTIONAL SAMPLING ACCESSORIES

CT-1 Current Transformer—With GR Cable. **$235**
Coupling Capacitor GR874-K—Order 017-0028-00 **$125**
Power Divider GR874-TPD—Order 017-0082-00 **$800**
Adapters—
(GR to BNC) Order 017-0063-00 **$55**
(Probe Tip-to-BNC) Order 013-0084-01 **$9.75**
(Probe Tip-to-GR) Order 017-0076-00 **$80**
(Probe Tip-to-GR Terminated) Order 017-0088-00 **$75**

RECOMMENDED PROBES

P6056 10X Passive **$200**
P6057 100X Passive **$195**

OPTIONAL SAMPLING HEAD ACCESSORIES

With SMA (3 mm) Connectors

50-Ω Attenuators—
(2X) Order 015-1001-00 **$150**
(5X) Order 015-1002-00 **$150**
(10X) Order 015-1003-00 **$155**
50-Ω Termination—Order 015-1004-00 **$75**
50-Ω Signal Cables—
(2 ns) Order 015-1005-00 **$120**
(5 ns) Order 015-1006-00 **$185**
Adapters—
(Male-to-GR874) Order 015-1007-00 **$130**
(Female-to-GR874) Order 015-1008-00 **$155**
(Male-to-N Female) Order 015-1009-00 **$42**
(Male-to-7 mm) Order 015-1010-00 **$215**
(Male-to-Male) Order 015-1011-00 **$27**
(Female-to-Female) Order 015-1012-00 **$11**
Coupling Capacitor—Order 015-1013-00 **$230**
50-Ω Power Divider T—Order 015-1014-00 **$270**
500-ps 50-Ω Semi-Rigid Cable—Order 015-1015-00 **$30**
SMA Adapters—
(T) Order 015-1016-00 **$41**
(Male-to-BNC Female) Order 015-1018-00 **$10.25**
1-ns 50-Ω Cable—Order 015-1019-00 **$150**
SMA Terminations—
(Male Short-Circuit) Order 015-1020-00 **$25**
(Female Short-Circuit) Order 015-1021-00 **$27**
(Male 50 Ω) Order 015-1022-00 **$40**

With 50-Ω BNC Connectors

Feed-Through Termination—Order 011-0049-01 **$32**
Feed-Through (5 W)—Order 011-0099-00 **$55**
Attenuators—
(2X) Order 011-0069-02 **$45**
(2.5X) Order 011-0076-02 **$44**
(5X) Order 011-0060-02 **$45**
(10X) Order 011-0059-02 **$45**
Coaxial Cables—
(18 in) Order 012-0076-00 **$18.25**
(42 in) Order 012-0057-01 **$19.25**

5000-SERIES PLUG-INS

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Each 5000-Series mainframe houses up to three plug-in units. For conventional Y-T operation, the left and middle are amplifier units and the right plug-in is a time-base unit. An amplifier unit may be used in the right plug-in compartment to provide X-Y operation to the full sensitivity of the amplifier unit used. A dual-trace amplifier unit in the right compartment can provide fully independent, dual X-Y displays.

PLUG-IN VERSATILITY

A wide choice of plug-ins is available in the 5000-Series family. All of these plug-ins are compatible with the 5400 Series, and most are compatible with 5100-Series mainframes. Compatibilities of 5000-Series mainframes and plug-ins are shown in the chart below.

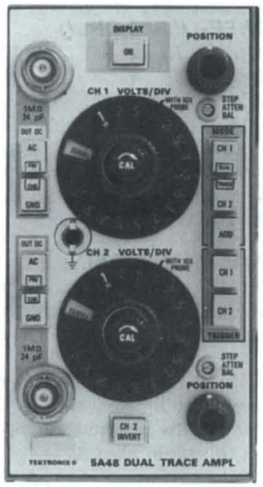
The amplifier plug-ins include single-, dual-, and four-trace units, and various differential amplifiers. The time-base plug-ins include single-, dual-, and delaying-sweep units, and a digital time base.

5000-SERIES MAINFRAME/PLUG-IN COMPATIBILITY

	5110 2 MHz Nonstorage	5111A 2 MHz CRT Storage	5113 2 MHz Dual Beam CRT Storage	5440 50 MHz Nonstorage W/Readout	5441 50 MHz Variable Persistence W/Readout	Price
5A14N Four Trace, 1 MHz, 1 mV/div	F	F	F	L*1	L*1	$1,855
5A15N Single Trace, 2 MHz, 1 mV/div	F	F	F	L*1	L*1	$445
5A18N Dual Trace, 2 MHz, 1 mV/div	F	F	F	L*1	L*1	$930
5A19N Single-Trace Differential, 2 MHz, 1 mV/div	F	F	F	L*1	L*1	$545
5A21N Single-Trace Differential, 1 MHz, 50 μV/div, 0.5 mA/div	F	F	F	L*1	L*1	$725
5A22N Single-Trace Differential, 1 MHz, 10 μV/div	F	F	F	L*1	L*1	$1,365
5A26 Dual-Trace Differential, 1 MHz, 50 μV/div	F	F	F	F	F	$1,530
5A48 Dual Trace, 50 MHz, 1 mV/div	0	0	0	F	F	$1,385
5B10N Single-Sweep Time Base/ Amplifier, 1 μs to 5 s	F	F	F	L*1	L*1	$705
5B12N Dual-Sweep Time Base, A-1 μs to 5 s, B-2 μs to 0.5 s	F	F	F	L*1	L*1	$1,490
5B40 Single-Sweep Time Base, 0.1 μs to 5 s	0	0	0	F	F	$985
5B42 Delaying Time Base, A-0.1 μs to 5 s, B-0.1 μs to 0.5 s	0	0	0	F	F	$1,740

F=Full compatibility L=Limited compatibility 0=No compatibility

*1 *Plug-ins with an "N" suffix do not implement the readout feature of the 5440 and 5441.*



5A48 Dual-Trace Amplifier

5A48

- **DC to 50-MHz Bandwidth**
- **1-mV to 10-V/Div Calibrated Deflection Factors**

The 5A48 is a dual-trace, 50-MHz plug-in amplifier for use in the 5223 and the 5400-Series mainframes. The 5A48 features fiveng modes, selectable trigger source, and CRT readout of deflection factor.*1

CHARACTERISTICS

Bandwidth—DC Coupled: DC to at least 50 MHz at 5 mV to 10 V/div, dc to at least 25 MHz at 1 and 2 mV/div (3 dB down). AC coupled: 10 Hz or less (1 Hz with 10X probe) at all deflection factors (3 dB down).

Deflection Factors—Calibrated: 1 mV to 10 V/div in a 1-2-5 sequence. Accuracy: ≤5% at 1 and 2 mV/div; ≤3% from 5 mV to 10 V/div from +15 to +35°C; ≤4% from 5 mV to 10 V/div from 0 to +50°C. Uncalibrated: Variable is continuous between steps to at least 25 V/div.

Input R and C—1 MΩ within 1% paralleled by ≈24 pF.

Maximum Input Voltage—DC Coupled: 250 V (dc +peak ac). AC Coupled: 500 V (dc +peak ac). AC Component: 500 V p-p maximum, 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.

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: Selectable from Channel 1 or Channel 2.

Rise Time—7 ns or less (5 mV to 10 V/div), 14 ns or less (1 and 2 mV/div).

*1 *CRT readout not functional in 5223.*

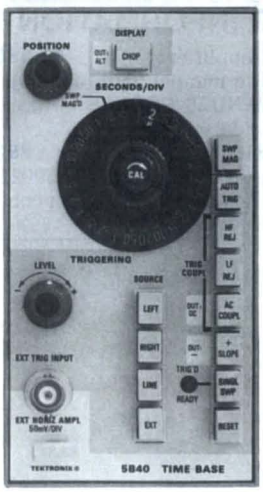
ORDERING INFORMATION

5A48 Dual-Trace Amplifier **$1,385**
Includes: Instruction manual (070-1450-00).

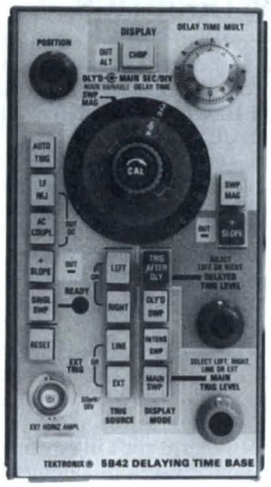
RECOMMENDED PROBES

See Signal Acquisition section.

P6105A—10X Passive. **$93**
For floating measurements, order A6902B Isolator. See Signal Acquisition section for complete description.



5B40 Time Base



5B42 Delaying Time Base

5B40/5B42

- **Single Sweep**
- **10-ns to 5-s/Div Calibrated Time Base**
- **Triggering to 50 MHz**

The 5B40/5B42 Time Bases are designed for use in 5400-Series mainframes. They feature sweep rates from 10 ns to 5 s/div and CRT readout of the sweep rate selected. The 5B42 also features delayed-sweep rates up to 10 ns/div.

CHARACTERISTICS

The following characteristics are the same for the 5B40 and 5B42 unless otherwise noted.

Sweep Rate—0.1 μs 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 eight graticule divisions. Valid for 100 div of magnified sweep after the first 30 ns.

	Unmagnified		Magnified	
Time/Div	+15 to +35°C	0 to +50°C	+15 to +35°C	0 to +50°C
1 s/div to 0.5 μs/div	3%	4%	4%	5.5%
5 and 2 s/div, 0.2 and 0.1 μs/div	4%	5%	5%	6.5%

TRIGGERING

Triggering Sensitivity

Coupling	Frequency Range	Minimum Signal Required Internal	External
DC 5400 ampl	DC to 10 MHz	0.4 div*1 0.4 div*2	60 mV*1 100 mV*2
5400 ampl	10 MHz to 60 MHz	1.0 div*1 1.0 div*1	150 mV*1 400 mV*2
5100 ampl	DC to 2 MHz	0.4 div*2	100 mV*2
AC	Trigger requirements increase below 50 Hz		
LF Rej	Trigger requirements increase below 7.5 kHz		
HF Rej	Trigger requirements increase above 50 kHz*1		

*1 *5B40 only.* *2 *5B42 only.*

Single Sweep—Triggering requirements are the same as normal sweep. When triggered, sweep generator produces only one sweep.

Ext Trigger Input—Maximum Input Voltage: 350 V dc +peak ac, 350 V p-p ac at ≤1 kHz. Input R and C: 1 MΩ paralleled by ≈24 pF. Trigger Level Range: ≥ ±1.5 V (5B40) and ±2.5 V (5B42).

Ext Horizontal Input—Deflection Factor: 50 mV/div ±3%. Input R and C: 1 MΩ paralleled by ≈24 pF. DC-Coupled Bandwidth: DC to ≥2 MHz. AC-Coupled Lower Response: ≤50 Hz. Maximum Input Voltage: 350 V (dc +peak ac) or 350 V p-p ac at ≤1 kHz.

DELAYING SWEEP (5B42 ONLY)

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 to 1 s to 5 s delay time.

Jitter—<0.05% of the time represented by one division of delaying sweep selected.

DELAYED SWEEP (5B42 ONLY)

Sweep Rate—0.1 μs 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.

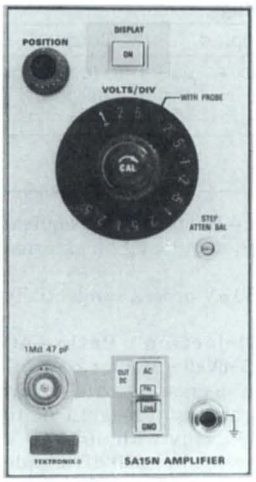
Sweep Accuracy—Measured over the center eight divisions. Same as undelayed sweep.

Triggering—The same as the internal triggering specifications in the table above.

ORDERING INFORMATION

5B40 Time Base **$985**
Includes: Instruction manual (070-1742-00).

5B42 Delaying Time Base **$1,740**
Includes: Instruction manual (070-1447-00).



5A15N Single-Trace Amplifier

5A15N

- **DC to 2-MHz Bandwidth**
- **1 mV to 5 V/Div**

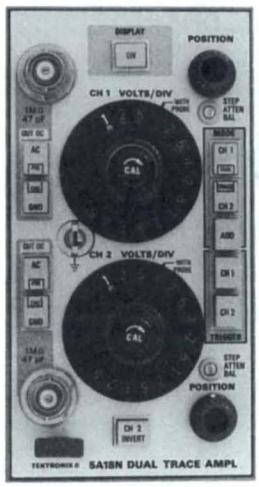
The 5A15N is the simplest of the 5A-Series plug-in amplifiers to use. It provides a bandwidth of dc to 2 MHz in any 5000-Series mainframe at sensitivities to 1 mV/div. Two 5A15Ns may be used in a mainframe to provide dual-trace operation, or to provide 1 mV/div X-Y operation if one of the amplifiers is inserted in the right mainframe compartment.

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—Calibrated: 1 mV to 5 V/div in 12 steps (1-2-5 sequence). Accuracy is within 2%. Uncalibrated: Variable is continuous between steps to at least 12.5 V/div.
Input R and C—1 MΩ within 1% paralleled by ≈47 pF.
Maximum Input—DC Coupled: 350 V (dc + peak ac). AC Coupled: 350 V dc.

ORDERING INFORMATION

5A15N Single-Trace Amplifier **$445**
Includes: Instruction manual (070-1136-00).



5A18N Dual-Trace Amplifier

5A18N

- **DC to 2-MHz Bandwidth**
- **1 mV to 5 V/Div**

The 5A18N is essentially a dual-trace 5A15N. Bandwidth is dc to 2 MHz in any 5000-Series mainframe at sensitivities to 1 mV/div. The Channel-2 signal may be inverted by means of a front-panel switch to provide difference measurements of two signals in the ADD mode. The internal trigger signal is selectable from Channel 1 or Channel 2 by means of front-panel pushbuttons.

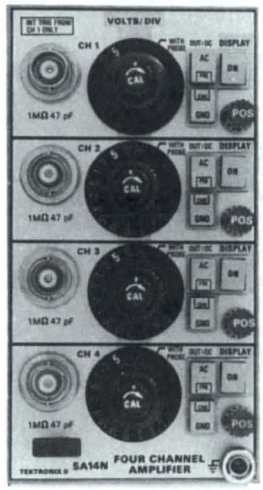
Dual-trace X-Y operation may be obtained with a 5A18N in the right compartment of any 5000-Series mainframe.

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—Calibrated: 1 mV to 5 V/div in 12 steps (1-2-5 sequence). Accuracy is within 2%. Uncalibrated: Variable is continuous between steps to at least 12.5 V/div.
Input R and C—1 MΩ within 1% paralleled by ≈47 pF.
Maximum Input—DC Coupled: 350 V (dc + peak ac). AC Coupled: 350 V dc.
Chopping Rate—25 to 100 kHz depending upon plug-in combinations and number of traces displayed.

ORDERING INFORMATION

5A18N Dual-Trace Amplifier **$930**
Includes: Instruction manual (070-1137-00).



5A14N Four-Trace Amplifier

5A14N

- **DC to 1-MHz Bandwidth**
- **1 mV to 5 V/Div**

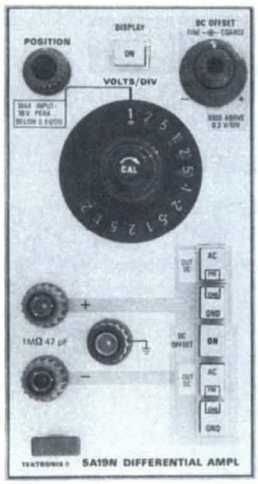
The 5A14N is a four-trace amplifier unit that provides 1-MHz bandwidth and sensitivity to 1 mV/div in any 5000-Series mainframe. Each channel may be displayed separately, or the channels may be alternated or chopped in any combination. The internal triggering signal is available from Channel 1 only. Two 5A14Ns may be combined to provide eight-trace operation in any 5000-Series mainframe.

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—Calibrated: 1 mV to 5 V/div in 12 steps (1-2-5 sequence). Accuracy is within 2%. Uncalibrated: Variable is continuous between steps to at least 12.5 V/div.
Input R and C—1 MΩ within 1% paralleled by ≈47 pF.
Maximum Input—DC Coupled: 350 V (dc + peak ac). AC Coupled: 350 V dc.
Chopping Rate—25 to 100 kHz depending upon plug-in combinations and number of traces displayed.

ORDERING INFORMATION

5A14N Four-Trace Amplifier **$1,855**
Includes: Instruction manual (070-1229-00).



5A19N Differential Amplifier

5A19N

- **DC to 2-MHz Bandwidth**
- **1 mV to 20 V/Div**
- **DC Offset**

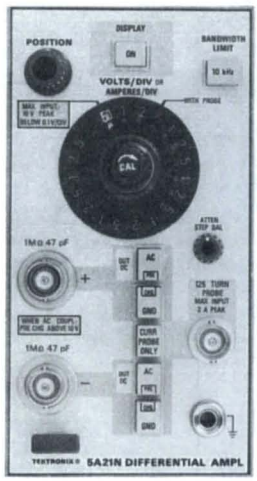
The 5A19N is a low-cost differential amplifier featuring variable dc offset and simplicity of controls. It is ideal for monitor and systems applications. It operates in the left or middle plug-in compartment of a 5000-Series mainframe for Y-T displays, or in the right compartment for X-Y displays.

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—Calibrated: 1 mV to 20 V/div in a 1-2-5 sequence. Accuracy is within 2%. Uncalibrated: Variable is continuous between steps to at least 50 V/div.
Input R and C—1 MΩ within 0.3% paralleled by ≈47 pF.

Signal and Offset Range

Deflection Factor Settings	1 to 200 mV/div	500 mV to 20 V/div
Common-Mode Signal Range	±16 V	±350 V
Maximum DC Coupled Input (DC + Peak AC at 1 kHz or Less)	±350 V	
Maximum AC Coupled Input (AC Voltage)	±350 V	
DC Offset Range	+15 to −15 V	+350 to −350 V



5A21N Differential Amplifier

Common-Mode Rejection Ratio—DC Coupled: 1 to 200 mV/div, at least 1000:1 from dc to 10 kHz; decreasing to 100:1 at 500 mV to 20 V/div.

ORDERING INFORMATION

5A19N Differential Amplifier **$545**
Includes: Instruction manual (070-1328-00).

5A21N

- **DC to 1-MHz Bandwidth**
- **10-kHz Bandwidth Limiter**
- **50 μV to 5 V/Div**
- **100,000:1 CMRR**
- **Voltage- and Current-Probe Inputs**

The 5A21N is a differential amplifier with a current-probe input. In the voltage mode, it provides sensitivities of 50 μV to 5 V/div; with the optional P6021 Current Probe, it provides current sensitivities from 0.5 mA to 0.5 A/Div.

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—Calibrated: 50 μV to 5 V/div in 16 steps (1-2-5 sequence). Accuracy is within 2%. Uncalibrated: Variable is continuous between steps to at least 12.5 V/div.
Input R and C—Voltage Mode: 1 MΩ within 0.15% paralleled by ≈47 pF.

Maximum Input Voltage

	DC Coupled	AC Coupled
50 μV to 50 mV/div	10 V (dc + peak ac)	350 V dc (coupling cap precharged), 10 V peak ac
10 mV to 5 V/div	350 V (dc + peak ac)	

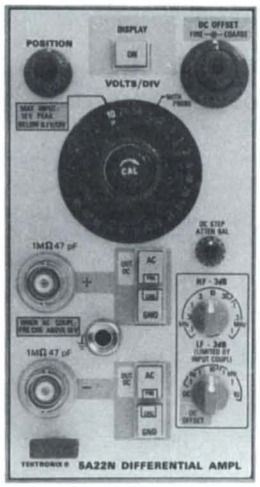
Input Gate Current—100 pA or less (equivalent to 100 μV or less, depending on external loading, at +25°C.
Displayed Noise—30 μV or less, tangentially measured.
Common-Mode Rejection Ratio—AC Coupled: 50 μV to 0.5 mV/div, at least 20,000:1 at 5 kHz and above decreasing to 400:1 at 10 Hz. DC Coupled: at least 100,000:1 dc to 30 kHz at 50 and 100 μV/div with up to 20 V p-p sine wave, decreasing by <20 dB/decade on sensitivity ranges up to 50 mV/div. From 100 mV to 5 V/div, CMRR is at least 400:1 with up to 100 V p-p sine wave.

CURRENT PROBE INPUT (WITH P6021 CURRENT PROBE)

Bandwidth—15 Hz or less to at least 1 MHz. Bandwidth may be limited to 10 kHz.
Deflection Factor— Calibrated: 0.5 mA to 0.5 A/div in 10 steps (1-2-5 sequence). Accuracy is within 3%. Uncalibrated: Variable is continuous between steps to at least 1.25 A/div.
Maximum 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 to +50°C.

ORDERING INFORMATION

5A21N Differential Amplifier **$725**
Includes: Instruction manual (070-1139-01).
Option 01—P6021 5-ft current probe. **+ $315**



5A22N Differential Amplifier

5A22N

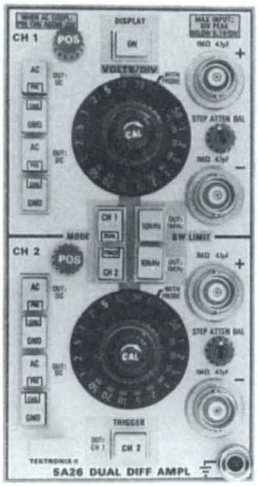
- **DC to 1-MHz Bandwidth**
- **10 μV to 5 V/Div**
- **100,000:1 CMRR**
- **Selectable Upper and Lower −3 dB Points**
- **DC Offset**

The 5A22N is the most versatile of the 5000-Series differential amplifiers. It features front-panel selectable filtering that 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 accuracy is 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. Accuracy is within 20% of selected frequency. AC Coupled: 2 Hz or less.
Deflection Factor—Calibrated: 10 μV to 5 V/div in a 1-2-5 sequence. Accuracy is within 3%. Uncalibrated: Variable is continuous between steps to at least 12.5 V/div.
Input R and C—1 MΩ within 0.15% paralleled by ≈47 pF.
Maximum Input Gate Current—200 pA or less.
Displayed Noise—20 μV at maximum bandwidth, source resistance 25 Ω or less, measured tangentially.



5A26 Dual Differential Amplifier

Overdrive Recovery—10 μs or less to recover to 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.
Drift With Temperature—100 μV/°C or less.
Common-Mode Rejection Ratio—AC Coupled: 10 μV 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 to 100 μV/div with up to 20 V p-p sine wave, decreasing by <20 dB/decade on sensitivity ranges up through 50 mV/div. From 100 mV to 5 V/div, CMRR is at least 400:1 with up to 100 V p-p sine wave.

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
Maximum DC Coupled Input (dc + peak ac at 1 kHz or less)	±12 V	±350 V
Maximum AC Coupled Input (dc voltage)	±350 V DC rejection, at least 4×10^6:1	
DC Offset Range	+0.5 to −0.5 V	+50 to −50 V

ORDERING INFORMATION

5A22N Differential Amplifier **$1,365**
Includes: Instruction manual (070-1230-00).

The 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 Sales Engineer for details.

5A26

- **DC to 1-MHz Bandwidth**
- **50 μV/Div Sensitivity at 1 MHz**
- **100,000:1 CMRR**
- **2 Differential Amplifiers in One Plug-In**
- **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.

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.

The 5A26 has many applications in areas that require dual differential performance, especially in biomedical and electro-mechanical fields, education, and component manufacturing.

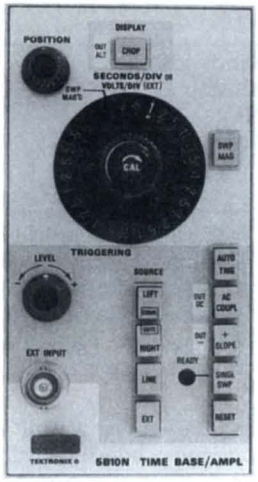
CHARACTERISTICS

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—Calibrated: 50 μV to 5 V/div in 16 steps (1-2-5 sequence). Accuracy is within 2%. Uncalibrated: Variable is continuous between steps to at least 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 ≈47 pF.

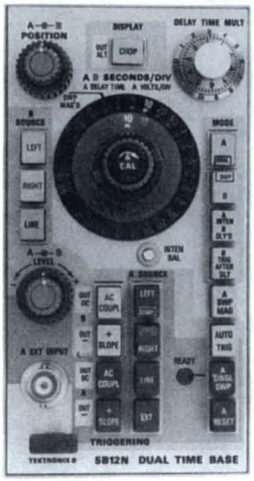
Maximum Input Voltage

	DC Coupled	AC Coupled
50 μV to 50 mV/div	10 V (dc+ peak ac)	10 V ac, 350 V (coupling cap precharged)
100 mV to 5 V/div	350 V (dc+ peak ac)	350 V (dc+ peak ac)

Maximum 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.



5B10N Time Base/Amplifier



5B12N Dual Time Base

Common-Mode Rejection Ratio	
DC Coupled	
50 μV 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 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 to 50 mV/div	At least 20,000:1 at 5 to 30 kHz, decreasing to not less than 2000:1 at 60 Hz

ORDERING INFORMATION

5A26 Dual Differential Amplifier **$1,530**
Includes: Instruction manual (070-1947-00).
P6055 High CMRR Differential Probes Matched pair for maximum CMRR performance. See Signal Acquisition section. **$555**

5B10N/5B12N

- **100 ns to 5 s/Div Calibrated Time Base**
- **Single-Sweep Operation**
- **X10 Magnifier**
- **Alternate and Chopped Displays**
- **50 and 500 mV/Div External Input**
- **Dual and Delayed Sweep (5B12N)**

The 5B10N and the 5B12N time-base units are designed for use with the Tektronix 5100-Series oscilloscope mainframes. They can also be used with the Tektronix 5400-Series mainframes, although they do not activate the scale-factor readout in the 5400 Series.

The 5B12N is a dual time-base unit that provides both delayed and dual sweeps.

An external signal-input connector on both the 5B10N and the 5B12N allows their use as a conventional amplifier to provide X-Y operation of the oscilloscope without the need for switching plug-in units.

CHARACTERISTICS

The following specifications are the same for the 5B10N and the A sweep of the 5B12N. B sweep specifications are identical except where indicated.

MAIN SWEEP

Sweep Rates—Calibrated: 1 μs to 5 s/div in 21 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. B Sweep: 0.2 μs to 0.5 s/div in 20 calibrated steps.
Sweep Accuracy—Unmagnified: Within 3% from 1 μs to 1 s/div and within 4% at 2 and 5 s/div. Add 1% for magnified sweep operation. B Sweep: Within 3% from 1 μs to 0.1 s/div. Within 4% at 0.2 μs, 0.5 μs, 0.2 s, and 0.5 s/div.

TRIGGERING

Triggering Sensitivity

	Coupling	To 1 MHz	At 2 MHz
DC	Internal	0.4 div	0.6 div
	External (A sweep only)	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 (A sweep only).
External Trigger Input—Maximum Input: 350 V (dc +peak ac). Input R and C: 1 MΩ within 2% paralleled by ≈70 pF. Trigger-Level Voltage Range: +5 to −5 V.

EXTERNAL HORIZONTAL MODE

Deflection Factor— Calibrated: 50 and 500 mV/div. Accuracy is within 3%. X10 variable extends range to at least 5 V/div.
Bandwidth—DC Coupled: DC to at least 1 MHz. AC Coupled: 2 Hz or less to at least 1 MHz.
Input R and C—1 MΩ within 2% paralleled by ≈70 pF.
Maximum Input Voltage—350 V (dc +peak ac).

DELAYING SWEEP (5B12N)

Delay Time—Accuracy: 1 μs to 0.5 s/div, within 1%. 1 to 5 s/div, within 2%. Multiplier range: 0.2 to 10.2 times the time/division setting. 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 to 5 s delay times.
Jitter—<0.05% of the time represented by one division of the delaying sweep selected.

ORDERING INFORMATION

5B10N Time Base/Amplifier **$705**
Includes: Instruction manual (070-1140-00).
5B12N Dual-Sweep Time Base **$1,490**
Includes: Instruction manual (070-1141-00).

OSCILLOSCOPE ACCESSORIES

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Travel Line Package

- **Impact-Resistant Packaging**
- **Pouch and Cover**
- **Carrying Strap**

Now give your 2200 Series instrument the added protection often necessary when used in rough environments. The Travel Line package provides protection from impacts along the front and rear of the instrument. The rear bumper is designed to provide a wider base to set the instrument on and reduces the potential of tip over when standing vertically.

The high-quality rubber moldings offer long life and are resistant to cracking and becoming brittle with age. The rubber composition provides excellent desk/bench and inclined plane grab, so there is no worry about instrument slippage.

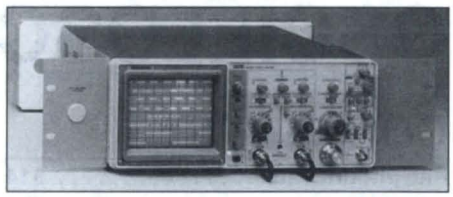
A front panel protective cover and an accessory pouch for carrying probes and documentation is also included, plus a convenient carrying strap for hands free operation and transport.

The Travel Line Package is available for the 2235/2236 and 2220/2221/2230. It can be ordered at the time of purchase or as a field retrofit kit.

ORDERING INFORMATION

Travel Line Package—Order Option 33 for specific instrument.
(2235/2236) Includes rubber molding, accessory pouch, front panel cover, carrying strap. **+$295**
(2220/2221/2230) Includes rubber molding, carrying strap. **+$245**

Travel Line Package Conversion Kits—Includes: Replacement cabinet and rear cover with the rubber moldings installed.
2213A, Order 040-1188-02 **$275**
(2236) Order 040-1187-01 **$135**
(2220/2221/2230) Order 040-1202-02 **$230**



Rackmount Adapter

- **Standard 19-Inch Mount**
- **Rack Depth Extenders**
- **Easy Assembly**

The low-cost rack adapter provides the means to rackmount any one of the high-performance high-value 2200 Series oscilloscope family. The rackmount is very space efficient, requiring only 5.14 inches of rack height (7 inches for 2245A, 2246A, 2247A). Rack extenders are provided to allow mounting to virtually any depth rack main frame. A mounting hole is provided for a BNC connector to route the Z-axis input to the front face of the rack. All hardware is supplied for complete mounting into your mainframe.

Kits are available for all 2200 Series products. They can be ordered at any time and are customer installable. For the 2220, 2221 and 2230 Digital Storage Oscilloscopes the kit also provides access for the optional GPIB or RS-232C interface connections for automated systems.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	483	19.0
Mount Width	464	18.3
Height*1	131	5.1
Depth*2	458	18.1
Weight ≈	**kg**	**lb**
Net, Kit	1.5	3.2
Net, Additional to instrument mount	0.7	1.6

*1 *Height for 2245A, 2246A, 2247A is 178 mm/7 inches.*
*2 *Does not include extenders.*

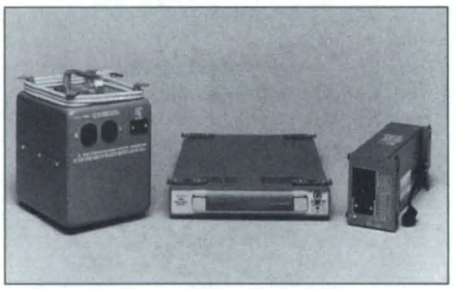
ORDERING INFORMATION

Rackmount Adapter Kit—Includes: Rackmount depth extenders, all mounting hardware, labels, instruction manual.
(2213/A, 2215/A, 2235, 2220, 2221, 2230) Order 016-1003-00 **$140**
(2235 Opt 01) Order 016-0833-00 **$155**
(2236) Includes DMM connector. Order 016-0015-00 **$230**
(2205, 2210, 2225) Order 016-0819-00 **$190**

OPTIONAL ACCESSORIES

BNC Female to BNC Female Connector—Order 103-0070-00 **$6**
50 Ω RF Coaxial Cable—Order 012-0117-00 **$17**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.



Shown (from left) are the 1105 Power Supply, the 1106 Battery Pack, and the 1107 DC Inverter.

Portable Power

Tektronix power accessories offer true field-use-portability and operating freedom at service and maintenance sites where conventional ac power sources are not available. They let your scopes go where you need them—and have enough power for your testing and troubleshooting tasks.

The following table outlines the preferred power accessory (or accessory combination) for Tektronix portable oscilloscopes. Note that for many instruments, the 1105 Power Supply is a compatible alternate dc power source.

Instrument	Recommended Power Accessory
2205*1,2213*2, 2213A*1,2215*2, 2215A*1,2221*1,2220*1, 2225*1, 2230*1,2235 Option 01*1, 2235*1,2236*1,2335*1, 2336YA*1,2337*1,2245*1 2246*1,2467B,2465B*1, 2443B CT,2463B DV, 2465B DM, 2465B DV*1	1107/1106 Inverter Battery Pack Combination or 1107 dc Inverter with Auxiliary dc Source
464*3,465B*3, 466*3,475*3,475A*3	1106 Battery Pack or 1105 Power Supply
314,335,336,434,465M, 468*4,485*1	1105 Power Supply

*1 *The 1105 Power Supply is also compatible with these instruments.*

*2 *Some lower serial-numbered units are not compatible for use with the 1107 DC Inverter and the 1105 Power Supply. Neither the 1107 DC Inverter nor the 1105 Power Supply are compatible with the following instruments, unless Option 48 is installed:*
US-built 2213 below Serial Number B020100
US-built 2215 below Serial Number B022000
UK-built 2213 below Serial Number 200239
UK-built 2215 below Serial Number 200307

*3 *These instruments require Option 07 for operation with the 1106 Battery Pack. Field conversion kits are available. Contact your local Tektronix Sales Engineer. But when the 1105 Power Supply is used with these 400 Series instruments, Option 07 is not required.*

*4 *Because of limited instrument operating time available when running from the internal batteries, it is recommended that an external dc power source be used.*

1105 Power Supply

CHARACTERISTICS

ELECTRICAL

Internal Battery Voltage Range—22 to 28 V.
External DC Input Voltage Range—24 to 30 V. (Maximum elevation for the positive and the negative power leads is 60 V with respect to chassis ground.)
Output—Waveform: Square wave. Frequency: 60 Hz ±10%.

Amplitude

DC Power Source	Peak AC Output: Standard Configuration (0.9 A Load)	Peak AC Output: Option 01 Configuration (0.45 A Load)
+22 V Internal		
+24 V External	108 V ±7%	216 V ±7%
+28 V Internal		
+30 V External	138 V ±7%	276 V ±7%

Maximum Recommended Output Current—Standard: 0.9 A. Option 01: 0.45 A.
Minimum Battery Operating Time—50 W hours from full charge.
Battery Charging Time—14 to 16 hours from full discharge at temperatures from 0 to 40°C (+32 to +104°F).
Battery Charging Rate—Full: 600 mA ±10%. With Thermal Cutout Open: 254 mA ±10%.
AC Charging Power Frequency Range—50 to 60 Hz.

AC Charging Voltage Rates

Line Voltage Selection Wiring	AC Voltage Ranges: Standard Configuration	AC Voltage Ranges: Option 01 Configuration
From Factory	100 to 132 V	200 to 264 V
With Internal	90 to 120 V	90 to 120 V
Connection	180 to 240 V	100 to 132 V
Changes	200 to 264 V	180 to 240 V

Maximum Power Consumption From AC Source—40 W.

ENVIRONMENTAL

Ambient Temperature—Operating: 0 to 40°C (32 to 104°F). Nonoperating (with battery installed): −40 to +60°C (−40 to +140°F). Nonoperating (without battery): −55 to +75°C (−67 to +167°F).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	165	6.5
Height	250	9.8
Depth	216	8.5
Weight ≈	**kg**	**lb**
Net	8.8	19.4

ORDERING INFORMATION

1105 Power Supply **$2,090**
Includes: DC power cord, 915 mm (36 in), for external dc input (161 0094-00); instruction manual (070-1479-01).

OPTION

Option 01—230 V ac Operation. **NC**
Includes: 2.1 m (7 ft) IEC power cable (161-0098-00).

1106 Battery Pack

CHARACTERISTICS

ELECTRICAL

DC Power Output—+22 to +24 V for 7 ampere-hours (with maximum current of 5 A).
Minimum Battery Operating Time—75 W hours (from full charge).
Battery Charging Time—14 to 16 hours (from full discharge, at temperatures from 0 to +40°C (+32 to +104°F).
Battery Charging Rate—Full: 620 mA. With Thermal Cutout Open: 60 mA.
AC Charging Power Frequency Range—50 to 400 Hz.
AC Charging Voltage Ranges—Standard: 100 to 132 V; 200 to 264 V. With Internal connection change: 90 to 120 V; 180 to 240 V.
Maximum AC Charging Power Consumption—40 W at 115 V, 60 Hz.

ENVIRONMENTAL

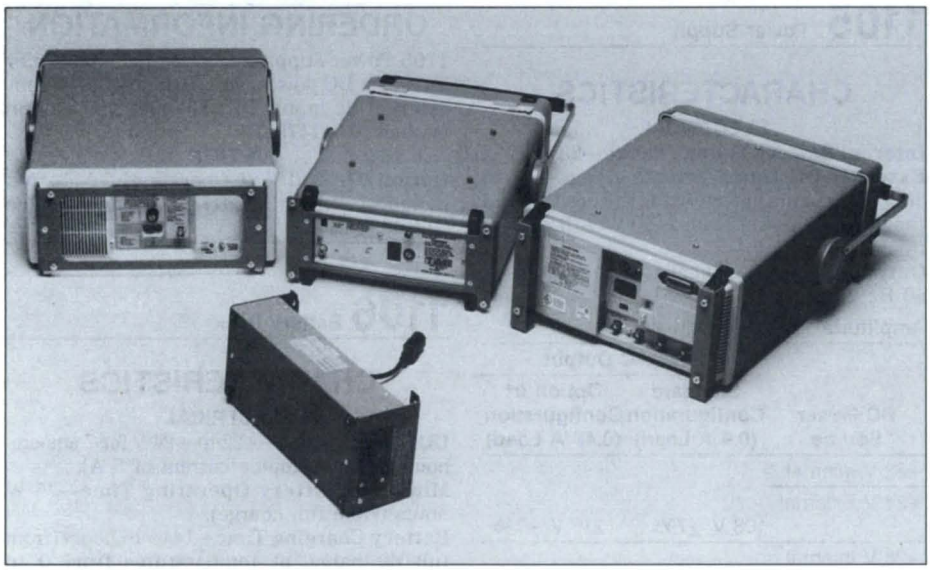
Ambient Temperature—Operating: 0 to +40°C (+32 to +104°F) Nonoperating (with battery installed): −40 to +60°C (−40 to +140°F). Nonoperating (without battery): −55 to +75°C (−67 to +167°F).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width, latches in latched position	292	11.5
Height w/feet & latches	66	2.6
Depth	432	17.0
Weight ≈	**kg**	**lb**
Net	7.3	16.0

ORDERING INFORMATION

1106 Battery Pack **$1,580**
Includes: Instruction manual (070-1713-00).
2220—Mounting kit not available
2300—Mounting kit not available
Mounting Kit for 2445A, 2465A, 2467 Oscilloscopes—Order 016-0797-02. **$95**



The 1107 DC Inverter can be quickly attached to or detached from the rear of Tektronix 2000 Series oscilloscopes via easily installed adapter kits. Shown here with adapters installed are (from left) the Tektronix 2236, 2336 and 2465A Oscilloscopes.

1107 DC Inverter

CHARACTERISTICS

ELECTRICAL

Output Frequency—Approximately 60 Hz.
Output Voltage and Timing (+12 V Mode)—Measured with a 200 Ω resistive load (approximately 60 W).

Output Parameter	Output With +12.3 V DC Input	Output With +14.2 V DC Input
Peak Voltage	160 V ±10%	160 V ±10%
Table Voltage	130 V ±10%	140 V ±10%
Turn-on Time	6.2 ms ±15%	6.2 ms ±15%
Dead Time	2.2 ms ±15%	2.2 ms ±15%

Output Voltage and Timing (+24 V Mode)—(Measured with a 166 Ω resistive load at ≈100 W).

Output Parameter	Output With +22.5 V DC Input	Output With +28.5 V DC Input
Peak Voltage	150 V ±10%	160 V ±10%
Table Voltage	135 V ±10%	150 V ±10%
Turn-on Time	6.2 ms ±15%	6.2 ms ±15%
Dead Time	2.2 ms ±15%	2.2 ms ±15%

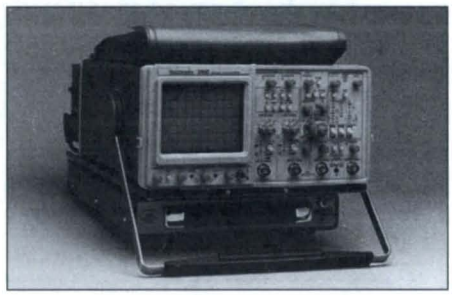
Rated Output Power in +12 V Mode—70 W (−15 to +35°C); 50 W (−15 to +55°C). DC source must be 117 V A +11.7 V or greater.
Rated Output Power in +24 V Mode—100 W.
Output Overload Protection—Output disabled and audible tone generated when ac load exceeds 100 W.
Input Voltage Range Selection—Automatic between +12 V mode and +24 V mode.
Operating Inputs—Measured at input of supplied dc power cord.

	DC Volts +12 V Mode	DC Volts +24 V Mode
Turn-on Range	+11.7 to 15.9 ±5%	+22.2 to +30.0 ±5%
Battery Protection Shut-down Limit*1	+10.0 ±5%	+21.0 ±5%
Difference Between Minimum Turn-on Range and Battery Protection Shut-down Limit*1	≥1.2	≥0.85

*1 *Tested with a variable dc supply without a load on the output.*

ENVIRONMENTAL

The 1107 DC Inverter meets environmental requirements of MIL-T-28800C for Type III, Class 3, Style C equipment with humidity and temperature requirements defined in paragraphs 3.9.2.2, 3.9.2.3, and 3.9.2.4 (except Electromagnetic Compatibility).
Ambient Temperature—Operating: −15 to +55°C (+5 to +131°F). Nonoperating: −62 to +85°C (−80 to +185°F).
Altitude—Operating: To 4600 m (15,000 ft). Maximum operating temperature decreases 1°C for each 300 m (1,000 ft) above 1500 m (5,000 ft). Nonoperating: To 15 250 m (50,000 ft).
Humidity—Operating and Nonoperating: 5 cycles (120 hours) referenced to MIL-T-28800C para. 4.5.5.1.2.2. for Type III, Class 3 Instruments.
Electromagnetic Compatibility—Meets radiated emission requirements per VDE 0871 Class B, Meets MIL-STD-461B for the following tests: Part 4 (CE01, CE03, and CS02); Part 5 (CS06 and RS02); and Part 7 (CS01, RE02, and RS03). Conducted emissions measurements performed on the dc input power cord.
Vibration—Operating: 15 minutes along each of three major axes at a total displacement of 0.025 inch p-p (4 g at 55 Hz), with frequency varied from 10 to 55 to 10 Hz in one minute sweeps. Held 10 minutes at 55 Hz in each of the three major axes.



The Tektronix 2465 Oscilloscope with attached 1106 Battery Pack and 1107 DC Inverter becomes a completely independent measurement package—readily transportable to remote sites where conventional ac power sources are not available.

Shock—Operating and Nonoperating: 50 g, ½ sine, 11 ms duration, three shocks per axis each direction, for a total of 18 shocks

Note: The following 1107 DC Inverter and oscilloscope combinations meet or exceed MIL-T-28800C Class 3 requirements for vibration and shock when attached together with designated mounting hardware:

1107/2445A
1107/2465A
1107/2455A
1107/1106/2467
1107/1106/2465A
1107/1106/2445A
1107/2335
1107/2336
1107/2337

Transportation Package Vibration—Meets limits of National Safe Transit Association Test Procedure 1A-B-1.
Transportation Package—Drop Meets limits of National Safe Transit Association Test Procedure 1A-B-2 with a 914 mm (36 inch) drop.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	276	10.9
Height	119	4.7
Depth	84	3.3
Weight ≈	**kg**	**lb**
Net	1.6	3.5
Shipping	1.8	4.0

ORDERING INFORMATION

1107 DC Inverter **$1,175**
Includes: 559 mm (22 in), dc power cord (161-0095-00); instruction manual (070-5056-00).

OPTIONAL ACCESSORIES
OSCILLOSCOPE MOUNTING KITS

1106—(2445A, 2465A, and 2467) Order 016-0797-02. **$95**
1107—(2445A and 2465A) Order 016-0783-01. **$50**
1107—(2335, 2336, 2336YA and 2337) Order 016-0786-00. **$50**
1107—(2200 Series) Cannot be used with Travel Line Package. Order 016-0785-00. **$60**
1107—(2235/2236, 2220/2230) Order 016-0785-00. **$60**
Not available for 2245 or 2246.

LOGIC ANALYZER PRODUCTS & DEVELOPMENT SYSTEMS

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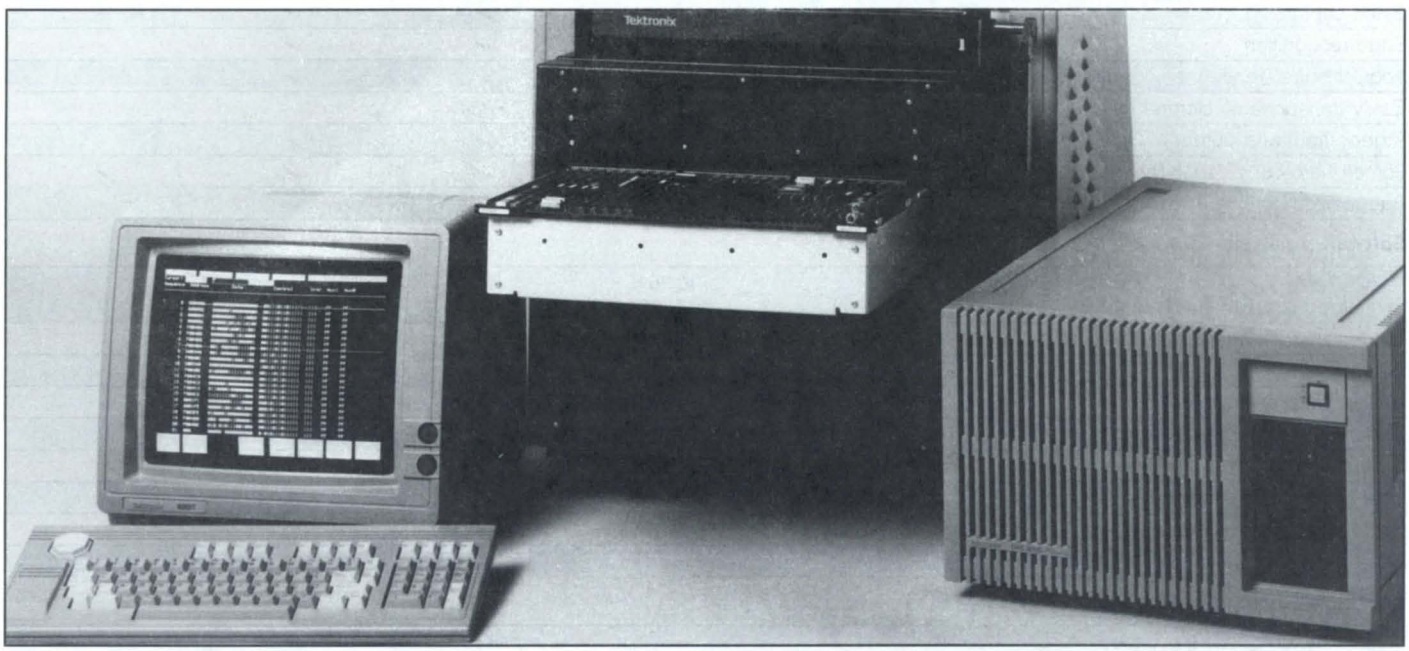
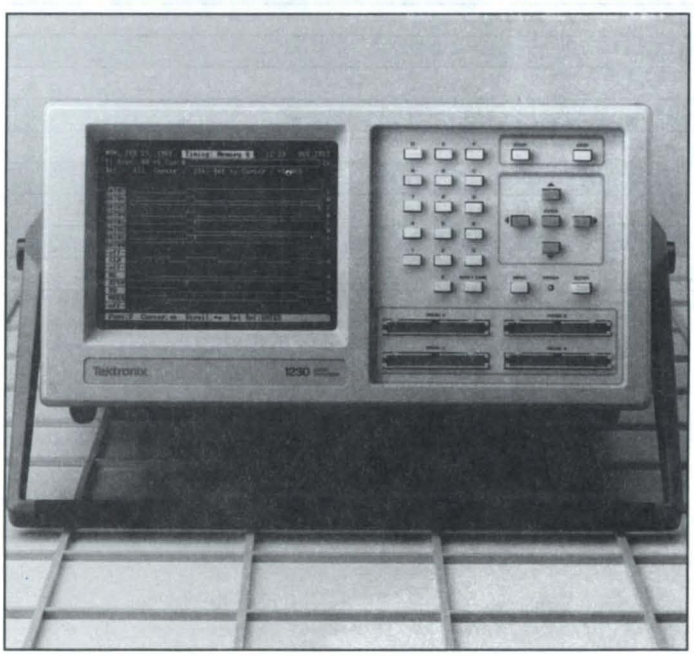
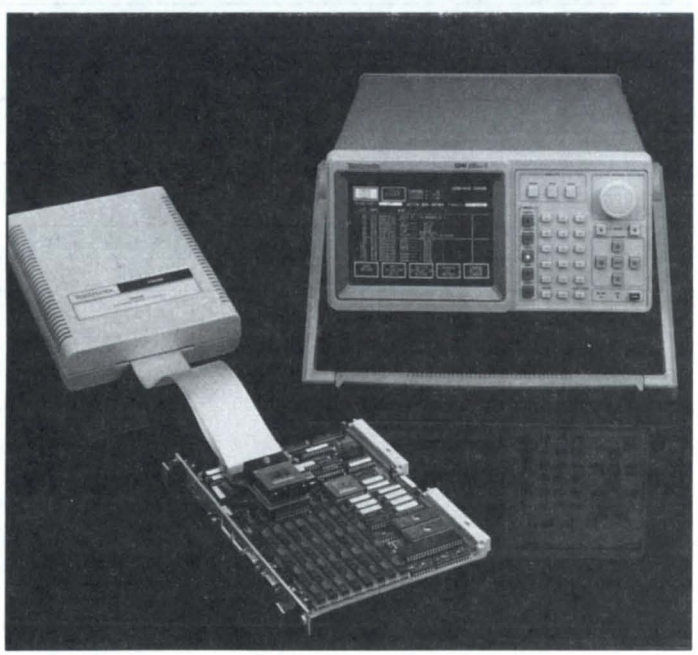






SELECTION GUIDE

For more information on a specific model, refer to the description on the following pages, or contact your Tektronix Sales Engineer.

Application/Feature	DAS 9200	DAS 9100	1240/1241	1230	1205
Hardware Analysis					
Asynchronous acquisition rate (MHz)	20,200 2,000	10,25 100,660 2,000	100	100	100
Color display	✓	✓	✓		
Modular	✓	✓	✓	✓	
Simultaneous state/timing acquisition	✓	✓	✓	✓	
Maximum acquisition channels	540	104	72	64	24
Maximum pattern generation channels	1792	384			
Glitch capture	✓	✓	✓	✓	✓
Edge recognition	✓		✓	✓	
Acquisition/reference memory compare	✓	✓	✓	✓	
Easily transportable storage media	Floppy	Tape	Pack		
Trigger input and output	✓	✓	✓	✓	
Screen hard-copy capability	✓	✓	✓	✓	✓
Ruggedized mainframe			✓	✓	
Software Analysis					
Synchronous acquisition rate (MHz)	20,200	10,25 100,330	50	25	9
Trigger on complex program flow	✓	✓	✓	✓	
Data qualification	✓	✓	✓	✓	
Microprocessor mnemonics	✓	✓	✓	✓	✓
Multiple microprocessor support	✓				
Time stamp	✓				
User-definable mnemonics		✓			
Performance analysis	✓		✓		
Serial data analysis to 19.2 kbaud	✓	✓	✓	✓	
Hardware/Software Integration					
Multiple synchronous timebases	✓		✓	✓	
Trigger arming	✓	✓	✓		
Time-aligned state and timing displays	✓	✓	✓		
Graph display	✓				
Demultiplexing	✓	✓	✓	✓	
Programmable via RS-232C	✓	✓	✓	✓	
Programmable via GPIB	✓	✓	✓	✓	
Remote control via master/slave		✓	✓		
See page:	336	342	345	351	354
Prices Begin At:	$9,970	$9,240	$4,500/$6,000	$2,795	$1,845

Tektronix provides integrated solutions to support the development of embedded microprocessor applications. Software and hardware products equip engineers with efficient tools to address state-of-the-art designs and applications.

Tektronix hardware and software products support designers during the CODE,TEST, and INTEGRATION phases of the development lifecycle. During the CODE PHASE, the software engineer translates a system design into assembly or high level language software modules. In the TEST PHASE, the software engineer tests new code in known good hardware environments and the hardware subsystems before integration. In the INTEGRATION PHASE, newly developed software and hardware is brought together for system level testing and verification.

Tektronix provides a range of products to meet your microprocessor design needs. The Language Development System (LANDS) is a cross-software development environment for implementing C and PASCAL applications. A family of Logic Analyzers offers the widest selection of 8, 16, and 32 bit microprocessor support packages in the industry, including support for single chip microcontrollers, digital signal processors, and RISC processors. Finally, a family of emulator systems provide designers with system integration and verification tools.

Language Development Systems

In the CODE, TEST, and INTEGRATION PHASES, Tektronix offers a complete software cross-development environment. The Tek Language Development System (LANDS) is an integrated set of code development and debug tools, first offered in 1982 and enhanced since then with support for C, PASCAL, and Ada. LANDS includes a Language Directed Editor (LDE), a cross-compiler, an Integration Control System (ICS), a macro assembler/linker, and a symbolic and source level debugger.

Tek's LANDS integrates with Tek's emulation and logic analyzers to provide both software development and complete system integration. This popular solution for microprocessor support is the result of over ten years of experience in supporting embedded microprocessor applications.

Logic Analyzers

For the TEST and INTEGRATION PHASES of the development lifecycle, Tektronix offers a family of logic analyzer and emulator products.

Tektronix offers the industry's widest selection of logic analyzer based microprocessor support tools. Ranging from the Digital Analysis Systems (DAS) to the 1200 Series, both system level and portable applications are addressed. Modularity across the entire product line allows you to configure systems for today's requirements, and to expand or upgrade systems as your needs grow.

Microprocessor support products provide display and setup software, and single-connection probe adapters for the most popular 8-bit, 16-bit, and 32-bit microprocessors.

Hardware Timing Analysis provides the measurement tools to verify microprocessor system timing. Software Analysis provides a real-time look at program execution for one microprocessor or the interaction of several processors simultaneously. The DAS' exceptionally deep trace memory lets you see and solve your problem with a single acquisition. Performance Analysis lets you monitor software activity in real-time, and provides timing and code efficiency statistics for your code using graphical displays, without the delays and compromises of breakpoints, wait states, or instrumented code.

Emulation Systems

Tektronix emulation systems provide engineers with real-time tools that automate hardware/software testing and integration.

Ranging from V Systems for 8-bit and 16-bit microprocessors, to Multi-V Systems for 32-bit microprocessors, real-time and transparent emulators provide fast download of object code into target prototypes, and interactive symbolic and source level debugging.

To support your development environment, Tektronix has configured its LANDS and emulation products with your computer platform into a tightly integrated development system.

Tektronix emulators provide you with an easy-to-use connection to your prototype. Operation without your prototype is also possible, giving engineers a known good environment for testing new software. Program memory can be added to your emulator, replacing deficient prototype memory resources. Real-time trace looks back at software program execution, giving you a window into assembly or high-level code execution.

Tektronix also provides you with an easy-to-use connection to your host computer or workstation, with both RS-232 and Ethernet interfaces. Tektronix emulators rely on industry standard Ethernet connections to provide fast download of code.

TEK Microprocessor Support

Microprocessor, Digital Signal Processor, Bus, and Interface Support

Tektronix Logic Analyzers and Microcomputer Development Products offers a wide range of microprocessor support with a broad selection of single connection probe adapters and mnemonic disassembly packages, software development tools, and emulation systems.

For custom microprocessors, or microprocessors listed below, Tektronix offers several general purpose support packages: Extended Define Mnemonics (EDM) on the DAS 9100; UPIK40 Universal Probe Interface Kit on 1240/1241; PM301 on the 1205.

This selection guide summarizes the microprocessor and bus support products offered for the DAS 9200, DAS 9100, 1240, 1241, 1230, and 1205 families of logic analyzers, and the V and Multi-V Systems, and 8540 families of emulation systems.

Micro-processor	Logic Analyzer Family	For Software ORDER	For Probe Adapter ORDER	Acq. Boards Required	Acq. Probes Required	Fastest Clock Rate Supported	Price*1
INTEL MICROPROCESSORS							
8080	DAS 9100	91TM01	Opt 01	2*2	4*9	Max	$550
	1240/41	12RM01	Opt 01	2*4	4*9	Max	$600
8031	DAS 9100	91TM07	Opt 01	2*2	4*7	Max	$550
	1240/41	12RM99 (Opt 03)	UPIK40	2*4	4*7	Max	$575
	1230	*21	DP8031D	1*22	None		*23
8039	DAS 9100	91TM10	Opt 01	1*3	3*7	Max	$550
8085	DAS 9100	91TM02	Opt 01	2*2	4*9	Max	$550
	1240/41	12RM02	Opt 01	2*4	4*9	Max	$600
	1230	*21	PM404	*20	None		$800
8086	DAS 9200	92DM03	92DM03	*5	None	Max	$1,250
(DIP)	DAS 9100	91TM03	Opt 02*10	2*2	None	8.0 MHz	$2,450
	1240/41	12RM03	Opt 02*10	3*4	None	8.0 MHz	$2,500
	1230	*21	DP8086D	*20	None	Max	$1,500
8088	DAS 9200	92DM04	92DM04	*5	None	Max	$1,250
(DIP)	DAS 9100	91TM04	Opt 02*10	2*2	None	8.0 MHz	$2,450
	1240/41	12RM04	Opt 02*10	3*4	None	8.0 MHz	$2,500
	1230	*21	DP8086D	*20	None	Max	$1,500
80186	DAS 9200	92DM05	92DM05	*5	None	Max	$1,250
(LCC/PGA)	DAS 9100	91TM05	Opt 02*10	2*2	None	8.0 MHz	$2,450
	1240/41	12RM05	Opt 02*10	3*4	None	8.0 MHz	$2,500
80188	DAS 9200	92DM06	92DM06	*5	None	Max	$1,250
(LCC/PGA)	DAS 9100	91TM06	Opt 02*10	2*2	None	8.0 MHz	$2,450
	1240/41	12RM06	Opt 02*10	3*4	None	8.0 MHz	$2,500
80286	DAS 9200	92DM08	92DM08	*5	None	Max	$1,600
(LCC/PGA)	1240/41	12RM08	Opt 02*10	3*4	None	10.0 MHz	$2,500
80386	DAS 9200	92DM09	92DM09	*6	None	Max	$1,900
8096/7	1240/41	12RM99(Opt 16)	N/A*11	3*4	6*7	Max	$400

*1 *Price for Software and Probe Adapter (if available)—probes and boards not included.*
*2 *Requires one 91A24 and one 91AE24.*
*3 *Requires one 91A24.*
*4 *1240D2 boards.*
*5 *Works with 92A60, 92A90, 9260D, and 92A90D.*
*6 *Requires 92A90 or 92A90D.*
*7 *P6460s are always required.*
*8 *P6460s are required for CMOS versions.*
*9 *Can be used with P6460s or P6462s.*
*10 *PM200 personality module required.*
*11 *No configured probe interface available.*
*12 *Uses GPIB lead set (103-0209-00).*
*13 *Use 92A60/90 General purpose lead set (standard with 92A60 or 92A90) and a 003-0801-00 IC clip. Order Option 1D to delete 6809 probe adapter.*
*14 *Comes with adapter for Emulator PIAs (8300P53 options). Order Option 10 for Flying Lead PIA with grabber tips, Option 11 for stripped and tinned Flying Lead PIA, Option 12 for DIN cable PIA.*
*15 *Use 92DM64 Option 13 for non-MMU applications.*
*16 *Use 92DM64 Option 14 for MMU-based applications.*
*17 *Depends on 1750A implementation.*
*18 *Substitutes a PGA probe adapter.*
*19 *Refer to DAS 9100 section for further information.*
*20 *Does not apply.*
*21 *Software is included in/with personality module.*
*22 *1230E1 Board(s).*
*23 *Contact your local sales office.*

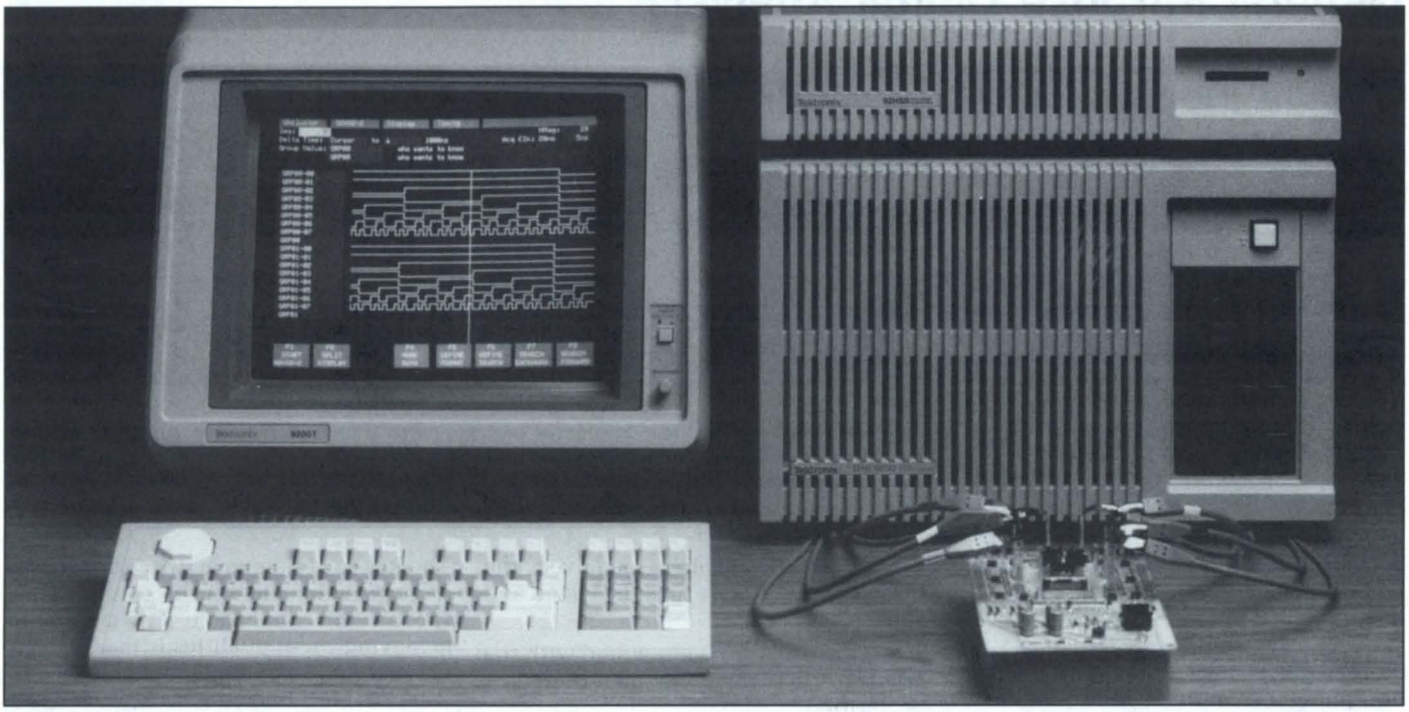
Micro-processor	Logic Analyzer Family	For Software ORDER	For Probe Adapter ORDER	Acq. Boards Required	Acq. Probes Required	Fastest Clock Rate Supported	Price*1
MOTOROLA MICROPROCESSORS							
6800	DAS 9100	91TM21	Opt 01	2*2	4*9	Max	$550
	1240/41	12RM21	Opt 01	2*4	4*9	Max	$600
	1230	*21	PM407	1*22	None	Max	$800
6801	DAS 9100	91TM28	Opt 01	2*2	4*9	Max	$550
	1240/41	12RM99 (Opt 05)	UPIK40	2*4	4*9	Max	$575
6802	1240/41	12RM22	Opt 01	2*4	4*9	Max	$600
	1230	*21	PM407	1*22	NONE		$800
6805E2	1240/41	12RM99 (Opt 06)	UPIK40	2*4	2*7	Max	$575
6805E3	1240/41	12RM99 (Opt 07)	UPIK40	2*4	3*7	Max	$575
6808	1240/41	12RM23	Opt 01	2*4	4*9	Max	$600
6809	DAS 9200	92DM24	92DM24	*5	None	Max	$900
	DAS 9100	91TM24	Opt 01	2*2	4*9	Max	$550
	1240/41	12RM24	Opt 01	2*4	4*9	Max	$600
	1230	*21	PM406	1*22	None	Max	$800
6809E	DAS 9200	92DM24	N/A*13	*5	None	Max	$900
	DAS 9100	91TM24	Opt 01	2*2	4*9	Max	$550
	1240/41	12RM24	Opt 01	2*4	4*9	Max	$600
	1230	*21	PM406	1*22	None	Max	$800
68HC11	1240/41	12RM99 (Opt 08)	N/A*11	2*4	3*7	Max	$400
	1230	*21	DPHC11Q	1*22	None	Max	*23
68000	DAS 9200	92DM27	92DM27	*5	None	Max	$1,250
(DIP)	DAS 9100	91TM25	Opt 02*10	2*2	None	12.5 MHz	$2,450
	1240/41	12RM25	Opt 02*10	3*4	None	12.5 MHz	$2,500
	1230	*21	DP68KD	2*22	None	Max	$1,200
68000	DAS 9200	91TM27	Opt 2S*17	*5	None	Max	$2,450
(PGA)	DAS 9100	91TM25	Opt 04*10	2*2	None	12.5 MHz	$2,450
	1240/41	12RM25	Opt 04*10	3*4	None	12.5 MHz	$2,500
	1230	*21	DP68KP	2*22	None	Max	$1,200
68008	DAS 9100	91TM26	Opt 02*2	2*2	None	8.0 MHz	$2,450
(DIP)	1240/41	12RM26	Opt 02*10	3*4	None	8.0 MHz	$2,500
68010	DAS 9200	92DM27	92DM27	*5	None	Max	$1,250
(DIP)	DAS 9100	91TM27	Opt 02*10	2*2	None	12.5 MHz	$2,450
	1240/41	12RM27	Opt 02*10	3*4	None	12.5 MHz	$2,500
	1230	*21	DP68KD	2*22	None	Max	$1,200
68010	DAS 9200	91TM27	Opt 2S*17	*5	None	Max	$2,450
(PGA)	DAS 9100	91TM27	Opt 04*10	2*2	None	12.5 MHz	$2,450
	1240/41	12RM27	Opt 04*10	3*4	None	12.5 MHz	$2,500
	1230	*21	DP68KP	2*22	None	Max	$1,200
68020	DAS 9200	92DM31	92DM31	*6	None	Max	$1,900
	1240/41	12RM31	Opt 02*10	3*4	None	20.0 MHz	$2,500
68030	DAS9200	92DM33	92DM33	*6	None	33.0 MHz	*23
	1240/41	12RM33	Opt 02*10	3*4	None	25.0 MHz	$3,500
88100	DAS9200	92DM35P	92DM35P	2*6	None	20.0 MHz	9,950
DSP56000/1	1240/1241	12RM99(Opt 17)	N/A*11	3*4	6*7	Max	$400
ZILOG MICROPROCESSORS							
Z80	DAS 9200	92DM41	92DM41	*5	None	Max	$900
	DAS 9100	91TM41	Opt 01	2*2	4*7	Max	$550
	1240/41	12RM41	Opt 01	2*4	4*7	Max	$600
	1230	*21	PM402	1*22	None	Max	$800
	1205	*21	PM302	*20	None	4 MHz	$700
Z8001/3	DAS 9100	91TM42	N/A*11	2*2	4*9	Max	$350
	1240/41	12RM42	N/A*11	3*4	4*9	Max	$400
Z8002/4	DAS 9100	91TM43	Opt 01	2*2	3*9	Max	$350
	1240/41	12RM43	Opt 01	3*4	3*9	Max	$600

*1 *Price for Software and Probe Adapter (if available)—probes and boards not included.*
*2 *Requires one 91A24 and one 91AE24.*
*3 *Requires one 91A24.*
*4 *1240D2 boards.*
*5 *Works with 92A60, 92A90, 92A0D, and 92A90D.*
*6 *Requires 92A90 or 92A90D.*
*7 *P6460s are always required.*
*8 *P6460s are required for CMOS versions.*
*9 *Can be used with P6460s or P6462s.*
*10 *PM200 personality module required.*
*11 *No configured probe interface available.*
*12 *Uses GPIB lead set (103-0209-00).*
*13 *Use 92A60/90 General purpose lead set (standard with 92A60 or 92A90) and a 003-0801-00 IC clip. Order Option 1D to delete 6809 probe adapter.*
*14 *Comes with adapter for Emulator PIAs (8300P53 options). Order Option 10 for Flying Lead PIA with grabber tips, Option 11 for stripped and tinned Flying Lead PIA, Option 12 for DIN cable PIA.*
*15 *Use 92DM64 Option 13 for non-MMU applications.*
*16 *Use 92DM64 Option 14 for MMU-based applications.*
*17 *Depends on 1750A implementation.*
*18 *Substitutes a PGA probe adapter.*
*19 *Refer to DAS 9100 section for further information.*
*20 *Does not apply.*
*21 *Software is included in/with personality module.*
*22 *1230E1 Board(s).*
*23 *Contact your local sales office.*

Micro-processor	Logic Analyzer Family	For Software ORDER	For Probe Adapter ORDER	Acq. Boards Required	Acq. Probes Required	Fastest Clock Rate Supported	Price*1
TEXAS INSTRUMENTS MICROPROCESSORS							
TMS32020/ 320C25	1240/41	12RM99 (Opt 11)	N/A*11	3*4	5*7	Max	$400
TMS32010	1240/41	12RM99 (Opt 14)	UPIK40	2*4	4*7	Max	$575
HITACHI MICROPROCESSORS							
6301/3	1240/41	12RM99 (Opt 09)	UPIK40	2*4	4*9	Max	$575
64180R0/R1	1240/41	12RM99 (Opt 12)	N/A*11	3*4	5*7	Max	$400
OTHER MICROPROCESSORS							
6502/C02	DAS 9100	91TM63	Opt 01	2*2	4*8	Max	$550
	1240/41	12RM63	Opt 01	2*4	4*8	Max	$600
	1230	*21	PM403	1*22	None	Max	$800
	1205	*21	PM303	*20	None	4 MHz	$700
1802/4/5/6/ (A/C/AC/BC)	1240/41	12RM99 (Opt 22)	UPIK40	2*4	3*7	Max	$575
ADSP2100	1240/41	12RM99 (Opt17)	N/A*11	3*4	6*7	Max	$400
F9450	DAS 9200	92DM64	Opt 13*15	*5	None	Max	$4,000
	DAS 9200	92DM64	Opt 14*16		None	Max	$5,050
	DAS 9100	91TM62	N/A*11	2*2	3*9	Max	$350
	1240/41	12RM62A	N/A*11	3*4	3*9	Max	$400
1750A	DAS 9200	92DM64	*14	*5	None	40.0 MHz	$3,050
	DAS 9200	92DM64	Opt 10	*5	None	40.0 MHz	$1,650
	DAS 9200	92DM64	Opt 11	*5	None	40.0 MHz	$1,550
	DAS 9200	92DM64	Opt 12	*5	None	40.0 MHz	$1,650
	DAS 9100	91TM64	N/A*11	2*2	*16	10.0 MHz	$350
NSC800	DAS 9100	91TM71	Opt 01	2*2	4*7	Max	$550
	1240/41	12RM71	Opt 01	2*4	4*7	Max	$600
GM ECM	1240/41	12RM99 (Opt 01)	UPIK40	2*4	4*9	Max	$875

BUS	Logic Analyzer Family	For Software ORDER	For Probe Adapter ORDER	Acq. Boards Required	Acq. Probes Required	Fastest Clock Rate Supported	Price*1
DEC							
VAXBI	DAS 9100	12RM99	VB100	*19	*19	Max	$9,350
	1240/41	(Opt 13)	012-1164-00	3*4	6*9	Max	
UNIBUS	DAS 9100	91TM51	N/A*11	2*2	4*9	Max	$350
Q-BUS	DAS 9100	91TM52	N/A*11	2*2	4*9	Max	$350
OTHER							
GPIB	1230	None	Opt 07	None	1		$195
	DAS 9100	91TM53	Opt 01	1*3	2*9	Max	$380
	1240/41	12RM99 (Opt 04)	*12	2*4	2*9	Max	$400
STD	1230	*21	PM405	1*22	None	Max	$800

*1 *Price for Software and Probe Adapter (if available)—probes and boards not included.*
*2 *Requires one 91A24 and one 91AE24.*
*3 *Requires one 91A24.*
*4 *1240D2 boards.*
*5 *Works with 92A60, 92A90, 9260D, and 92A90D.*
*6 *Requires 92A90 or 92A90D.*
*7 *P6460s are always required.*
*8 *P6460s are required for CMOS versions.*
*9 *Can be used with P6460s or P6462s.*
*10 *PM200 personality module required.*
*11 *No configured probe interface available.*
*12 *Uses GPIB lead set (103-0209-00).*
*13 *Use 92A60/90 General purpose lead set (standard with 92A60 or 92A90) and a 003-0801-00 IC clip. Order Option 1D to delete 6809 probe adapter.*
*14 *Comes with adapter for Emulator PIAs (8300P53 options). Order Option 10 for Flying Lead PIA with grabber tips, Option 11 for stripped and tinned Flying Lead PIA, Option 12 for DIN cable PIA.*
*15 *Use 92DM64 Option 13 for non-MMU applications.*
*16 *Use 92DM64 Option 14 for MMU-based applications.*
*17 *Depends on 1750A implementation.*
*18 *Substitutes a PGA probe adapter.*
*19 *Refer to DAS 9100 section for further information.*
*20 *Does not apply.*
*21 *Software is included in/with personality module.*
*22 *1230E1 Board(s).*



Fastest digital analysis system in the world—DAS 9219 mainframe and color display with four 8-channel, 2 GHz 92HS8 modules.

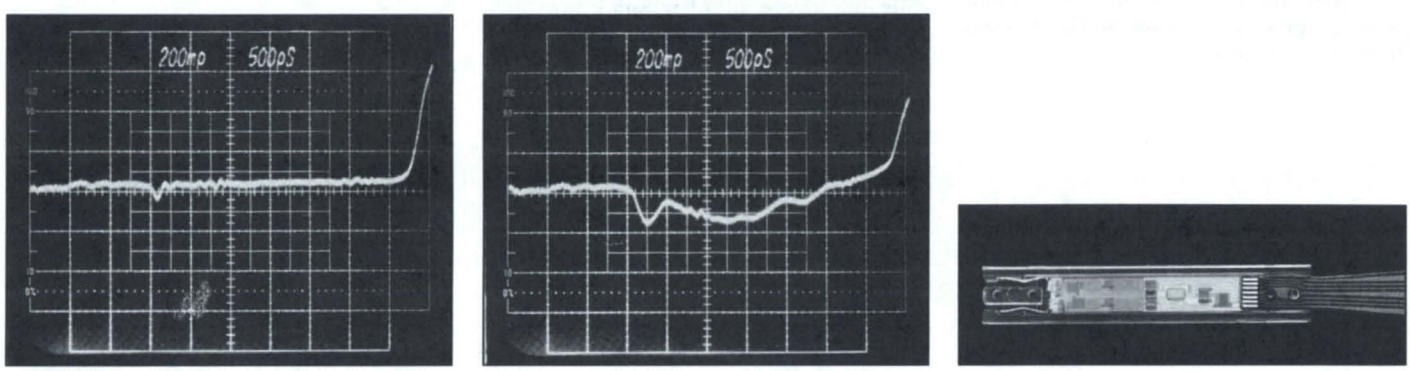
Systems designed to operate above 50 MHz are becoming commonplace, and the advanced acquisition capabilities that Tektronix' Logic Analyzers offer today's designers have become mandatory.

All instruments have a maximum asynchronous sampling rate of 100 MHz (10ns sample interval). In addition the DAS9100 Series also offers 330 MHz (3ns), 660 MHz (1.5ns), and 2 GHz (500ps) asynchronous sampling rates with selected acquisition cards; the DAS9200 Series offers 200 MHz (5 ns) and 2 GHz (500 ps).

For synchronous applications the 1241 Logic Analyzer can sample at 50 MHz across all channels. The DAS9100 has 330 MHz true synchronous and 350 MHz "external asynchronous" operation with selected acquisition cards. The DAS9200 offers true 200 MHz synchronous and 350 MHz "external asynchronous" operation.

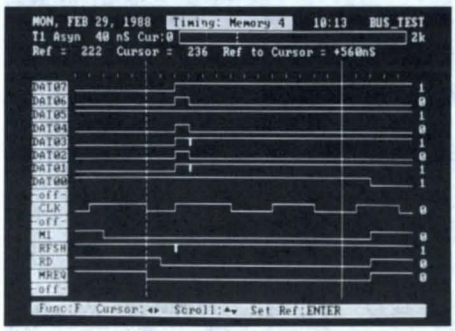
For leading edge designs or for designs that require the best resolution available, Tektronix offers the 92HS8 Data Acquisition Module. The 92HS8 is designed for ultra-high speed hardware analysis and is capable of sampling at 2 GHz (500 ps sampling period). A fully expanded DAS9200 system can support five sets of 32-92HS8 channels, for a total of 160 channels at 2 GHz.

To ensure the accuracy of sampled data, the 92HS8 uses acquisition probes designed specifically for high-speed sampling. They contain custom hybrids within the probe tip. This provides a high-impedance, differential input with very low input capacitance ($\leq$1 pF), which prevents common mode noise, excessive loading of the circuit under test, and allows connection to high-speed transmission lines without introducing reflections.

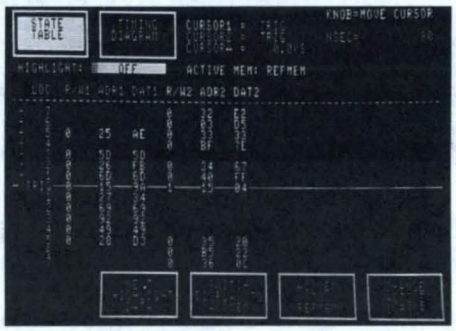


Comparison of the line distortion of the 92HS8 probe attached to a nominal 500 Ω test point on an ECL-based circuit (left), versus that of a typical 100 MHz probe (right).

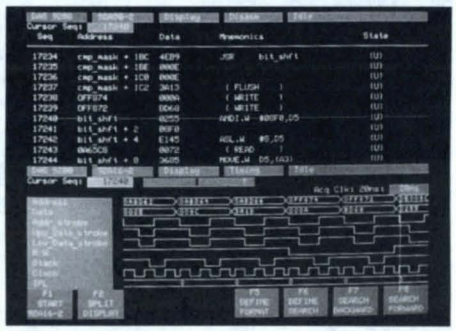
General Purpose Digital Analysis



The 1230 Logic Analyzer's glitch detection reveals a transient spike on a refresh line causing unwanted data line transitions.



The 1241 Logic Analyzer's two fully time-correlated and independent timebases help solve a problem between two microprocessors interfacing through a dual RAM port.



The DAS 9200 Logic Analyzer's split window feature allows you to simultaneously view execution of instruction mnemonics (upper window) and control, address bus, and data bus timing (lower window).

Today you often hear about *general purpose logic analyzers* but it's hard to define what that phrase means. However, most people would agree that the requirements placed on *general purpose* equipment include versatility, configurability and expandability. Fundamentally, a general purpose instrument or system should help you solve problems which are not yet defined.

As a digital development project moves from design into implementation, evaluation, manufacturing and service, the engineers and technicians on the project encounter a wide variety of test and measurement needs.

To verify hardware performance, bus timing signals must be measured, unwanted interactions such as noise coupling from one signal to another must be investigated and characterized, and basic data flow must be verified.

As new modules are added into a system, their performance must be checked and performance of the rest of the system must be re-verified.

If a processor/controller is involved, the firmware or software must be tested and verified.

When the software is integrated with the hardware, actual system operation must be verified.

If the system operates under real-time constraints, the operation of critical linkages (such as interrupt response time) must be measured.

The ability of a logic analyzer or a microprocessor development system to perform this wide variety of tasks is very important. If a single instrument or system can be used for all of these activities, you save money.

First, you save by buying only one product, instead of several. Second, you save by investing time to learn to use only one product. Third, you save when your needs grow, if you can expand and reconfigure the product. And finally, you save by making communication easier among your employees, all of whom know how to use the same equipment.

The key to obtaining all these benefits is having equipment that is configurable, flexible and expandable. And the key to achieving these qualities is modular architecture. Depending upon your needs, you can select or configure logic analyzer modules for wide data acquisition, high-speed acquisition, acquisition memory depth, and pattern generation. You can configure your microprocessor development system to fit your needs for programming language and debug environment.

Tektronix has been providing and is continuing to provide digital instruments of unparalleled modularity. In logic analyzers and microprocessor development systems, Tektronix delivers the broadest range of the most modular, flexible solutions.

By purchasing a Tektronix digital instrument or system, you are investing in your future wisely.

By building on the foundation of the DAS 9200, Tektronix makes ASIC prototype verification a simple, reliable, turnkey process. No longer are you forced to invest in a dedicated tester.

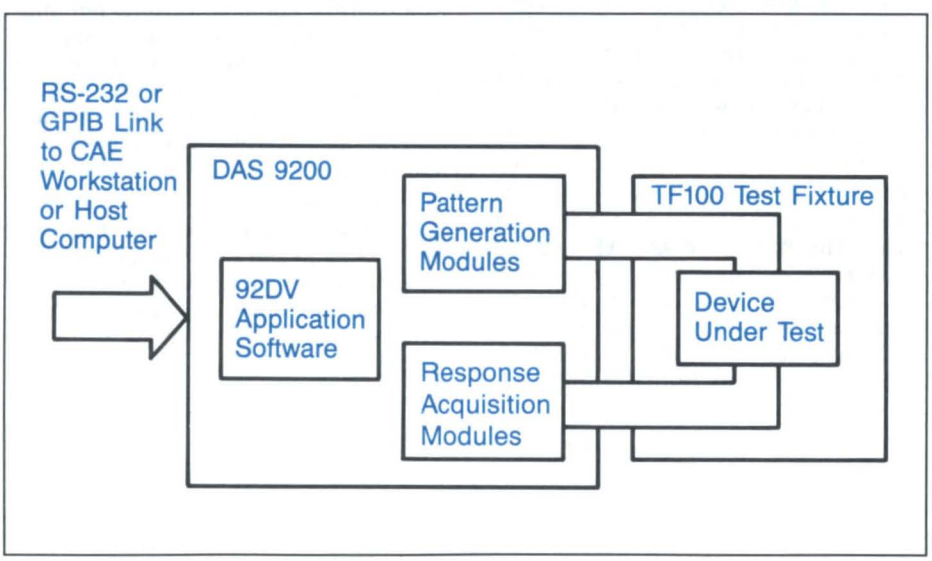
The DAS 9200 ASIC Verification system is intended specifically for ASIC designers who need to evaluate first devices from the vendor, determine if the parts work, and decide whether or not to release the part for volume production.

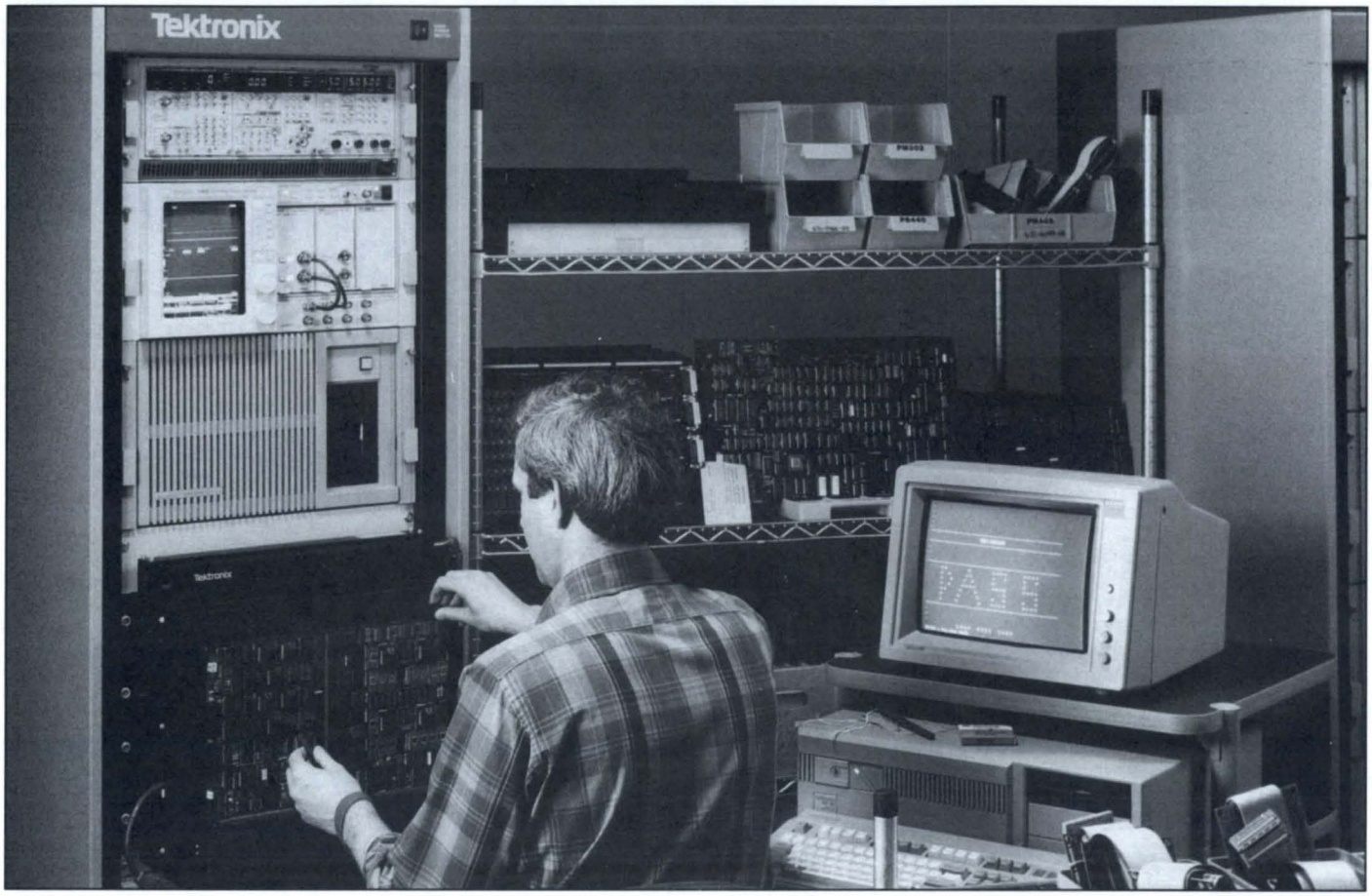
The system features 50 MHz test rates, 1 ns edge placement, 5 ns guaranteed detectable pulse width, and ±1.6 ns maximum data skew. Plus a programmable 30 ns setup/hold time.

Translators are available so that designers can download the same test vectors developed during the ASIC design phase to the test system. These translators support simulators from Mentor, Daisy, Valid, Teradyne (LASAR), and GenRad (Hilo-3).

The ASIC verification system aplies the translated test vectors to the device under test and compares the expected response (predicted by the logic simulator) to its actual response. Test results can be conveniently displayed in several formats.

When the ASIC Verification process is complete, you can continue to capitalize on your investment in the DAS 9200 by simply reconfiguring the system for use as a general purpose tool.





With the introduction of greater device density (ASICs as an example), complexities, and lightening speeds, many of today's systems designs are clearly exceeding the operating speed and pin count of traditional board testers. The sophistication of the DAS 9200, however, makes it an attractive, cost-effective solution for circuit board functional testing. This system is fully prepared for the future: you can configure systems with over 1000 channels of stimulus or up to 540 channels of acquisition—or combinations of both stimulus and acquisition.

Tektronix further enhances the use of the DAS 9200 in this environment with fixturing. The 92BTA and 92BTARM provide convenient, reliable, and flexible Unit-Under-Test (UUT) interfacing. These fixtures are optimized to preserve the superior electrical performance of the DAS 9200 resources. Both the 92BTA and 92BTARM are compatible with Tek's signal routing and interface products as well as the TM5000 Modular Instrumentation. Mixed digital/analog applications can be accomplished by bringing additional resources to the test head receiver.

Local mass storage and high-speed 9200-to-Host communications minimize upload/download time and improve overall tester throughput. Time correlated module interactions allow you to use data acquired by one sub-system to change the activity of another for more realistic conditional tests.

Operable as a stand-alone or as a peripheral under host computer control, the DAS 9200 can move from engineering to manufacturing with no loss of functionality. This makes it a single, inexpensive solution for your digital testing requirements.

Test Fixtures for Simplified Connections

The 92BTA and 92BTARM are mechanical assemblies that hold DAS 9200 probes, connectors, and associated wiring. These fixtures also provide the test head receiver mechanism for physical connections to the UUT. The assembly provides the necessary mechanical integrity and mating mechanisms for connecting the DAS 9200 resources to the UUT.

The 92BTA, the desk top version of the Board Test Adapter is enclosed in a bench-top cabinet. This fixture contains an internal rack that can hold up to forty DAS 9200 probes, a test head receiver, cooling fans, thermal cutout switch and a UUT power block connector set.

The 92BTARM is a rackmount version of the 92BTA. It is identical to 92BTA, except it does not include the cabinet.

Logic analyzers are rapidly becoming an essential tool in industry for designing and troubleshooting hardware and software based on digital data. Logic analysis can be applied to a number of educational areas such as electronics engineering, computer technnology, robotics, automotive technology, and avionics. Learning to use a logic analyzer can help students prepare for their chosen professions. With an easy-to-learn menu interface and an affordable price, the 1205 and 1230 Logic Analyzers are ideally suited to the classroom environment.

The 1230 Logic Analyzer provides a modular, expandable solution for a wide variety of logic analysis tasks. Acquisition and option cards can be shared between units, which allows the student to quickly reconfigure the 1230 for the task at hand. This reduces the need for each instrument to be fully equipped, which saves expenses for educational institutions. The 1230 Logic Analyzer excels in general-purpose hardware and software analysis, as well as integration of both. Instructors and students will keep abreast of changing microprocessor technology with a growing list of 8- and 16-bit microprocessors supported by the 1230.

The 1230 Logic Analyzer serves as a excellent base around which a logic analysis educational curriculum can be developed. Classroom support materials available from Tektronix include an operation manual, a reference guide, several types of self-instruction workbooks, a training test card, and a training video tape. A system of onscreen instructional notes quickly provides reference information for hands-on help at the touch of a key. An option provides instructional notes in English, Dutch, French, German, or Spanish, allowing students to work in their native language. Menu setups and data screens can be printed to document lab results using either the parallel printer port or the RS-170 video output port. The video output port can also be used with a large viewing monitor to aid in classroom lessons.

The 1205 provides the lowest cost means to teach basic logic analysis concepts. This makes the 1205 Logic Analyzer an ideal solution when multiple logic analyzers are often required on a limited budget. Unlike low cost logic analyzers from other vendors, the 1205 is a complete, self-contained instrument, including a CRT display. Its easy-to-learn menu interface allows students to quickly grasp the basics of digital analysis.

Classroom support materials for the 1205 Logic Analyzer include an operation manual, a system of onscreen instructional notes, and a video port for use with a large viewing monitor.

A complete software integration environment from Tektronix. Products shown from left are the V1750S Software Integration System, Digital's VAXstation 2000, and Ada Language Development System (ALANDS).

Support for Aerospace/Defense Applications

- **Real-Time Software Testing in the Target System**
- **30 MHz PACE 1750 Support (New)**
- **High-Order-Language Development Systems; Ada**
- **VAX Family Host Support**
- **Worldwide Service and Support**

The use of microprocessors in military applications has mushroomed in the past few years. Military applications usually have strict reliability and environmental requirements that prevent the use of commercially popular microprocessors. Tek is addressing the need to support microprocessors used in military applications by offering support for the following processors: Z8000 including the 10-MHz Z8001B and Z8002B, and MIL-STD 1750A processors including the F9450, MDC281, PACE1750, Delco M-372, Tracor RH1750, and the 32-bit 68020.

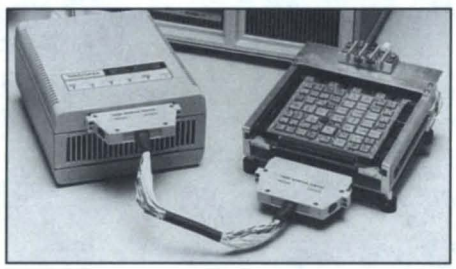
MIL-STD 1750A Background

In an effort to control the spiraling cost of developing software, the military community has instituted several standardization programs. One of these, MIL-STD 1750A, was developed for the United States Air Force and defines the standard 16-bit processor to be used in all embedded weapons systems. MIL-STD 1750A standard specifies the Instruction Set Architecture (ISA) but not the physical, electrical, or performance characteristics of the processor. This allows processors to be implemented as several boards, a single board, or a microprocessor chip. Since the ISA is the same, application software can be transported from one processor to another without modification.

MIL-STD 1750A Support System

The Tektronix 1750A support system includes tools for developing and debugging software for embedded applications. The package includes a Tektronix assembler/linker system for software development and a full-function emulation system for testing the software with or without the target system.

The 1750A assembler/linker package provides all of the functions to support machine-level program development. The assembler supports either the MIL-STD 1750A instruction mnemonics or the IEEE version. The package can be hosted on the DEC VAX, MicroVAX, and VAXstation Series with VMS.



The MIL-STD 1750A emulator supports the unique requirements for integrating software into the target environment. The emulation system can be used to test software written in assembly, or in a high-order language such as Ada, JOVIAL, or CMS-II. A series of probe adapters are available for connection into the various processor environments. These probe adapters can be used to connect the emulator to a board, a bus, or to the CPU's mechanical enclosure.

Performance Semiconductor PACE1750 Processor Support

Tektronix has expanded its MIL-STD 1750A program by announcing V1750A Software Integration System support for the 30 MHz Performance Semiconductor PACE1750.

At 30 MHz the V1750A system will track your program in real-time without adding wait-states.

McDonnell Douglas MDC281 Processor Support

Tektronix also supports the McDonnell Douglas MDC281 processor. Verification testing with the V1750A and the MDC281 was conducted at the McDonnell Douglas Microelectronics Center in St. Louis, Missouri.

The Tektronix V1750A Software Integration System provides the mechanism to transfer the run-time software from the mainframe into the MDC281 target system. This allows the software to be executed in real time, right in the target environment. The V1750A provides control and monitoring capability, while execution is progressing in real time. Both the 15-MHz and 20-MHz versions of the MDC281 are supported in real time.

Other MIL-STD 1750A Processors

In addition to the MDC281 and PACE1750, the V1750A also supports the Fairchild F9450, Delco M-371, Mikros MKS1750, and the Tracor RH1750.

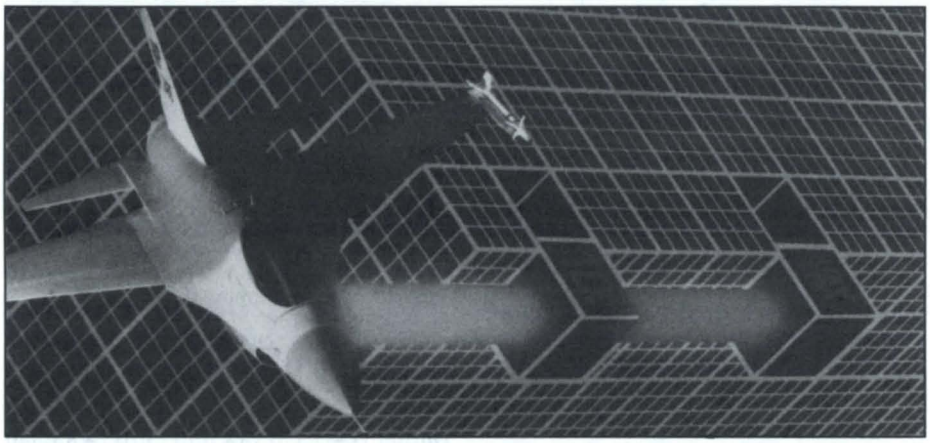
1750A Software Executer, 88M1750

When the target hardware isn't available, the 1750A Software Executer (SWE) can be used in its place. The 1750A SWE provides a MIL-STD 1750A compliant environment for testing and debugging software. Programs can be loaded and tested with the SWE processor before they are transferred into the target environment. I/O systems on the target can be simulated by using SVC calls to access host resources like file systems and peripheral hardware. Several MIL-STD 1750A options are supported by the SWE including expanded memory.

The 1750A SWE resides in the V1750A mainframe and can access up to 1 Megaword of internal memory for program execution. The V1750A can be located at the host site and accessed remotely. This means the SWE is available to other users in a multi-user host environment without moving the system. A software boot-up function also provides control so the V1750A can be restarted remotely.

68XXX Support Systems

In-circuit support is available for the 68000 family of processors including the 68000, 68008, 68010, and the 32-bit 68020. These systems provide a test and debug environment for embedded software. Run-time software can be executed on the target hardware for the 68xxx family; or on a software executer for the 68020.



The 68000, 68008, and 68010 support is available in the V-System configuration which is based on the 8540A mainframe. The 25 MHz 68020 is supported in the new MV6820 configuration. Each MV6820 can be configured with up to two separate 68020 probes so multiple processor environments can be supported. MV6820 systems can also be cascaded together to support up to eight microprocessors at one time.

Z8000 Support Systems

Z8000 processors are used in a wide variety of military applications, and are currently available to meet military reliability requirements like MIL-STD 883 screening.

Tektronix supports both the Z8001 segmented version, and the Z8002 non-segmented versions of the processor. An assembler/linker system is available to support machine language programming requirements. Both of these software systems are supported on VMS for the VAX family of hosts.

The emulator supports in-circuit probes for either the Z8001 or Z8002 microprocessors. Both the 10-MHz Z8001B and Z8002B are supported in real-time with no-wait states. The emulator system provides trace, break-point, and memory substitution in the actual target environment.

Local Area Network Connections *(NEW)*

Downloading the code has always been a bottleneck when using microprocessor development systems. While RS-232 is the most convenient interface for downloading code it is also the slowest. A new Ethernet connection is now available to connect V1750A, V68xxx, and VAX/VMA, SUN-3, and Tek 43xx systems. With this option you can download code up to 32 times faster than over standard RS-232 (from 20 minutes to 32 seconds).

MIL-STD 1815A (Ada) Support

Ada has been mandated by the Department of Defense to be used as the single High Order Language (HOL) used in all mission critical applications. The effect of this mandate is to reduce the escalating cost of developing and maintaining software for military applications. These software costs are currently estimated at $10 billion, and by 1990, they will triple to $30 billion. Ada is also being used for commercial applications, especially in the European electronics industry.

Ada is not just another programming language. It incorporates many characteristics that support modern software engineering principles. Tektronix is making a significant commitment to developing Ada support for its customers. An Ada language system is available to support MIL-STD 1750 and 68020 applications. This system is modeled after the Tektronix LANDS software development environment. Your Tektronix Sales Representative can give you the details.

ORDERING INFORMATION

V1750A Software Integration System Includes: 64K Word Program Memory, TTA, 1750A-2 Emulator and Probe.	**$36,300**
OPTIONS	
Option 3A—PIA with Flying Leads, Clips.	**+$750**
Option 3B—PIA with Flying Leads, Pigtail.	**+$650**
Option 3C—PIA Euro-Card Connector.	**+$750**
Option 10—256k bytes Total Memory	**+$1,000**
Option 11—512k bytes Total Memory	**+$2,900**
Option 12—768k bytes Total Memory	**+$4,000**
Option 13—1M bytes Total Memory	**+$6,000**
Option 14—1M Word Total Memory	**+$12,000**
Option 19—Ethernet Interface	**+$2,000**
88M1750 Software Execution Unit	**$8,500**
Option 05—Expanded Memory	**+$2,000**

LANDS I™

16-Bit Language Development Systems

- **Complete C/Pascal Code Generation Systems**
- **Integrated Set of Software Development Tools**
- **Tightly Linked With 16-Bit Emulation Systems**

Tektronix' Language Development Systems (LANDS I and LANDS II) offer a comprehensive set of tools for the development, debug, and integration of software modules.

LANDS I

Using a high-level language to generate code for microprocessors has advantages over assembly-language programming since programs are easier to understand and maintain and programmer productivity is higher. To support this approach, Tektronix offers a language-oriented development system for C or Pascal called LANDS I. The LANDS I package is an integrated set of 16-bit language development tools consisting of a Language-Directed Editor (LDE), a compiler (C or Pascal), an Integration Control System (ICS), a high-level-language symbolic debugger, and a 16-bit macro assembler and linker. These products allow you to work through the software development and debug cycle in the same high-level language from code entry through debugging.

Language-Directed Editors

The Language-Directed Editors for C and Pascal combine the text manipulation functions of a general-purpose screen editor with the syntax-checking function of a compiler. The time saving features of LDE will shorten the learning time for designers new to the C or Pascal language, and make experienced programmers more productive.

LDE identifies syntax errors during the editing session, minimizing the edit-compile iterations required to find and correct syntax errors. Syntax checking can be performed over the entire program or over specific functions, declarations or keyword statements.

Compilers—C and Pascal

For high-level-language programming, the LANDS I C and Pascal cross-compilers contain many enhancements for microprocessor programming.

These enhancements include interrupt handling, bit-level data manipulation, assignment of variables to specific hardware addresses, and direct access to I/O ports without having to resort to assembly language code. The LANDS I C compiler supports Kernighan and Ritchie's standard C and the proposed ANSI C standard and includes an implementation of the standard I/O libraries.

Integration Control System (ICS)

One major task associated with microcomputer design is to correctly interface the software with the specifics of the prototype hardware.

LANDS I includes a unique tool for implementing the hardware/software interface called the Integration Control System. The user fills in a brief source file with parameters defining the software modules and hardware configuration. From this source file, ICS automatically handles the details and generates the necessary code and command files to execute code in the target system.

High-Level Debug—C and Pascal

Program debugging is a tedious and time-consuming task. Tek's LANDS I debug system increases your productivity by enabling you to debug code at the source-code level.

Breakpoints can be set on statement numbers, procedure and function names, or on variables to halt program execution. Values can be returned to calling functions. This approach completely eliminates the time-consuming requirements of translating assembly-level debug information into its high-level counterpart.

In addition, your program and variables can be displayed in high-level source form, which speeds the analysis.

8- and 16-Bit Assemblers and Linkers

Tek assembler packages consist of an assembler for the specific microprocessor, a sophisticated linker for locating code, and a library generator for creating source code for object modules and reusing object modules previously created. Tektronix' assemblers and linkers include many features that are normally associated only with high-level coding.

ORDERING INFORMATION

LANGUAGE DEVELOPMENT SOFTWARE

C and Pascal LANDS I

Includes: HLL compiler, assembler, LDE, ICS, HLL debug.

CLAN68K C Support for 68000/08/10	**$10**
CLAN86 C Support for 8086/8088/186/188	**$10**
PLAN68K Pascal Support for 68000/08/10	**$10**
PLAN86 Pascal Support for 8086/8088/186/188	**$10**

OPTIONS

Option 1C—VAX 780/8xxx Ultrix.	**+$10,990**
Option 1F—VAX 780/8xxx VMS.	**+$10,990**
Option 1L—Micro VAX II/III Ultrix	**+$9,340**
Option 1N—MicroVAX II/III VMS	**+$9,340**
Option 1P—VAXstation Ultrix	**+$3,840**
Option 1Q—VAXstation VMS	**+$3,840**
Option 1R*—SUN Series 3	**+$3,840**
Option 1U*—Tektronix 43xx	**+$3,840**
Option 3S—12 Months Software Service	**+$1,100**

**CLAN68K only*

ASSEMBLERS

ASMZ80 Z80/NSC800 Assembler	**$10**
ASM8085 8085 Assembler	**$10**
ASM6809 6809 Assembler	**$10**
ASM1750 1750 Assembler	**$10**
ASM68K 68000/08/10 Assembler	**$10**
ASM8086 8086/8088/186/188 Assembler	**$10**

OPTIONS

Option 1C—VAX 780/8xxx Ultrix	**+$2,490**
Option 1F—VAX 780/8xxx VMS	**+$2,490**
Option 1L—MicroVAX II/III Ultrix	**+$1,990**
Option 1N—MicroVAX II/III VMS.	**+$1,990**
Option 1P—VAXstation Ultrix	**+$990**
Option 1Q—VAXstation VMS	**+$990**
Option 1R*—SUN Series 3	**+$990**
Option 1U*—Tektronix 43xx	**+$990**
Option 3S—12 Months Software Service	**+$250**

** ASM68K only*

COMMUNICATIONS

ICOM40A Integrated Communications System for V Systems	**$10**

OPTIONS

Option 1C—VAX 780/8xxx Ultrix	**+$1,990**
Option 1F—VAX 780/8xxx VMS.	**+$1,990**
Option 1L—MicroVAX II/III Ultrix	**+$1,490**
Option 1N—MicroVAX II/III VMS.	**+$1,490**
Option 1P—VAXstation Ultrix	**+$740**
Option 1Q—VAXstation VMS TK50	**+$740**
Option 1R—SUN Series 3	**+$740**
Option 1U—Tektronix 43xx	**+$740**
Option 3S—12 Months Software Service	**+$250**

IBM PC SUPPORT

Many of the above products are available on the IBM PC. Contact your Tektronix Sales Representative for additional information.

CLANDS II™

68K Family C Development System

- **Integrated Set of ANSI C Development Tools**
- **68000/08/10/20 and 68030 (NEW) Support**
- **Code Coverage Analyzer (NEW)**
- **TekDB™ Source Level Debugger**

The Tektronix 68K Family ANSI C Language Development System (CLANDS II) is a complete software development environment for developing software intensive embedded applications for the 68000/08/10/20 and now the 68030 microprocessors. When code size and code speed is of critical importance, the CLANDS II compliler system will provide you with the code quality you need.

CLANDS II supports large software projects in a team environment with a C Language Directed Editor for fast, easy C code entry; a 68K Family ANSI C compiler for producing fast, compact code; an Integration Control System (ICS) for tailoring software modules to your prototype environment; an assembler/linker; and TekDB, a source level debugger that supports both C and assembly level debug with an easy-to-use window interface.

By addressing the needs of the entire software development cycle with tools that complement your host tools, Tektronix' second generation CLANDS II helps software development schedules stay on track and keeps the constantly escalating cost of software development under control.

C Language-Directed Editor (LDE)

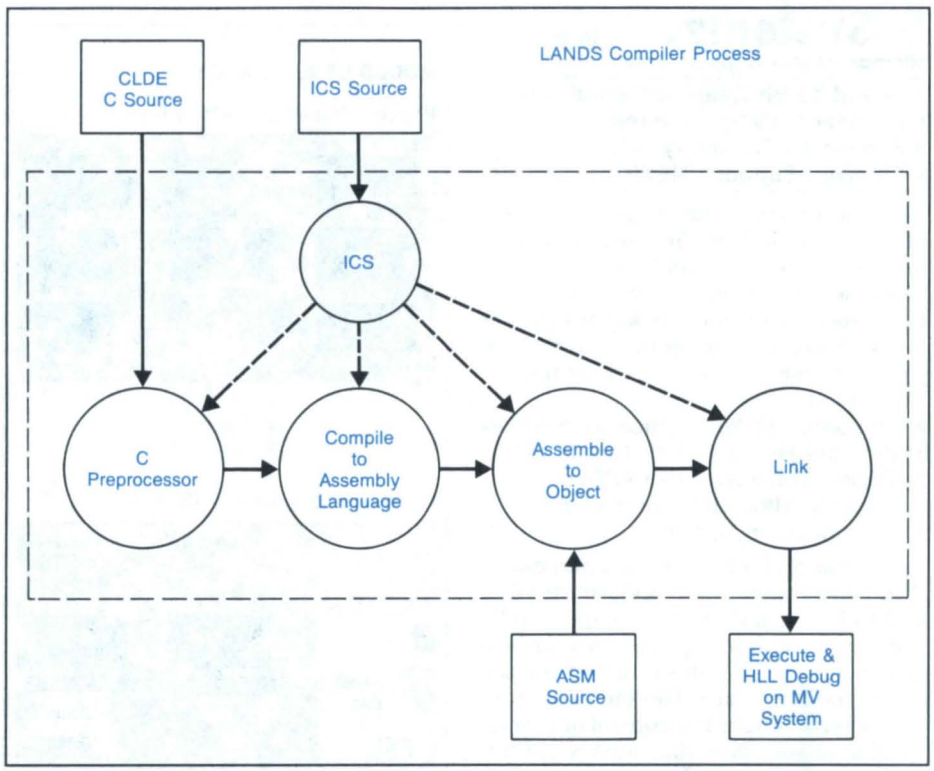
The C LDE is the same editor included in the LANDS I products. New enhancements to C LDE include ANSI compatibility.

68K Family Compiler

The high-performance requirements of many embedded applications demand a compiler that makes full use of the processor's capabilities to generate fast and compact code.

The 68K Family C compiler uses many techniques to produce fast compact code. These include constants folding, efficient addressing mode usage, automatic register allocation, dead code elimination, passing parameters in registers rather than on the stack, and in-line expansion of many library routines.

For those who need to generate code that can be loaded anywhere in memory at load time, PC (Program Counter) relative code can be generated. This feature is useful for developing applications that will be loaded off of disk.



Code Coverage Analyzer

Testing of software is one of the most time consuming and difficult tasks facing todays programmers. The Code Coverage Analyzer (CCA) is a powerful tool to help analyze the effectiveness of your test programs. To use the CCA, you compile your application with the CCA option, load it, and run it for the desired amount of time. The CCA then generates a report that identifies code that was never executed and how many times each line of code was executed.

Assembler and Linker

The CLANDS II full-function assembler is also designed for embedded applications. The assembler will optimize instructions and addressing modes wherever possible in order to reduce code size and speed execution.

The assembler includes the many features you would expect from a high-quality assembler; full macro capabilities, for inserting and modifying frequently used segments of source code, and conditional assembly, to generate object code that varies according to specified conditions.

Integration Control System

The Integration Control System (ICS) was designed to help automate the task of software/hardware integration by serving as the central coordinator for the compile/assemble/link process. Rather than add hardware-specific information to your program modules, the information is stored in one ICS file. The compliler, assembler and linker then extract specifics from this configuration file to automatically control the creation of load modules.

By locating hardware specific information in one file, it is much easier to write portable code. Routines can be ported to new hardware by simply changing the ICS file.

ORDERING INFORMATION

CLA6820 68K Family C compiler, CLDE, Assembler/Linker, ICS, CCA **$10**

OPTIONS

Option 1C—VAX 780/8xxx Ultrix.	**+ $10,990**
Option 1F—VAX 780/8xxx VMS.	**+ $10,990**
Option 1L—MicroVAX II/III Ultrix.	**+ $9,340**
Option 1N—MicroVAX II/III VMS.	**+ $9,340**
Option 1P—VAXstation Ultrix.	**+ $3,840**
Option 1Q—VAXstation VMS.	**+ $3,840**
Option 1R—SUN Series 3.	**+ $3,840**
Option 1U—Tektronix 43xx.	**+ $3,840**
Option 3S—12 Months Software Service.	**+ $1,100**

ASM6820 68K Family Assembler/Linker/ICS **$10**

OPTIONS

Option 1C—VAX 780/8xxx Ultrix.	**+ $3,490**
Option 1F—VAX 780/8xxx VMS.	**+ $3,490**
Option 1L—MicroVAX II/III Ultrix.	**+ $2,990**
Option 1N—MicroVAX II/III VMS.	**+ $2,990**
Option 1P—VAXstation Ultrix.	**+ $1,490**
Option 1Q—VAXstation VMS.	**+ $1,490**
Option 1R—SUN Series 3.	**+ $1,490**
Option 1U—Tektronix 43xx.	**+ $1,490**
Option 3S—12 Months Software Service.	**+ $350**

V Systems 8- and 16-Bit Microprocessor Support Systems

- **8- and 16-Bit Real-Time Emulation**
- **Modular Universal System**
- **Expansion Capability**
- **Ethernet Support (NEW)**

To support the test and integration phases of a user's project, Tek offers V Systems—complete 8- and 16-bit microprocessor development systems. Modularity and universality are key features of the V Systems enabling them to be configured to meet your needs. Modular options include:

- Full Range of Microprocessor Support
- Program Memory—64K to 2 M bytes
- Trigger Trace Analyzer (TTA)
- Memory Allocation Controller
- Comunication Options

Real-Time and Transparent Emulation

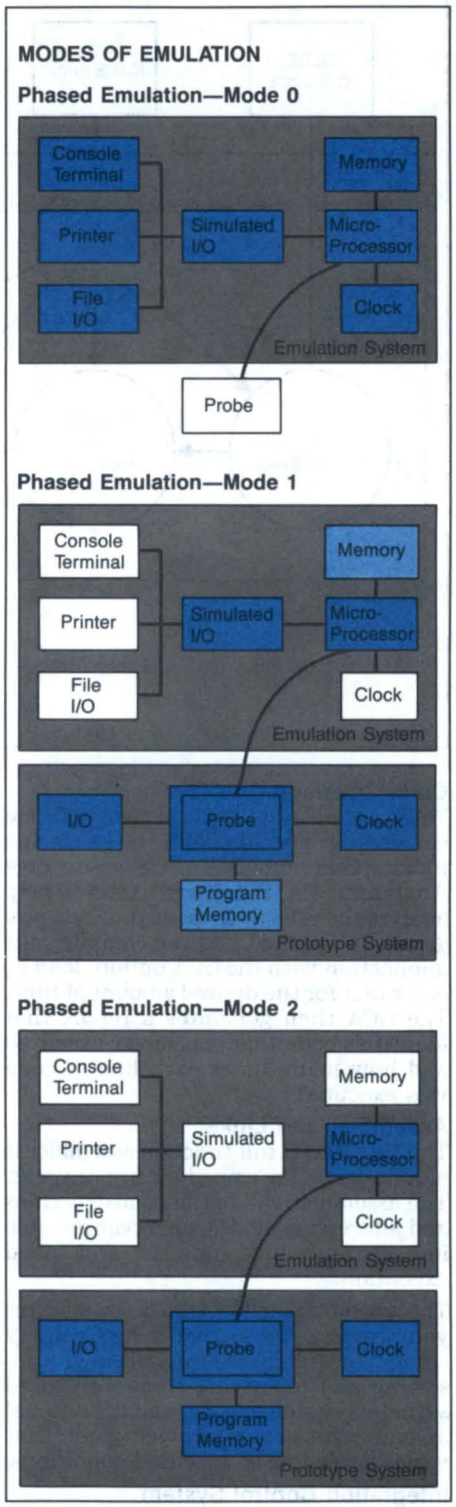
Real-time emulation, standard on all 8- and 16-bit emulators, is accomplished by executing code on a processor identical in function to the one targeted for the prototype hardware. The emulator processor is run under the control of powerful debug software that allows control and tracing of the code's execution. This debug software does not need to be linked into your code or use any of your memory or interrupt lines. Tek's superior emulators allow your code to execute in real time, with no wait states inserted or clock pulses stretched. This means the emulator is fully transparent to the user, therefore, you do not spend time "working around" the development system.

TTA Captures Real-Time Events (standard with V Systems)

A powerful option to Tek emulators is the Trigger Trace Analyzer (TTA), which uses a high-speed trace buffer to capture real-time software and hardware logic events, with the prototype running at the design's full specified operating speed. Multiple-word recognizers allow you to define sophisticated triggers when tracing code execution. And data qualification allows you to capture only the data you wish to see.

Three Modes of Emulation

The V-Systems enable you to incrementally integrate your prototype software and hardware. Starting with mode 0, you can do a majority of your software design without a prototype. Using Supervisor Calls (SVCs) to simulate I/O, mode 0 debug can begin long before actual hardware is available.



Once prototype hardware is available, designers gradually move from using emulation system resources to using prototype resources (mode 1). The final step is to use all of the prototype resources (mode 2) to execute the program. Because of the transparent nature of Tek emulators, your prototype will reliably perform in mode 2 as it will in actual operation with the emulator disconnected.

Local Area Network Connections

Downloading of code has always been a bottleneck when using Microprocessor Development Systems. A new Ethernet connection is now available to connect V Systems to industry standard networks. Ethernet support is available on VAX/Ultrix, VAX/VMS, SUN-3, and Tek 43xx systems. With this option you can download code up to 32 times (from 20 minutes to 32 seconds) faster than over standard RS-232.

ORDERING INFORMATION

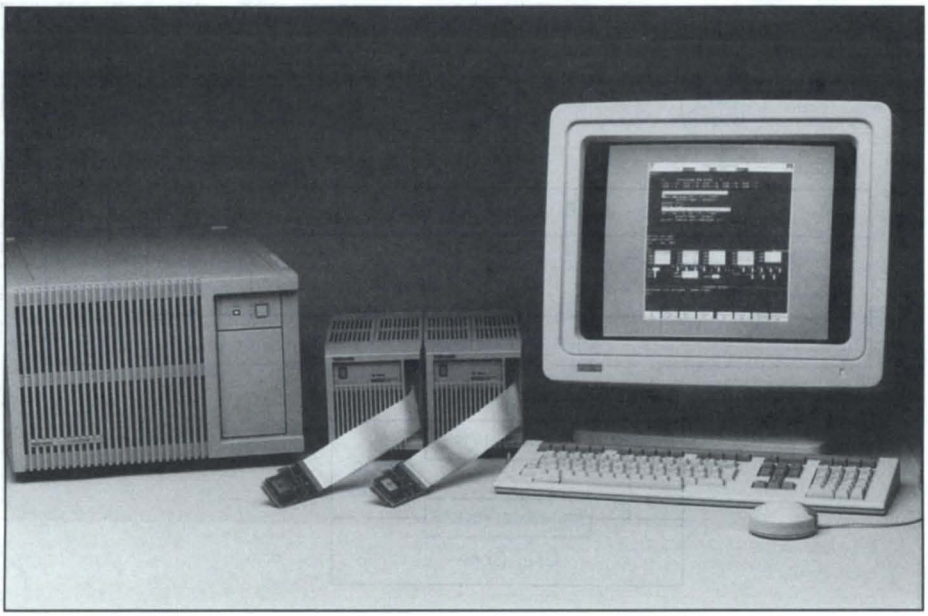
V SYSTEMS

Included: 8540A Integration Unit, 8- or 16-bit emulation support (emulator and probe) with 128K-byte memory and Trigger Trace Analyzer.

VZ80 Emulation Support	**$14,500**
V68000A Emulation Support	**$24,900**
V68008 Emulation Support	**$24,900**
V68010 Emulation Support	**$24,900**
V6809 Emulation Support	**$14,500**
V80186 Emulation Support	**$24,900**
V80188 Emulation Support	**$24,900**
V8085 Emulation Support	**$14,500**
V8086 Emulation Support	**$24,900**
V8088 Emulation Support	**$24,900**

OPTIONS

Option 11—512K Bytes Total Memory	**+$2,900**
Option 12—768K Bytes Total Memory	**+$4,000**
Option 13—1M Bytes Total Memory	**+$6,000**
Option 14—2M Bytes Total Memory	**+$12,000**
Option 18—Serial Comm Accelerator	**+$1,000**
Option 19—LAN Connection	**+$2,000**



Multi-V System

68020 Development System

- **25 MHz Real Time Emulation (NEW)**
- **Performance Analysis (NEW)**
- **Software Executer**
- **TekDB™ Source Level Debugger**

The Tektronix Multi-V System is a complete software/hardware toolkit for developing embedded 68020 applications. It supports large design teams from initial code development to final software/hardware integration.

The Multi-V system consists of a Software Executer for developing code before a prototype is available; a real-time emulation system that runs up to 25 MHz with no wait states; a Trigger State Analyzer for real-time, bus state and timing analysis; a Performance Analyzer for optimizing your code; up to 12 MB of program memory for developing large applications; and an Ethernet connection for fast downloads.

Multiple tools can be combined in a single Multi-V mainframe and each can be accessed via a local area network, making the Multi-V System a cost-effective design solution. Because of its modularity, the Multi-V System can be easily reconfigured or upgraded to keep up with your changing 32-bit development needs.

Software Executer

The Software Executer provides a known good environment for developing code before your hardware is available. Early in the design cycle, users can start developing their code using CLANDS II and running it on the Software Executer at processor speeds. When your software is ready to be tested with a prototype, the Software Executer can be upgraded to full emulation by adding an emulator pod. Since the Software Executer uses the same TekDB user interface and source level debugger as the emulator, transition time is minimal.

68020 Emulators

Two 68020 emulators are available; a 16.67 MHz version for less demanding applications and a NEW 25 MHz emulator for the ultimate in performance. The 25 MHz emulator contains all of the functionality of the 16.67 MHz emulator plus 128K of real-time, no-wait, state memory.

Real-Time Trace/Timing Analysis

The Trigger State Analyzer (TSA) is a real-time bus state analyzer that makes it easy to solve complex software and hardware problems. The TSA can be used as a timing analyzer so you can fine-tune your time-critical routines, or as a bus state analyzer that can display both C and assembly code to help you trace your program.

Performance Analysis (NEW)

For quickly characterizing your application program a Performance Analyzer (PA) that will run on both 68020 emulators or the Software Executer is included. The PA displays timing characteristics for the selected ranges (>2048 ranges available) in a bar-line format that shows execution times as a percentage of total time. A key feature of the PA is that it can be automatically set up from the output of the CLANDS II compiler or assembler.

TekDB C Source Level Debugger

As programs get larger and more complex, more powerful tools are needed for efficient program debug and verification. TekDB, a standard feature of the Multi-V System, is a state-of-the-art C source code and assembly level debugger. It's windowed user interface provides complete control over your embedded code.

Ethernet/RS-232 Communication

The traditional bottleneck in using microprocessor development systems has been downloading code from the host computer into your prototype. While RS-232 is the most convenient interface for downloading code, it is also the slowest. Tektronix has solved this problem by adding Ethernet connections to its development systems. The Multi-V system supports DEC/Ultrix, DEC/VMS, SUN-3, and Tek 43xx system based networks.

Multi-User/Multi-Tool System Configuration

An inherent capability of the Multi-V System is the ability for one user to control two emulators in one mainframe. With a simple expansion cable, you can connect an additional 3 mainframes to your Multi-V System to give you control of up to 8 emulators or software executers. Alternatively, up to 8 users can each control their own emulator or software executer.

ORDERING INFORMATION

MV6820 68020 Microprocessor Development System **$6,900**
Includes—Mainframe, power supply, controller card.

OPTIONS

Option 06—16 MHz Software Executer **+$6,400**
Option 08—16 MHz Emulator and Emulator Controller **+$13,500**
Option 09—25 MHz Emulator and Emulator Controller **+$16,500**
Option 10—Trigger State Analyzer **+$6,000**
Option 11—Mainframe Expansion and 1st I/O Probe **+$1,250**
Option 12—2nd I/O probe **+$1,000**
Option 15—1MB Program Memory **+$3,000**
Option 16—2MB Program Memory **+$4,600**
Option 17—3MB Program Memory **+$6,200**
Option 18—Ethernet Interface **+$2,000**

TekDB—User Interface/debugger.*1
Option 1C—VAX 780/8xxx Ultrix.*1
Option 1F—VAX 780/8xx VMS.*1
Option 1L—MicroVAX II/III Ultrix.*1
Option 1N—MicroVAX II/III VMS.*1
Option 1P—VAXstation Ultrix.*1
Option 1Q—VAXstation VMS.*1
Option 1R—SUN Series 3.*1
Option 1U—Tektronix 43xx.*1
Option 3S—12 Months Software Service.*1

*1 *Contact your local sales office.*

NEW TekDB Monitor

68K Family Debug ROM Monitor

- **Develop Real-Time Embedded Software**
- **68000/08/10/20 & 68030 (*NEW*) Support**
- **TekDB™ Source Level Debugger**
- **Compatible with Logic Analyzers**

Debug monitors have been a favorite way to debug embedded software for years. However, they generally offered only rudimentary debugging capability—stop at an address, examine/patch memory, and go at an address. Tektronix has expanded on this concept and developed a debug monitor with the functionality of an in-circuit emulator and integrated it with TekDB, a proven C source level debugger. This powerful combination of products provides the software engineer a new and flexible low-cost software development environment.

TekDB C Source Level Debugger

TekDB is a state-of-the-art windowed C source code debugger and user interface that provides you with complete control over your embedded code. This user interface and debugger works with the TekDB Monitor and the 68020 Multi-V Development System.

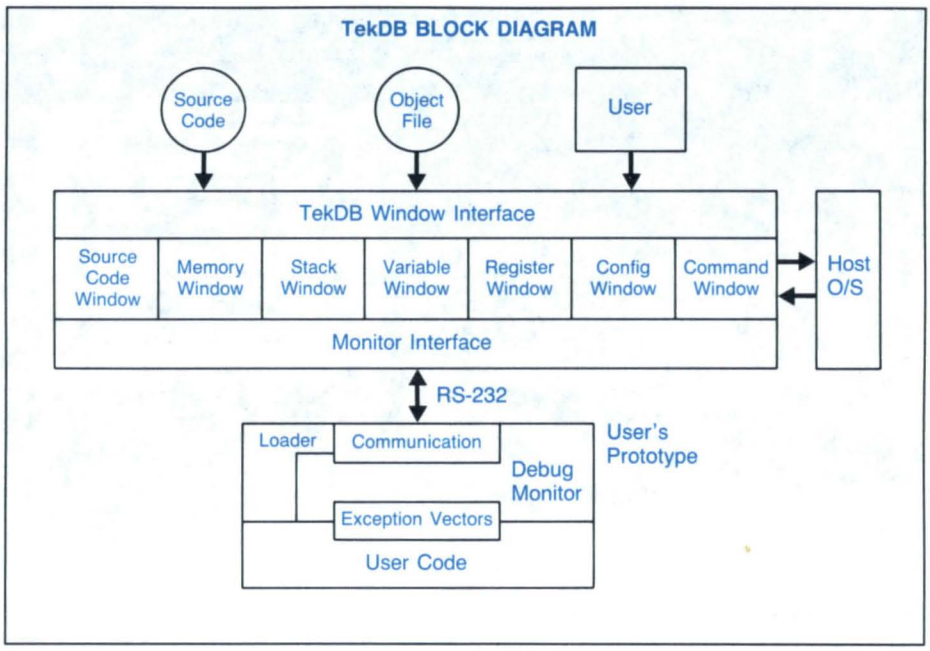
The TekDB interface consists of many windows including:

- Source Code
- Memory
- Stack
- Variables
- Register
- Configuration
- User Program
- Command

Each window is updated with new information whenever a breakpoint is reached. Three or four windows appear on the screen at any one time and each can be resized to meet your requirements.

TekDB Monitor

The TekDB Monitor is about 4K bytes of code that a user programs into his prototype's EPROM. This monitor performs two basic functions: 1) it establishes communications with a host computer, and 2) it links your embedded software to the TekDB debugger.



The TekDB Monitor gives you the functions of an in-circuit emulator except for hardware breakpoints or real-time functions such as real-time trace, timing analysis, or performance analysis. However, with the addition of a logic analyzer, even these emulator functions can be performed.

Using the Debug Monitor with a Logic Analyzer

Real-time trace, hardware breakpoints, timing analysis, and performance analysis can be obtained with a logic analyzer such as the Tek 1241 used in conjunction with the debug monitor. Use of a microprocessor-specific probe allows the logic analyzer to monitor the microprocessor's activity in real time.

Real-time trace, hardware breakpoints, timing analysis, and performance analysis can be performed with the TekDB Monitor and a logic analyzer. After the logic analyzer has been set up to trace/time the desired events, you can then have the LA trigger the debug monitor to stop your application when the acquisition buffer is full or the measurement is finished.

ORDERING INFORMATION

MV68KM—TekDB & 68K Debug Monitor. **$10**

MV68KMS—68K Debug Monitor Source and Right-to-Use license. **$10**

MV68KMK—68K Debug Monitor Development Kit. **$10**

Includes: TekDB, Debug Monitor, CLANDS II, Monitor source.

OPTIONS

Option 1C—VAX 780/8xxx Ultrix.
(MV68KM) **+$6,990**
(MV68KMS) **+$2,490**
(MV68KMK) **+$17,540**

Option 1F—VAX 780/8xxx VMS.
(MV68KM) **+$6,990**
(MV68KMS) **+$2,490**
(MV68KMK) **+$17,540**

Option 1L—MicroVAX II/III Ultrix.
(MV68KM) **+$3,990**
(MV68KMS) **+$2,490**
(MV68KMK) **+$13,490**

Option 1N—MicroVAX II/III VMS.
(MV68KM) **+$3,990**
(MV68KMS) **+$2,490**
(MV68KMK) **+$13,490**

Option 1P—VAXstation Ultrix.
(MV68KM) **+$2,490**
(MV68KMS)*[1]
(MV68KMK) **+$7,640**

Option 1Q—VAXstation VMS.
(MV68KM) **+$2,490**
(MV68KMS)*[1]
(MV68KMK) **+$7,640**

Option 1R—SUN Series 3.
(MV68KM) **+$2,490**
(MV68KMS) **+$2,490**
(MV68KMK) **+$7,640**

Option 1U—Tektronix 43xx.
(MV68KM) **+$2,490**
(MV68KMS) **+$2,490**
(MV68KMK) **+$7,640**

*[1] *Contact your local sales office.*

Emulation Systems and Design Environments

- **Real-Time Emulators**
- **VAX ULTRIX and VMS Support**
- **SUN UNIX**
- **Tektronix UTek Support**
- **MS DOS Support**
- **Ethernet and RS-232 Communications**

To support your engineering environment, Tektronix has tailored tools for working in several different computer environments. By providing tools on the most popular host computer environments, you can configure a microprocessor development system to best match your requirements.

Tek/DEC Software Compatibility

Tek offers powerful high-level language tools, both C and Pascal LANDS packages, and many popular assemblers on Digital Equipment Corporation's VAX series of computers using the VMS or ULTRIX operating systems. This Tek/DEC combination gives you a powerful series of options when configuring your design environment.

You can run Tek software development tools on the VAX to produce executable object code, and easily download the code to a V8, V16, or Multi-V Development System to perform emulation/debug tasks. Tek supplies you with the software needed to make your VAX/Development System function as a turnkey system.

Tek/SUN and Tek Workstation Support Now Available

Tektronix has broadened its host computer support with the addition of the SUN 3 and Tektronix 4300 Series Engineering Workstations. Now you can configure your engineering workstations with Tektronix Ethernet support, giving any workstation access to both LANDS software development tools, or emulation-based symbolic and source level debugging tools.

ColorKey+ User Interface

ColorKey+ and the Tek color graphics terminals work together to give simple single-keystroke access to the DEC VAX/VMS or ULTRIX operating system and Tek's 8 and 16-bit microcomputer design tools.

The color coding and graphically defined soft keys guide you through the system with a minimum of effort or knowledge.

TekDB User Interface

TekDB provides the latest in source level debug capability for Motorola's 68000 family of microprocessors.

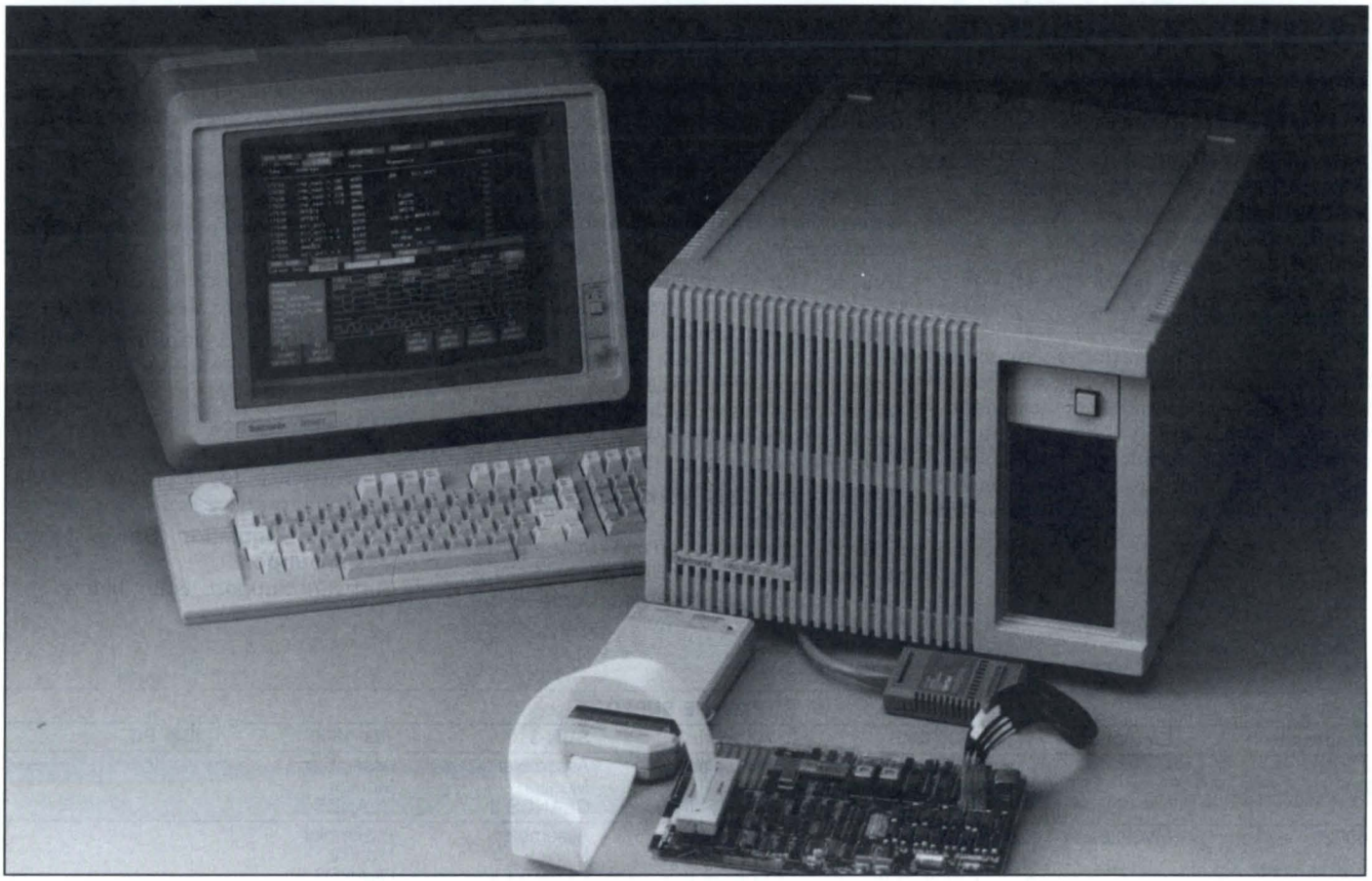
LANDS and Emulation Based Microprocessor Support

See Software Support listing below.

SOFTWARE SUPPORT

Processor	Emulation	VAX/VMS	VAX/Ultrix	SUN-3	Tek 4300	IBM PC
68030		Assembler Monitor LANDS II	Assembler Monitor CLANDS II	Assembler Monitor CLANDS II	Assembler Monitor CLANDS II	
68020	MV6820	Assembler Monitor CLANDS II Ada LANDS	Assembler Monitor CLANDS II	Assembler Monitor CLANDS II	Assembler Monitor CLANDS II	
68000/08/10	V68000A V68008 V6810	Assembler Monitor CLANDS I Pascal LANDS	Assembler Monitor CLANDS I Pascal LANDS	Assembler Monitor CLANDS I Pascal LANDS	Assembler Monitor CLANDS I	Assembler* C* Pascal*
8086/186 8088/80188	V8086 V8088 V80186 V80188	Assembler CLANDS I Pascal LANDS	Assembler CLANDS I Pascal LANDS			Assembler* C* Pascal*
1750A	V1750A	Assembler Ada LANDS	Assembler			
Z80	VZ80	Assembler C* Pascal*	Assembler C* Pascal*			Assembler* C* Pascal*
8085	V8085	Assembler C* Pascal*	Assembler C* Pascal*			Assembler* C* Pascal*
6809	V6809	Assembler	Assembler			Assembler*
Z8001/2	8540A 8300E54 8300P54 8300P55	Assembler	Assembler			

* *Distributed from Microtec Research*



The DAS 9220 mainframe and the color display form the cornerstone of the 9200 Series.

DAS 9200 Series

Digital Analysis System

GPIB IEEE-488

Tek 9200 communication module 92C02 (mainframe option 2C) complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

The Digital Analysis System (DAS) 9200 Series is a modern, configurable architecture that allows you to install the data acquisition and pattern generation modules you need today and easily expand or reconfigure as your needs grow and change. The high-resolution, color display and a menu-driven interface make the DAS 9200 system easy to learn and use.

The DAS 9220 mainframe and 9201T color display are the foundation of the 9200 Series. The mainframe is composed of a 68010 CPU, 8M-bytes of system RAM, 40M-byte hard disk, 1.2M-byte floppy disk, three RS-232 I/O ports, and a 750-watt power supply. A lower cost mainframe, the DAS 9219, is also available.

Several data acquisition and pattern generation modules can be added to these base systems. The modules are chosen by the number of channels, operating speed, and analysis features required. These subsystems allow you to increase the channel width by adding expansion boards. Refer to the DAS 9200 Performance Summary on page 337 for an overview.

Most any combination of data acquisition and pattern generation cards may be installed in a DAS 9200 system. These cards may interact in real time. For instance, two acquisition modules can be set up to run at different clock speeds yet display the acquired data in a *time correlated* format. This feature enhances the debugging of multi-processor designs. Or you could set an acquisition module to monitor the UUT for a specific *event* to occur. When that event is recognized, the acquisition module would then instruct the pattern generator to begin.

Ease of Use

All of this power doesn't come at the expense of user frustration. You control all of the DAS 9200 set-ups and operations through an intelligent menu-driven user interface. Each selection field is actually a pop-up menu that lists every item available for that field. Additionally, every menu entry or pop-up menu item is backed with a context-sensitive, on-line help system called NOTES. You can ask for NOTES on any item, at any time by pressing the NOTES key on the keyboard.

Multitasking

The DAS 9200 allows you to define *clusters* of cards, either acquisition, pattern generator, or both. By defining two *clusters* you effectively create two logic analyzers that can be operated independently or simultaneously. This would allow you to *baby-sit* your design for an intermittent failure with one cluster, and at the same time use the second cluster for other operations.

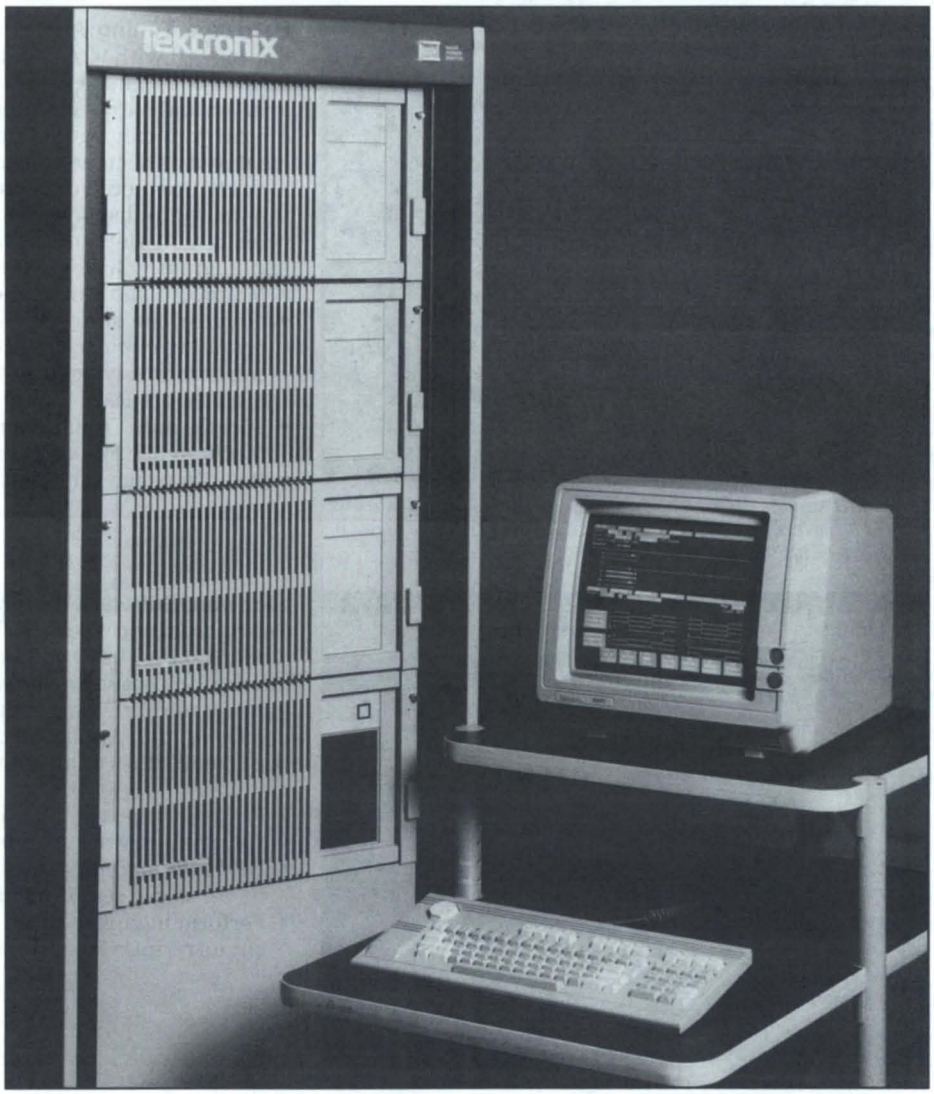
Expansion

Your initial investment in the DAS 9200 can grow along with your needs. The seven card slot DAS 9220 or DAS 9219 can be expanded by adding up to three 92E9 expansion mainframes. This can yield a system with 28 available card slots. Each DAS 92E9 has eight card slots, a 750-watt power supply, and an Expansion Receiver Interface. It has no CPU, disks, system memory, or display.

To connect a 92E9 expansion mainframe to the DAS 9220 mainframe, the top card slot of the DAS 9220 must contain an Expansion Interface card or Expansion/GPIB Interface card. This Expansion Interface card connects to the Expansion Receiver in the 92E9 with cables supplied. This process is the same for the DAS 9219 or other 92E9 expansion mainframes. DAS 9200 systems with two or more expansion mainframes must be rack mounted.

Pace Setting Memory Depth

Deep memory is the only means of dependably capturing the source of a problem when it happens long before the symptoms, or when the failure mode is infrequent or not repeatable. With the introduction of the 32K deep 92A60 and 92A90 acquisition cards, Tektronix established a new level of usefulness for logic analyzers. The 92A60D and 92A90D extend this deep memory to 131K! This means you can, in one pass, capture 131 times as much data, compared to other competitive logic analyzers. This large window of information (either before, after, or around the trigger point) is acquired without repetitive *store and restart* cycles.

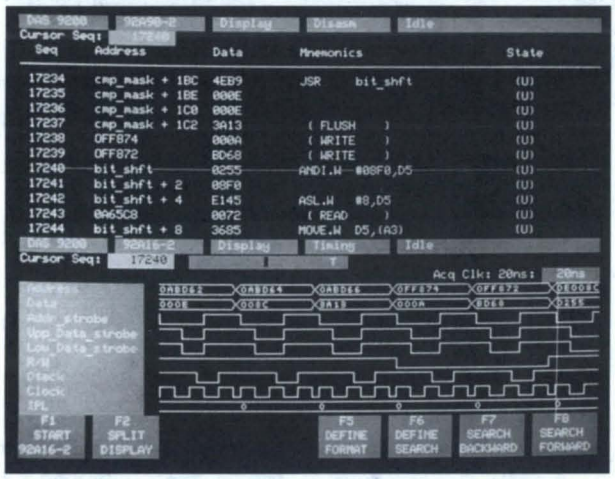


Up to three expansion mainframes can be connected to the DAS 9219 mainframe, in daisy-chain fashion, for a total of 28 slots. In an Automated Test Environment, the DAS 9200 can be set up and controlled over either RS-232 or GPIB interfaces.

DAS 9200 PERFORMANCE SUMMARY

Card Name	Type	Speed	Maximum Channels per Card	Maximum Channels per Module	Maximum Channels per System	Memory Depth	M/F Slots Req'd
92A16/92A16E	Acquisition	200 MHz	16	96	384	4K	1
92A60	Acquisition	20 MHz	60	60	360	32K	2
92A60D	Acquisition	20 MHz	60	60	360	131K	2
92A90	Acquisition	20 MHz	90	90	540	32K	2
92A90D	Acquisition	20 MHz	90	90	540	131K	2
92HS8/92HS8E	Acquisition	2 GHz	8	32	160	8K	2 (2/32 ch)
92S16	Pattern Generator (algorithmic)	50 MHz	18*1 32*2	270*3 480*4	936*3 1664*4	1K	1
92S32	Pattern Generator (sequential)	50 MHz	36*1 64*2	288*1 512*2	1008*1 1792*2	8K 4K	1 1

*1 *Using P6464 9-channel pattern-generator probes.*
*2 *Using P6463 16-channel pattern-generator probes.*
*3 *92S16 controlling multiple 92S32s; P6464 probes.*
*4 *92S16 controlling multiple 92S32s; P6463 probes.*

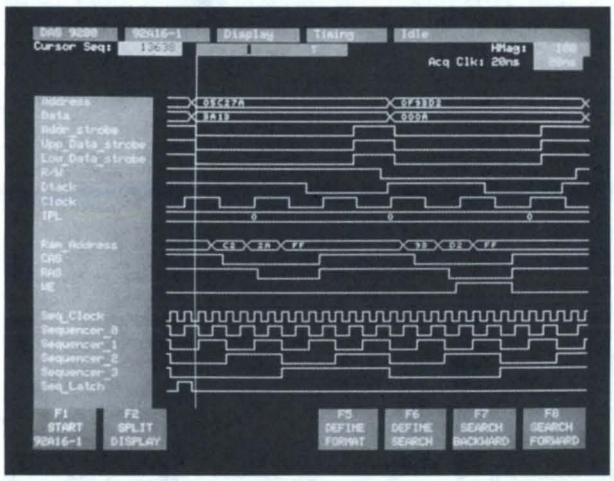


This split-screen display shows data acquired simultaneously from a microprocessor (using 92A90) and from bus timing signals (using 92A16).

Hardware Timing Analysis

Configured with 92A16 data acquisition modules, a DAS 9200 system makes an unbeatable tool for timing analysis and hardware integration. With the "bus-form" display you can define any number of channels to be displayed as a single trace. Using this format you could look at all acquired data on the display at one time! And the ability to display data acquired from non-synchronized circuit elements as *time correlated* data in a timing diagram will help you:

- Monitor a state machine synchronously
- Monitor the state machine synchronously and surrounding circuitry asynchronously
- Synchronously acquire transactions on both sides of a dual-port RAM
- Sample data from different parts of a circuit at different synchronous rates
- Identify which functional block is central to a problem

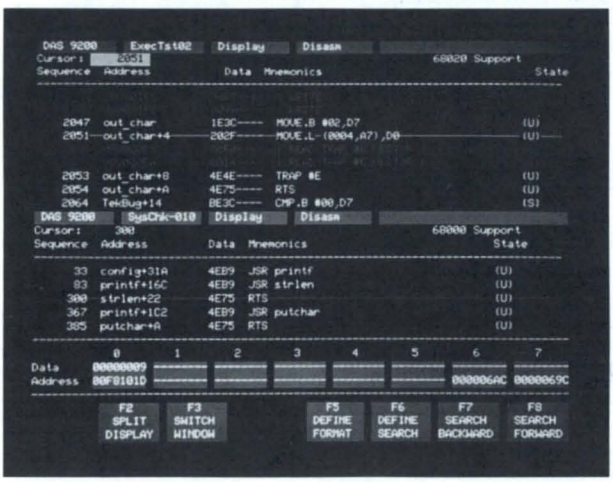


This display shows time-correlated data from a microprocessor, the dynamic RAM controller, and high-speed logic independent of the microprocessor bus.

Hardware/Software Integration

Configured with both a 92A16 and 92A60 or 92A90 cards, the DAS 9200 will help you evaluate the complex interactions between hardware and software. It lets you view disassembled microprocessor activity on the same display as high-resolution timing information, with true *time correlation* of all data. You can use the acquisition modules to:

- Pinpoint logic timing problems that occur relative to specific software events
- Evaluate dynamic memory and peripheral timing under a variety of conditions
- Perform high-resolution timing measurements of any circuitry interfaced to a microprocessor



This display shows data acquired simultaneously from two microprocessors using separate 92A60/92A90 modules. The display in the lower window includes register deduction.

Software Analysis

Configured with a 92A60D and 92A90D acquisition cards, the DAS 9200 system helps you monitor as many as six microprocessors at once! With its 16-state triggering and memory depth to 131,000 samples you can also:

- Handle the most complex, multi-phase microprocessor clocking schemes
- Accurately follow and capture the execution of your most sophisticated software
- Acquired an entire subroutine's execution in one pass
- Time-stamp the acquired data to *time correlate* acquired data from more than one microprocessor
- Filter the acquired data to just the information of interest; i.e., just subroutine calls and returns or control flow changes

Microprocessor Support

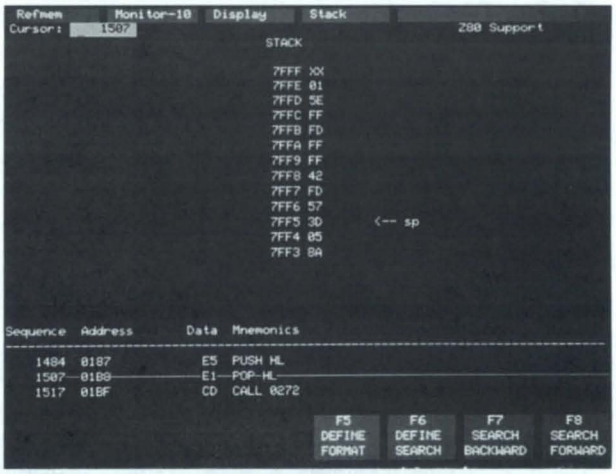
The DAS 9200 offers a family of microprocessor support packages. Each of these provides an automated instrument configuration file, microprocessor-specific mnemonic dissembly software, and a pre-configured connector to the microprocessor. see the microprocessor selection guide on pages 321 and 322 for information on the specific support packages available. These support packages allow you to:

- Quickly integrate multiple microprocessors by acquiring the execution from each simultaneously and then displaying *time-correlated* disassembly
- Display register content information deduced from accquired data simultaneously with disassembly
- Track down stack related problems using the Stack Display Format to scroll through acquired data and see the dynamic changes your code is making
- Outline program flow by filtering acquired data to display only Subroutine Calls and Returns
- Monitor an area of memory (an array of variables as an example) to see variables change
- Replace absolute addresses and data with your software symbols for both display and trigger specification

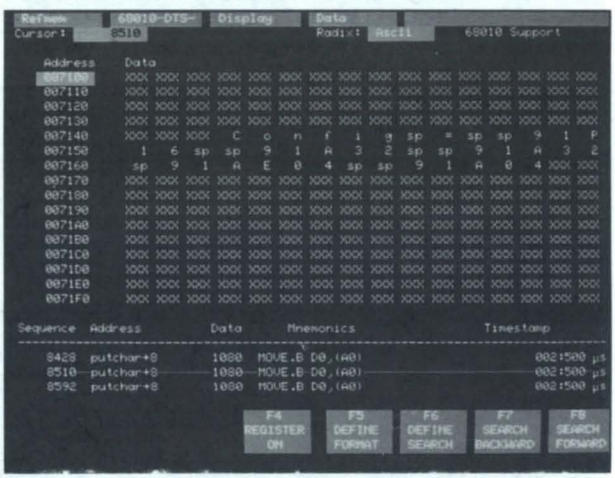
Disk-based mnemonics and single-connection probe adapters make DAS 9200 microprocessor support versatile and easy to use. Refer to page 320.

Performance analysis

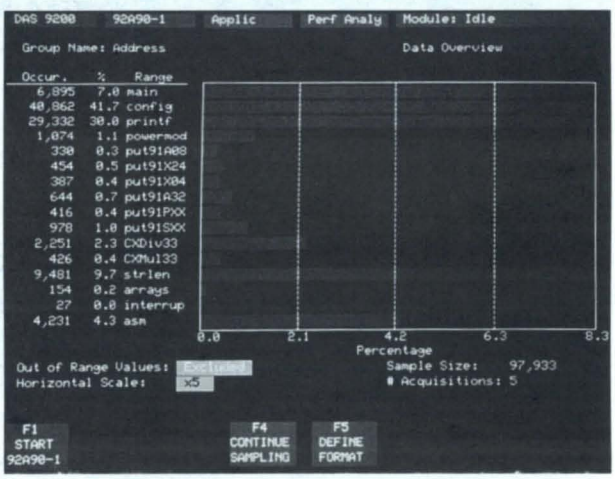
Both the 92A60 and 92A90 acquisition cards support Performance Analysis which allows you to monitor your software execution in real time without the delays and compromises of break-points, wait states, or debug code. And to put it all together, the color graphic 9201T display makes the information easy to access and easy to interpret.



Stack-simulation display. Problems like stack overflow of subroutines that don't correctly restore the stack pointer can be quickly identified by watching a continually updated stack model as you scroll through disassembly.



Data Display lets you see how variable space is modified by your software.



Performance analysis gives a graphic report on the activity of your code. This display shows an overview of the activity percentages of 16 different subroutines.

NOTE: All DAS 9200 products (including standard configurations, mainframes, and modules) include an extended warranty providing one year of on-site service.

STANDARD CONFIGURATIONS

Model Number	Recommended Application	Composed of*[1]	Performance Overview	Price
DAS 9230	General-purpose H/W analysis with 8-, 16-bit microprocessor support	1 92A16 with P6460 probes 1 92A60 without leadset 1 92S16	16-ch 200-MHz async/100-MHz sync 8-, 16-bit μP support 18-ch, 50-MHz stimulus	$31,230
DAS 9232*[2]	General-purpose H/W analysis with 8-, 16-, 32-bit microprocessor support	1 92A16 with P6460 probes 1 92A16E with P6460 probes 1 92A90 without leadset 1 92S16 1 92S32 with P6465 probes	32-ch 200-MHz async/100-MHz sync 8-, 16-, 32-bit μP support 50-ch 50-MHz stimulus	$52,780
DAS 9240	Timing analysis	1 92A16 with P6461 Probes 1 92A16E with P6461E Probes	32-ch 200-MHz async/sync	$31,400
DAS 9241	64 Channel, 200 MHz State/Timing Analysis System	2 92A16 with P6461 Probes 2 92A16E with P6461 Probes	64-ch 200 MHz async/sync	$44,000
DAS 9242	High-speed timing	1 92HS8 1 92A16 with P6461 Probes 1 92A16E with P6461E Probes	8-ch 2-GHz async 32-ch 200-MHz async/sync	$56,940
DAS 9250	Single Microprocessor Support for 8- or 16-bit μP	1 92A60 without leadset	60-ch 20 MHz async/sync supports one 8- or 16-bit μP	$16,410
DAS 9252	Single Microprocessor Support for 8-, 16-, or 32-bit μP	1 92A90 without leadset	60-ch 20 MHz async/sync Supports one 8-, 16-, or 32-bit μP	$18,180
DAS 9253	Dual Microprocessor Support for 8- or 16-bit μP	2 92A60 without leadsets	120-ch 20 MHz async/sync Supports two 8- or 16-bit μP	$26,640
DAS 9254	Dual Microprocessor Support for 8-, 16-, or 32-bit μP	2 92A90 without leadsets	180-ch 20 MHz async/sync Supports two 8-, 16-, or 32 bit μP	$30,550
DAS 9255	180 Channel Software Analysis for 8- or 16-but μP	3 92A60 without leadsets	180-ch 20 MHz async/sync Supports three 8- or 16-bit μP	$36,750
DAS 9256	270 Channel Software Analysis for 8-, 16-, or 32-bit μP	3 92A90 without leadsets	270-ch 20 MHz async/sync Supports three 8-, 16-, or 32-bit μP	$45,330
DAS 9257	240-Channel Software Analysis for 8- or 16-bit μP	4 92A60 without leadsets 1 DAS 92E9 Expansion Mainframe 1 GPIB/Expansion Interface	240-ch 20 MHz async/sync Supports four 8- or 16-bit μP	$55,015
DAS 9258	360 Channel Software Analysis for 8-, 16-, or 32-bit μP	4 92A90 without leadsets 1 DAS 92E9 Expansion Mainframe 1 GPIB/Expansion Interface	360-ch 20 MHz async/sync Supports four 8-, 16-, or 32-bit μP	$66,955
DAS 9260*[3]	ASIC prototype verification	1 92A16 with P6460 probes 3 92A16E with P6460 probes 2 92S32 with P6465 probes TF100 test fixture 92DV software	128-pin 50-MHz ASIC verification system: 64 pins acquisition and 64 pins stimulus	$68,110
DAS 9262*[2]	ASIC prototype verification	1 92A16 with P6460 probes 5 92A16E with P6460 probes 3 92S32 with P6465 probes TF100 test fixture 92DV software DAS 92E9 expansion M/F 92C02 GPIB/expansion	192-pin 50-MHz ASIC verification system: 96 pins acquisition and 96 pins stimulus	$106,350
DAS 9264*[3]	ASIC prototype verification	2 92A16 with P6460 probes 6 92A16E with P6460 probes 4 92S32 with P6465 probes DAS 92E9 expansion M/F 92C02 GPIB/expansion TF100 test fixture 92DV software	256-pin 50-MHz ASIC verification system: 128 pins acquisition and 128 pins stimulus	$134,500

*[1] *All configurations include a DAS 9219 mainframe and 9201T color display.*
*[2] *Includes mainframe Option 1A (115-V, single-phase power supply, 15-A power cord).*
*[3] *Includes mainframe Option A4 (230-V, single-phase power supply, 10-A power cord).*

DAS 9200 STANDARD CONFIGURATIONS (cont)

Model Number / Recommended Application	Composed of*1	Performance Overview	Price
192-pin, 50 MHz DAS 9200 Pre-configured Test System	1 92A16 with P6460 probes 5 92A16E with P6460 probes 3 92S32 DAS 92E9 expansion M/F 92C02 GPIB/expansion	192-pin 50 MHz test system: 96 pins acquisition and 96 pins stimulus	$95,120
265-pin, 50 MHz DAS 9200 Pre-configured Test System	2 92A16 with P6460 probes 6 92A16E with P6460 probes 4 92S32 DAS 92E9 expansion M/F 92C02 GPIB/expansion	256-pin 50 MHz test system: 128 pins acquisition and 128 pins stimulus	$117,890
360-pin, 50 MHz DAS 9200 Pre-configured Test System	2 92A90 6 92S32 DAS 92E9 expansion M/F 92C02 GPIB/expansion	360-pin 20 MHz test system: 180 pins acquisition and 192 pins stimulus	$100,920
512-pin, 50 MHz DAS 9200 Pre-configured Test System	3 92A90 8 92S32 DAS 92E9 expansion M/F 92C02 GPIB/expansion	512-pin 20 MHz test system: 270 pins acquisition and 256 pins stimulation	$132,480

*1 *All configurations include a DAS 9219 mainframe and 9201T color display.*
*2 *Includes mainframe Option 1A (115-V, single-phase power supply, 15-A power cord).*
*3 *Includes mainframe Option A4 (230-V, single-phase power supply, 10-A power cord).*

ORDERING INFORMATION

DAS 9200 MAINFRAMES AND TERMINAL

DAS 9219 Mainframe with 2 Mbyte RAM, 20 Mbyte hard disk, 400 Kbyte floppy $9,970

OPTIONS (DAS 9219 only)

Option 04—EMI Shielding for VDE 0871, Class B +$1,200
Option 10—Substitute 1.2 Mbyte floppy for 400 Kbyte +$250
Option 13—Substitute 40 Mbyte hard disk for 20 Mbyte +$700
Option 14—Substitute 20 Mbyte removable hard disk for 20 Mbyte +$1,200
Option 2C—Expansion/GPIB communications module +$1,950

DAS 9220 High Performance Mainframe with 8 Mbyte RAM, 40 Mbyte hard disk, 1.2 Mbyte floppy $13,970

OPTIONS (DAS 9220 only)

Option 04—EMI shielding for VDE 0871, Class B +$1,200
Option 12—Substitute 20 Mbyte hard disk for 40 Mbyte −$700
Option 14—Substitute 20 Mbyte removable hard disk for 40 Mbyte +$1,200
Option 15—Substitute 400 Kbyte floppy for 1.2 Mbyte −$250
Option 2C—Expansion/GPIB communications module +$1,950

DAS 92E9 Expansion mainframe $6,705

OPTIONS (DAS 9219, DAS 9220, DAS 92E9)

Option 1A—115V/15A Cord NC
Option 1B—125/208V 3-phase power supply +$180
Option 05—Rackmount kit +$400
Option 3C—Expansion module +$1,350
Option 88—Factory configuration.*1

9201T Color display terminal $3,635

INSTRUMENT MODULES

92A16 16-ch acq bd, 200 MHz, 4K deep, w/2 P6461 probes $9,750

OPTIONS (92A16 only)

Option 1D—Delete probes −$3,000
Option 2S—Substitute 2 P6460 probes −$2,000

92A16E 16-ch acq expension bd, 200 MHz, 4K deep, w/2 P6461E probes $9,340

OPTIONS (92A16E only)

Option 1D—Delete probes −$2,600
Option 2S—Substitute 2 P6460 probes −$1,600

92A60 8-bit & 16-bit μP Analysis module, 60 ch acq, 20 MHz, 32K deep, w/probe and G/P leadset $9,860
92A60D 8-bit & 16-bit μP analysis module, 60 ch acq, 20 MHz, 128K deep, w/probe and G/P leadset $13,000
92A90 32-bit μP analysis module, 90 ch acq, 20 MHz, 32K deep, w/probe and G/P leadset $12,470
92A90D 32-bit μP analysis module, 90 ch acq, 20 MHz, 128K deep, w/probe and G/P leadset $16,470

OPTION (92A60, 92A60D, 92A90, 92A90D)

Option 1D—Delete leadset −$450

92S16 18-ch, 50 MHz, Algorithmic Pattern Generator, 1K deep, 2 P6464 probes $7,290

OPTIONS (92S16 only)

Option 02—Add P6460 probe.*1
Option 1D—Delete probes −$2,700
Option 2S—Substitute 2 P6465 for 2 P6464 probes +$500

92S32 36-ch, 50 MHz, sequential pattern generator, 8K deep, 4 P6464 probes $9,430

OPTIONS (92S32 only)

Option 1D—Delete probes −$5,400
Option 1S—Substitute 1 P6465 for P6464 probe +$250
Option 2S—Substitute 4 P6465's for 4 P6464 probes +$1,000
Option 3S—Substitute 4 P6463 for 4 P6464 probes +$2,600
Option 4S—Substitute 2 P6463 for 2 P6464 probes +$4,000
92HS8 8-ch, 2 GHz acq module, 8K deep w/interface board $25,980
92HS8E 8-ch, 2 GHz acq module, 8K deep w/expansion interface board $25,980
92HS8C 8-ch, 2 GHz acq module, 8K deep $24,940

OPTION (92HS8, 92HS8E, 92HS8C)

Option 05—Rackmount +$300

*1 *Contact your local sales office.*

COMMUNICATION EXPANSION MODULES

92C02 Expansion/GPIB Comm. Module **$1,950**
92C03 Expansion Module **$1,350**

BOARD TEST FIXTURING

92BTA Board Test Adapter w/Benchtop Cabinet and Fans **$8,658**
92BTARM Board Test Adapter, Rackmount Version w/Fans (does not include benchtop cabinet) **$7,958**
92BTU30 30 ch probe connector, uni-directional **$285**
92BTB30 30 ch probe connector, bi-directional **$400**
92BTU90 90 ch probe connector, uni-directional **$750**

ASIC PROTOTYPE VERIFICATION

92DV ASIC Prototype verification software **$5,000**
Option 3M—Logic Simulator Translators **+ $2,000**
92SIMLK Logic Simulator Translators **$2,000**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian, 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

[1] Available with DAS 9219, DAS 9220, DAS 92E9, 9201T, 92HS8, 92HS8E, 92HS8c only.

WARRANTY-PLUS SERVICE PLANS

S0—Installation

(DAS 9219)	**+ $200**
(DAS 9220)	**+ $200**
(DAS 92E9)	**+ $200**
(9201T)	**+ $150**
(92A16)	**+ $150**
(92A16E)	**+ $150**
(92A60)	**+ $150**
(92A60D)	**+ $150**
(92A90)	**+ $175**
(92A90D)	**+ $175**
(92S16)	**+ $150**
(92S32)	**+ $150**
(92HS8)	**+ $200**
(92HS8E)	**+ $200**
(92HS8C)	**+ $200**

S2—2nd Year On-Site Warranty*[1]

(DAS 9219)	**+ $545**
(DAS 9220)	**+ $718**
(DAS 92E9)	**+ $375**
(9201T)	**+ $225**
(92A16)	**+ $600**
(92A16E)	**+ $570**
(92A60)	**+ $725**
(92A60D)	**+ $1,020**
(92A90)	**+ $945**
(92A90D)	**+ $1,288**
(92S16)	**+ $445**
(92S32)	**+ $665**
(92HS8)	**+ $1,575**
(92HS8E)	**+ $1,575**
(92HS8C)	**+ $1,515**
(92C02)	**+ $125**
(92C03)	**+ $85**
(92BTA)	**+ $652**
(92BTARM)	**+ $652**

S3—2nd & 3rd Year On-Site Warranty

(DAS 9219)	**+ $955**
(DAS 9220)	**+ $1,436**
(DAS 92E9)	**+ $660**
(9201T)	**+ $390**
(92A16)	**+ $1,045**
(92A16E)	**+ $1,000**
(92A60)	**+ $1,270**
(92A60D)	**+ $2,040**
(92A90)	**+ $1,655**
(92A90D)	**+ $2,576**
(92S16)	**+ $775**
(92S32)	**+ $1,165**
(92HS8)	**+ $2,765**
(92HS8E)	**+ $2,765**
(92HS8C)	**+ $2,655**
(92C02)	**+ $220**
(92C03)	**+ $150**
(92BTA)	**+ $1,296**
(92BTARM)	**+ $1,296**

[1] U.S. only

DAS 9100 Series

Digital Analysis System

GPIB IEEE-488

The DAS 9100 Series Option 06 complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats*.

- **Acquisition Speeds to 2-GHz (500 ps)**
- **Data Widths to 104 Channels**
- **State-Table and Timing Diagrams Displayed for All Channels**
- **Pattern Generation Up to 192 Channels at 50-MHz**
- **VAXBI Bus Simulation and Debug**
- **Disassembly Support for 24 Microprocessors and Buses**
- **Memory Depths From 512 to 8032 Bits per Channel**
- **Disassembly Support for Proprietary Processors and Buses**
- **Triggering to 16 Levels**
- **Patented Time Correlation of High-Speed and Low-Speed Data**
- **Separate Glitch Memory**
- **Supports GPIB, RS-232, Hard-Copy Units and Serial Line Printers**
- **Tape Drive Stores Patterns and Instrument Setups for Future Use**
- **Thirteen Standard Application Configurations Available or Custom Design Your Own System**

The Industry Standard

The DAS 9100 Series Digital Analysis System has set the industry standard for virtually all aspects of logic analysis. Its modular mainframe accepts a wide assortment of both data-acquisition and pattern-generation modules to fit your application needs.

High Speed

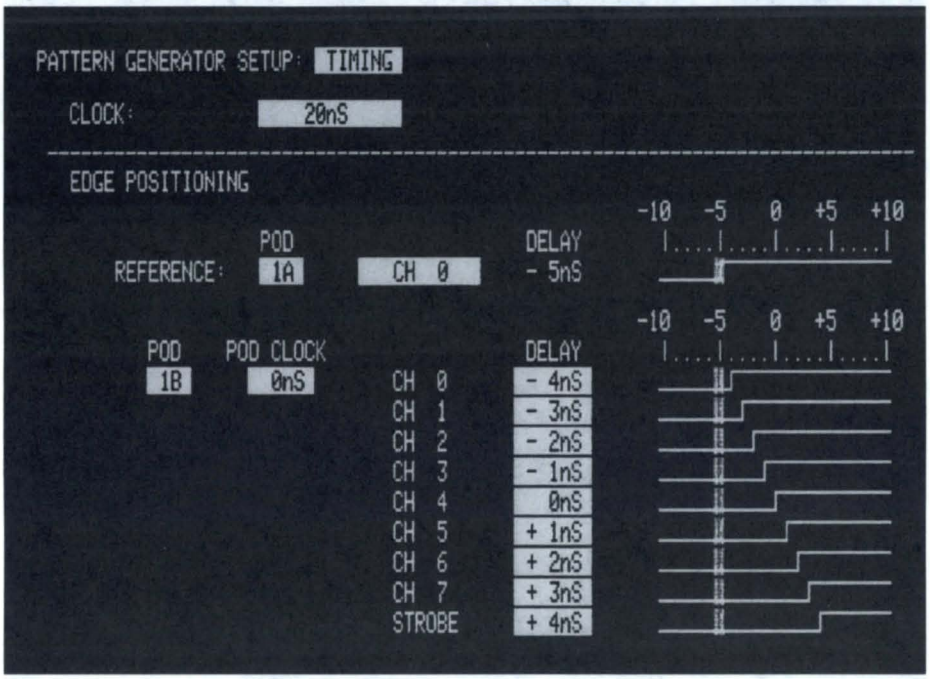
The 91HS8 acquisition module provides up to 32 channels at a 2-GHz asynchronous sample rate (500 picocosecond sample interval). The 91HS8 combines the time resolution of an oscilloscope with the flexible triggering, glitch detection, memory depth, and channel width of a logic analyzer.

Ease of Use

Besides color, the DAS 9100 Series includes many other important human engineering features. Its menu-driven user interface is easy to learn and self-documenting. There is a color-coded keyboard organized specifically to enhance user programming. All keys are arranged into logical groups that correspond to the display elements.

DAS 9100 PERFORMANCE SUMMARY

Module Name	Type	Channels	Maximum Channels	Memory Depth	Speed	Application
91HS8/91HSE8	Acquisition	8	32	8000	2 GHz	Ultra High-Speed Hardware Analysis
91A04A/91AE04A	Acquisition	2/4	16	4096/2048	660/330 MHz	High-Speed Hardware Analysis
91A08	Acquisition	8	32	512	100 MHz	Hardware Analysis
91A32	Acquisition	32	96	512	25 MHz	Hardware/Software Analysis
91A24/91AE24	Acquisition	24	96	1024	10 MHz	Sophisticated Software Analysis
91S16	Pattern Generator (Algorithmic)	16	176 with five 91S32	1024	50 MHz	High-Speed HW/SW Simulation
91S32	Pattern Generator (Stored-Pattern)	32	192	2048	50 MHz	High-Speed HW/SW Simulation
91P16/91P32	Pattern Generator (Algorithmic)	16/32	80	254	25 MHz	Hardware/Software Simulation



The 91S16/91S32 50-MHz pattern generator modules let you adjust the timing relationships between output clocks and data channels in 1 ns increments.

Pattern Generation

The DAS 9100 was the first logic analyzer with both acquisition and pattern generation in the same instrument. Pattern generation makes it possible to start debugging hardware before the software, or all of the hardware, is available. You can also use pattern generation to test VLSI devices. VLSI test software (91DVS) and a 320-pin VLSI test fixture are available.

Microprocessor Support

Tektronix offers the widest selection of microprocessor support packages in the industry. See Microprocessor and Bus Support at the end of this section.

VAXBI Bus Simulation and Debug

The DAS 91VB, a configured DAS 9100 system, supports the 32-bit VAXBI bus from Digital Equipment Corporation. Developed in cooperation with DEC, the DAS 91VB is a complete VAXBI test system that can fully monitor and simulate the VAXBI bus. The DAS 91VB can be used as a stand alone or from a VAX-connected terminal. Special control software installed on the VAX automatically performs all VAX-DAS 91VB communications and translations.

ORDERING INFORMATION

STANDARD CONFIGURATIONS

DAS 9121	**$18,000**	**DAS 9127**	**$31,140**
DAS 9122	**$19,110**	**DAS 9128**	**$50,330**
DAS 9123	**$24,380**	**DAS 9130**	**$108,840**
DAS 9124	**$36,720**	**DAS 9131**	**$36,120**
DAS 9125	**$21,490**	**DAS 9132**	**$53,070**
DAS 9126	**$27,000**	**DAS 91VB**	**$57,120**

MAINFRAME ONLY

DAS 9129 Color Mainframe **$9,240**
Includes: P6452 probe; P6454 external clock probe; ejector tool (214-3154-00); operator's manual (062-5847-09); workbook (062-7596-00).

MAINFRAME OPTIONS

Option 01—DC-100 Tape Drive **+$1,450**
Option 03—One Additional Power Supply **+$800**
Option 04—Two Additional Power Supplies **+$1,600**
Option 05—Rackmount Hardware **+$200**
Option 06—GPIB, RS-232, Line Printer Port **+$1,550**
Option 88—Mainframe shipped with modules installed and checked as part of the mainframe **NC**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian, 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

MAINFRAME FIELD-INSTALLABLE OPTIONS

DAS 91F1 Field-Installed Option 01 (Includes Installation in Service Center) **$1,700**
DAS 91F3 Field-Installed Additional Power Supply **$800**
DAS 91F6 Field Installed Option 06 (For Mainframes Above S/N B020100). **$1,700**

MAINFRAME MODULES

The following modules include probes. See Probe Selection Guide on page 130 for more information. Maximum of six modules per mainframe, 104 data-acquisition channels, 80 pattern-generator channels when using 91P16/91P32, or 192 pattern-generator channels when using 91S16/91S32.

91A04A Data Acquisition, 660/330 MHz **$8,740**
91AE04A Data Acquisition, Expander **$6,540**
91A08 Data Acquisition, 100 MHz **$4,380**
91A24 Data Acquisition, 10 MHz **$5,480**
91AE24 Data Acquisition, Expander **$5,170**
91A32 Data Acquisition, 25 MHz **$5,480**
91HS8 Data Acquisition, 2 GHz **$25,000**
91HSE8 Data Acquisition, Expander **$25,000**
91P16 Pattern Generator, 25 MHz **$4,380**
91P32 Pattern Generator, 25 MHz **$7,590**
91S16 Pattern Generator, 50 MHz **$7,590**
91S32 Pattern Generator, 50 MHz **$11,440**

Note: When adding modules, check that the correct number of power supplies is also selected. The mainframe includes sufficient power for two modules. One additional power supply (Option 03) is required for three or four modules. Two additional power supplies (Option 04) are required for a total of five or six modules.

OPTIONAL ACCESSORIES

PROBES

P6452—8-Channel Data Acquisition Probe **$730**
P6453—4-Channel Data Acquisition Probe **$1,560**
P6454—External Clock Probe For 91A08 Modules. (Only one required, included with each DAS 9100 Mainframe.) **$265**
P6455—8-Channel TTL/MOS Pattern Generator Probe **$575**
P6456—8-Channel ECL Pattern Generator Probe **$575**
P6457—4-Channel Tri-State Pattern Generator Probe **$575**
P6460—8-Channel Data Acquisition Probe **$700**
P6462—8-Channel TTL Only Data Acquisition Probe **$340**
P6463—TTL/CMOS Pattern Generator Prove. 9-Channels at 50 MHz or 16-Channels at 25 MHz. For use with 92S32. **$1,000**
P6464—8-Channel TTL/ECL Pattern Generator Probe **$1,350**

OTHER PRODUCTS

91DVS—IBM PC XT/AT-DAS 9100 Device Verification Support Packages **$5,000**
TF100—VLSI Device Text Fixture, 320 pins, 50 MHz **$5,000**
VB100—VAXBI Bus Support Package **$8,950**

DAS 9100 STANDARD CONFIGURATIONS

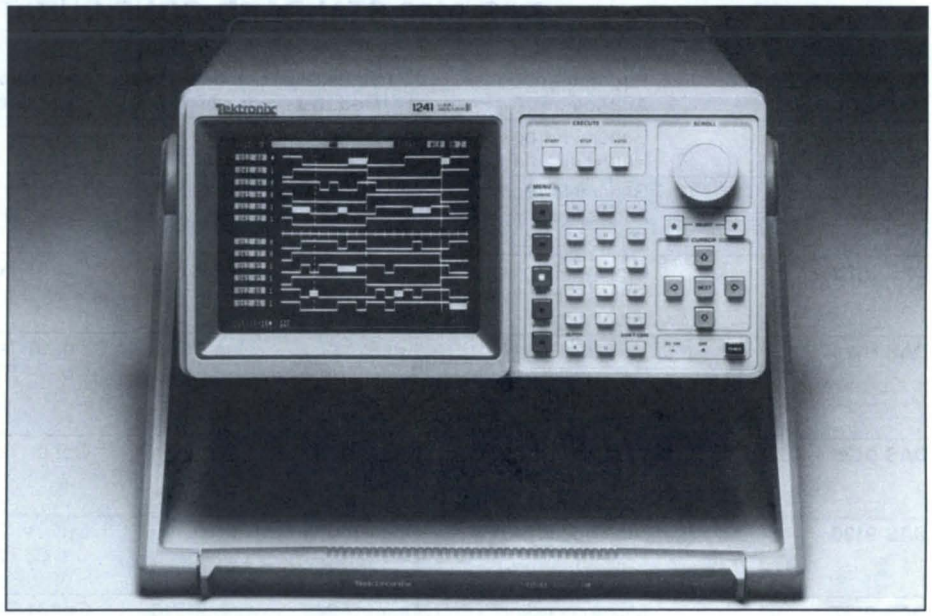
Standard Configuration Model Number	Recommended Application	Acquisition Modules	Pattern Generation Modules	Options Included	Performance Features
DAS 9121	General-Purpose Hardware Analysis	Two 91A08			16-Channel, 100-MHz Data Acquisition
DAS 9122	General-Purpose Acquisition With Stimulus	One 91A32	One 91P16		32-Channel, 25-MHz Data Acquisition 16-Channel, 25-MHz Pattern Generation
DAS 9123	General-Purpose Software/Hardware Integration	One 91A32 One 91A08	One 91P16	Opt 03 Power	32-Channel, 25-MHz Data Acquisition 8-Channel, 100-MHz Data Acquisition 16-Channel, 25-MHz Pattern Generation
DAS 9124	Expanded Software/Hardware Integration	Two 91A32 Two 91A08	One 91P16	Opt 01 Tape Opt 04 Power	64-Channel, 25-MHz Data Acquisition 16-Channel, 100-MHz Data Acquisition 16-Channel, 25-MHz Pattern Generation DC-100 Tape Mass Storage
DAS 9125	General-Purpose Microprocessor Support	One 91A24 One 91AE24		Opt 01 Tape	48-Channel, 10-MHz Data Acquisition DC-100 Tape Mass Storage
DAS 9126	High-Speed Hardware Analysis	One 91A04A One 91AE04A		Opt 01 Tape Opt 03 Power	4-Channel, 660-MHz or 8-Channel, 330-MHz Data Acquisition DC-100 Tape Mass Storage
DAS 9127	Microprocessor Software/Hardware Integration	One 91A24 One 91AE24 One 91A08	One 91P16	Opt 01 Tape Opt 03 Power	48-channel, 10-MHz Data Acquisition 8-Channel, 100-MHz Data Acquisition 16-Channel, 25-MHz Pattern Generation DC-100 Tape Mass Storage
DAS 9128	Interactive ATE: VLSI Verification	Three 91A32	One 91P16 Two 91P32	Opt 01 Tape Opt 04 Power Opt 06 Comm	96-Channel, 25-MHz Data Acquisition 80-Channel, 25-MHz Pattern Generation DC-100 Tape Mass Storage GPIB/RS-232 Communications Interface Serial Line Printer Port Display Video Output
DAS 9130	Ultra High-Speed Hardware Analysis	One 91HS8 Three 91HSE8		Opt 01 Tape Opt 03 Power Opt 06 Comm	32-Channel, 2-GHz Data Acquisition DC-100 Tape Mass Storage GPIB/RS-232 Communications Interface Serial Line Printer Port Display Video Out
DAS 9131	General-Purpose Acquisition With Stimulus	One 91A32 One 91A04A	One 91S32	Opt 01 Tape Opt 04 Power Opt 06 Comm	32-Channel, 25-MHz Data Acquisition 4-Channel, 330-MHz Data Acquisition 32-Channel, 50-MHz Pattern Generation
DAS 9132	General-Purpose Acquisition With Stimulus	One 91A32 One 91A08	One 91S16 One 91S32	Opt 01 Tape Opt 04 Power Opt 06 Comm	32-Channel, 25-MHz Data Acquisition 8-Channel, 100-MHz Data Acquisition 48-Channel, 50-MHz Pattern Generation
DAS 91VB	VAXBI Bus Simulation and Debug	One 91A24 Three 91AE24	One 91P16 One 91P32	Opt 01 Tape Opt 04 Power Opt 06 Comm	96-Channel, 10-MHz Data Acquisition 48-Channel, 25-MHz Pattern Generation VB100 VAXBI Support Package

1240/1241

GPIB IEEE-488

The 1240/1241 comply with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

- **Total Design Support: Hardware, Software, and Integration**
- **1241's Color Display Enhances User Interface**
- **Up to 72 Acquisition Channels**
- **Acquisition Speeds to 100 MHz Async, 50 MHz Sync**
- **14 Levels of Triggering With Conditional Branching**
- **Dual Timebase Triggering, Acquisition, and Display**
- **Simple Menu Operation With On-Screen Soft Keys**
- **Transfers Easily Into Manufacturing and Service**



Expanded 1241 Timing Diagram With Glitches.

TOTAL PERFORMANCE

With the 1240/1241 Logic Analyzers, the key phrase is **total performance.** These instruments provide complete support for all aspects of the design task, including hardware analysis, software analysis, and integration.

The 1241 color mainframe with its LCCS (Liquid-Crystal Color Shutter) and 1240 monochrome mainframe provide rapid setup and operation. Use of either instrument is made simple through a straightforward menu-oriented approach, combined with multilevel operation and touch-screen soft keys. Multi level operation allows the user to select from one of four levels best matched to the user's skill level and the task at hand. Touch-screen soft keys provide high-level commands at a keystroke, keeping operator selections simple and well labeled.

Hardware Analysis

For hardware analysis, the 1240/1241 offer up to 36 channels of acquisition at sampling rates of 100 MHz asynchronous and 50 MHz synchronous. 6 ns glitch detection is also available.

Standard memory depth of 512 bits per channel can be extended to a maximum of 2048 bits per channel by using a special memory chaining feature. This feature allows you to chain one card's memory to another, trading channel width for memory depth.

Superior hardware triggering capabilities include data and glitch triggering for isolating the problem area; clocked and unclocked triggering for capturing events that might not coincide with sample points; and counters, timers, and duration filters for triggering on the characteristics of a signal as well as its occurrence.

Auto-run capability allows you to track intermittents through continuous acquisitions and change parameters on the system under test and dynamically monitor their effects.

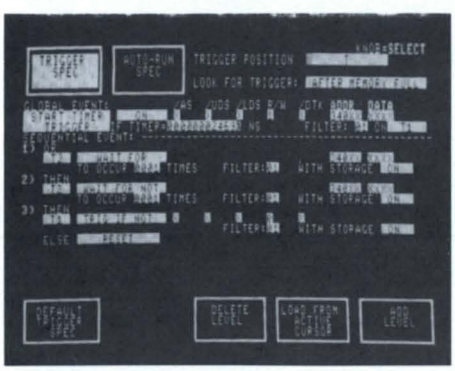
Software Analysis

Software analysis is supported by up to 72 data channels at sampling rates of 50 MHz synchronous/asynchronous. A flexible clocking scheme includes data demultiplexing without double-probing. Powerful software triggering capabilities are provided so that you can track program flow. Included are 14 trigger levels, conditional branching, counters, timers, and both program flow and data flow qualification. These functions are implemented in two independent event recognizers.

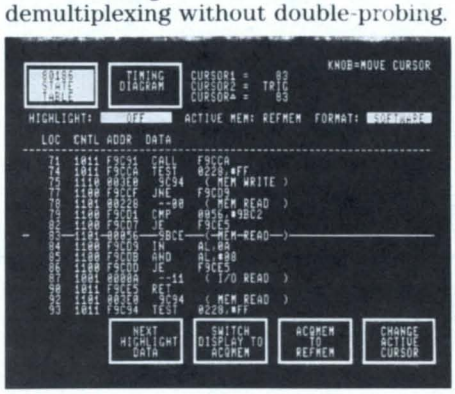
Other features that assist in software analysis are flexible channel groupings for display, standard display radices (including ASCII and EBCDIC), and an eight-level pattern search and memory compare with highlighting.

Hardware/Software Integration

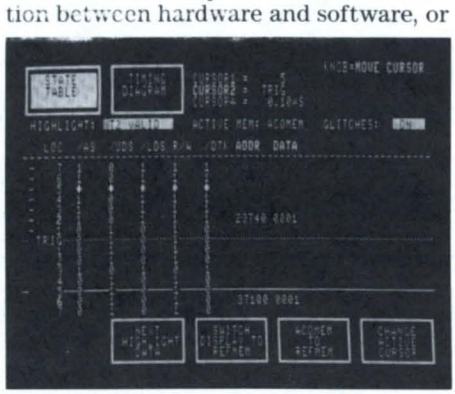
The 1240/1241 offer a dual timebase system that integrates all the hardware and software analysis capabilities. The dual timebase system greatly speeds the hardware/software integration process by tying together the acquisition, triggering, and display of two independent timebases. You can fully monitor the interaction between hardware and software, or



Trigger Specification Menu.



80186 Software Format.



State Table Display with Dual Time Base Acquisition.

the relationship of two interdependent systems. All data displays are time aligned and completely correlated. The dual timebase allows you to integrate functional modules, an increasingly important design task.

FLEXIBILITY NOW AND IN THE FUTURE

The power of the 1240/1241 stems from the configurable architecture of the mainframes. You can select features that meet your current application needs, then later upgrade the mainframe to increased performance.

Selectable Acquisition Cards

Each mainframe has four card slots which accommodate any combination of 9-channel (1240D1) and 18-channel (1240D2) data acquisition cards, with a maximum of 72 channels.

ROM Packs for Data Processing

Data processing capabilities can be added by inserting ROM packs into the ROM port on the side of the mainframe. These ROM packs provide the capability to capture data which is very specific to your problem at hand and assist in analyzing that data, by processing it and presenting it to you in the most useful manner. Currently, there are ROM Packs supporting performance analysis (12R01) and mnemonic disassembly (12RMXX) of popular microprocessors, busses and digital signal processors. Special communications applications, such as printer support (12RC01) and master/slave (12RC02), require both a ROM Pack and COMM Pack.

COMM Packs for External Communications

Communication capabilities can be added by inserting COMM Packs into a communications port on the rear of the mainframe. These COMM Packs act as adapters, allowing the 1240/1241 to function in different communication environments. The 1200C01 supports RS-232C, the 1200C02 supports GPIB, and the 1200C11 supports the parallel printer interface.

EASE OF USE

In line with Tek's goal of easy-to-use logic analyzers, the 1240/1241 human interface has been designed to facilitate the user's operation of the instrument.

Menu Operation and Soft Keys

Ease of use starts with the 1240/1241's menu operating system. Straightforward menu displays and on-screen soft keys allow you to make set-up choices on the screen where your attention is already directed. You are not distracted by the need to look elsewhere on the instrument.

Multiple Operation Levels

Another major feature of the menu operating system is user-selected operation levels. The 1240/1241 provide four operation levels, ranging from basic operation for simple applications to full operation for complex applications. The sophistication of system features increases with the operation levels.

Configurable From the Front Panel

The 1240/1241 are completely configurable from the front panel, thus eliminating the need to switch boards and reconnect probes when changing from hardware to software applications. Probe connections are on the side of the instrument so they can be easily accessed. The keyboard has a simple layout, with single-function keys. Also, a knob is included on the keyboard for data scrolling. This knob, along with the extreme smoothness of the data scrolling, makes the 1240/1241 displays easier to read and manipulate.

Automatic Nonvolatile Storage

A battery-backed CMOS memory stores two complete instrument set-ups, including the last set-up used before the 1240 or 1241 is powered down. This facilitates quick instrument start-up when returning to work, and eliminates the problem of losing a set-up as a result of power system interruptions.

IDEALLY SUITED FOR ENGINEERING, MANUFACTURING, AND SERVICE

In addition to their usefulness in the engineering environment, the 1240/1241 are well suited for manufacturing and service tasks. They transfer easily from one environment to another and help facilitate communications between the different groups through their portability, remote control, mass storage, and teleservicing capabilities.

Portability

The 1241 weighs 12.7 kg (28.0 lb) and meets environmental Class 5 specifications. The 1240 weighs 12.0 kg (26.5 lb) and meets environmental Class 3 specifications.

Remote Control

The 1200C01 RS-232C and 1200C02 GPIB COMM Packs are ideally suited to automated test environments and remote control.

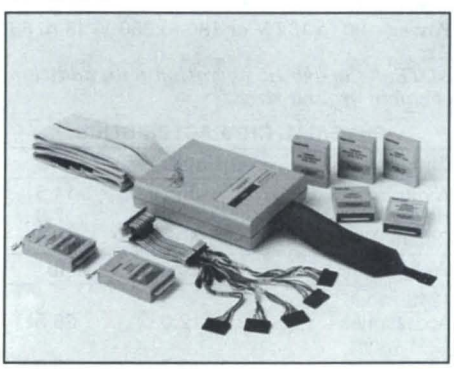
Mass Storage

Mass storage of set-ups, acquisition memories, and reference memories is achieved through RAM and EPROM Packs.

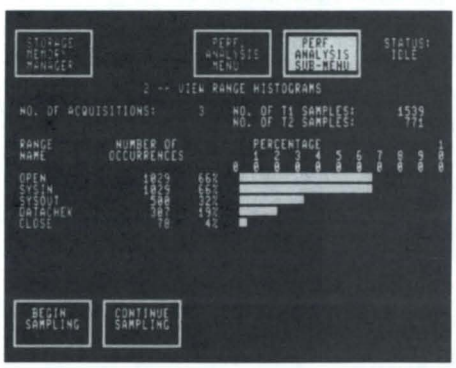
Storage and retrieval of information from the 12RS01 8K RAM Pack and the 12RS02 64K RAM Pack is accomplished via menu soft keys. The 12RS11 32K EPROM Pack (no EPROMs included) and the 12RS12 32K EPROM Pack (EPROMs included) provide a permanent storage medium for set-ups and memories. Menu soft keys are used to retrieve files.

Teleservicing

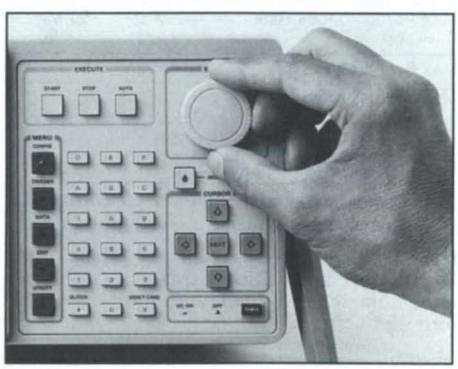
Master/Slave capability allows one 1240/1241 to remotely control another over a telephone line. This capability greatly eases the higher levels of service troubleshooting, as service specialists can get to the problem via the telephone rather than having to physically travel to the problem site. The 1240/1241 supports master/slave operation with the following configuration at each end of the phone line: 12RC02 Master/Slave ROM Pack, a 1200C01 RS-232C COMM Pack and a modem.



Personality Module with COMM Packs and ROM Packs.



View Range Histograms Menu.



Scroll Knob.

CHARACTERISTICS

Characteristics are common to the 1240/1241 unless otherwise indicated.

OPERATING LEVELS

Level 0—Basic operation.
Level 1—Advanced timing analysis (includes basic state analysis).
Level 2—Advanced state analysis (includes basic timing analysis).
Level 3—Full operation.

TIMEBASES

Two per Instrument—Assignable by probe. Timebase 1: Asynchronous or Synchronous. Timebase 2: Synchronous or Demultiplex.

INPUTS

Clocks—C1, C2, . . . Cn. Where n= number of probes = number of channels/9. Minimum Pulse Width: 8 ns. Specifiable as rising, falling, or either edge.
Qualifiers—Q1, Q2, . . . Qn. Where n= number of probes = number of channels/9. Set-up Time, Hold Time: = (P6460) 11 ns, 0 ns; (P6462) 17 ns, 6 ns. Specifiable as high or low level.
Asynchronous—Rate: 1240D1: 10 ns to 1 s, (1240D2: 20 ns to 1 s). Specification: (1-2-5 sequence)•(Q1•Q2• . . .•Qn). Accuracy: 0.01%. Channel-to-Channel Skew: ±3 ns. Glitch Detection: (1240D1 only) 6 ns.
Synchronous—Rate: Dc to 50 MHz. Set-up Time, Hold Time: On 1240D1 is (P6460) 7 ns, 2 ns; (P6462) 12 ns, 7 ns. On 1240D2 is (P6460) 12 ns, 0 ns; (P6462) 17 ns, 5 ns. Specification: (C1 + C2 + . . . +Cn)•(Q1•Q2•. . .•Qn). Minimum Delay After Previous Clock: 20 ns.
Demultiplex—Rate: Dc to 50 MHz. Set-up Time, Hold Time: On 1240D1 is (P6460) 7 ns, 2 ns; (P6462) 12 ns, 7 ns. On 1240D2 is (P6460) 12 ns, 0 ns; (P6462) 17 ns, 5 ns. Specification: First Phase Clock (Latch Data) (C1 + C2 + . . . + Cn)•(Q1•Q2•. . .•Qn). Minimum Delay After Last Phase Clock: 20 ns. Last Phase Clock (Store Data): (C1 + C2 + . . . + Cn)•(Q1•Q2•. . .•Qn). Minimum Delay After First Phase Clock: 10 ns.

DATA ACQUISITION CARDS

Two types of acquisition cards: 1240D1, 1240D2. Maximum of four cards per 1240/1241, in any combination.

	1240D1	1240D2*2
Number of Channels	9	18
Max Asynchronous Rate w/Glitches	100 MHz 50 MHz*1	50 MHz N/A
Max Synchronous Rate	50 MHz	50 MHz
Memory Depth (Bits/Channel w/Glitches)	 512 256	 512 N/A
Max Depth via Chaining	2048	2048

*1 *Glitch capture available on all channels.*
*2 *Supports single probe demultiplexing.*

Depth vs Channels—Tradeoffs possible between data acquisition cards of same type. Maximum depth is 2048 (with four 1240D1 or four 1240D2).

DATA ACQUISITION PROBES

Two Types of Acquistion Probes: P6460, P6462. One probe required per 1240D1, two per 1240D2.

	P6460	P6462
Signal Input Data Channels Clock/Clock Qualifier Lines	 9 1	 9 1
Nominal Impedance	1 MΩ, 5 pF	≈1 LTTL
Threshold Range	−6.35 to +6.35 V	+1.4 V
Increments	0.05 V	—
Accuracy	±0.5% ±0.065 V	±0.25 +0.0055 V/ (0−25°C)
Threshold Assignment	By acquisition card	—
Polarity Assignment	By channel	By channel
Max Input Voltage Peak Channel to Channel	 ±40 V ± 60 V	−2 to +7 V No restriction

NOTE: All system specifications are based upon P6460 probes, for specifications based upon P6462 probes, please refer to the 1240/1241 Data Sheet.

TRIGGER DEFINITION (TWO EVENT RECOGNIZERS)

Global Event Recognizer (Event Recognizer #1)—One level. Event Recognition specified by: Word recognizer—data (data or glitch on 1240D1). Duration filter—1 to 16 consecutive samples or 10 ns to 160 ns. Commands: Store On (Not), Trigger On (Not), Reset On (Not), Start Timer On (Not), Time While On (Not), Increment Counter On (Not), or Off. Counter/timer: Clock interval is 10 ns. Range is 0 to 99,999,999,999 (either counts or 10 ns increments) Counter/timer value may be used to cause trigger or reset.
Sequential Event Recognizer (Event Recognizer #2)—14 levels. Event Recognition on Each Level Specified By: Timebase: Which timebase to monitor for event. Word Recognizer: Data (data or glitch on 1240D1). Iteration Counter: 1 to 9999 occurrences. Duration Filter: 1 to 16 consecutive samples. Selective Storage on Each Level Specifiable: With Storage On or With Storage Off. Commands on Each Level: Wait For (Not), Trigger If (Not), Reset If (Not), Jump If (Not) or Delay (up to 9999). Commands at End of Sequence: Trigger, Reset or Do Nothing.
External Trigger Out—TTL level output whenever trigger attempted.
External Trigger In—TTL level input can be required for enabling trigger.

AUTORUN

Four Modes of Operation

Compare Acquisition Memory to Reference Memory—Specifiable which channels to compare, specifiable starting and ending memory locations of comparison. Specifiable result of Comparison Outcome: Display and reacquire, discard and reacquire, or display and stop. Specifiable Minimum Display Time: 0 s to 99 s.
Continuous Trigger Out—Data is not stored. 1240/1241 acts as trigger source.
Trigger In—Requires Trigger In signal to enable trigger. Enables two 1240/1241s to work in parallel.
Store After Trigger—Data at last trigger is available after stopping 1240/1241. Time between storages is minimum.

DISPLAY FORMATS

State Table—Acquisition or reference memory. Data displayed in binary, octal, hex, ASCII, EBCDIC. Glitch display can be turned on or off.
Timing Diagram—Acquisition or Reference Memory. Horizontal Expansion: *1, *2, *5, *10, *20. Vertical Expansion: (1241 only): *1, *2.
Distance Between Cursors—Value displayed as absolute time for unqualified asynchronous measurement, as number of memory locations for qualified or synchronous measurement.
Highlighting Modes—Memory comparison differences, glitches, search pattern occurrences, time base 1 occurrences, time base 2 occurrences.
Search Pattern—Length: 1 to 8 contiguous locations.

STORAGE

Internal (Standard)
Nonvolatile Memory (NVM)—Size: Contains two set-ups, including status at power down, lithium iodide battery.
Volatile Memory (RAM)—Size: Contains two set-ups.
Memory Types
Set-Up—Stored in NVM, RAM, or Pack, contains all data pertinent to making an acquisition.
Reference Memory—Stored in Pack, reference memory is editable in Edit Reference Memory menu.

ENVIRONMENTAL

Temperature—Operating: 1240 is −10 to +55° C; 1241 is 0 to 50° C. Nonoperating: -62 to +85° C.
Altitude—Operating: To 4600 m (15,000 ft). Nonoperating: To 15,000 m (50,000 ft).
Vibration—0.025-inch displacement. 10-to 55-Hz frequency range.
Shock—30 gs.

OTHER CHARACTERISTICS

Diagnostics—At power-up, the 1240/1241 performs processor, ROM, RAM and board checks. A test pattern generator located on the side provides stimulus for verifying probes and acquisition system operation. Complete system verification and extended diagnostics are available with an optional ROM Pack.
Rear Panel Connections— Trigger In: TTL compatible. Trigger Out: TTL compatible. Video Out: (1240 only) Conforms with RS-170 (composite video).
Power—90 to 132 V or 180 to 250 V, 48 to 63 Hz.
NOTE: 48 to 440 Hz operation with addition of safety ground strap.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	368	14.5
Height	197	7.8
Depth	498	19.6
Weight ≈	**kg**	**lb**
1240 w/out Accessories	12.0	26.5
1241 w/out Accessories	12.7	28.0

ROM Packs

Analysis

12R01 (Performance Analysis)—State Overview: 1 to 11 ranges. Ranges can be different groups and different timebases. Ability to halt and resume measurement. Display in count, percentage, and histogram. Event Measurement: 1 to 11 distribution intervals, 1 to 4 events, 10 ns resolution. Five measurement types (measure total time, count cycles, count occurrences, time occurrence, accumulate time). Display in distribution, min, mean, max, and histogram.

Communication Support

12RC01 (Printer Support)—Requires: 1200C01 for serial interface or 1200C11 for parallel interface. Output: Menus, search pattern, acquisition and reference memory. Memory Format: State table, timing diagram, and combined.

12RC02 (Master/Slave)—Requires: 1200C01 and modem. With Option 01: Auto-answer, auto-dial, voice-data switching, nonvolatile storage of four phone numbers, 300 baud and 1200 baud. Diagnostics: Local 1240/1241 with COMM Pack and RS-232 cable, modem, and link between local and remote 1240/1241.

External Storage (Optional)

12RS02 (64K RAM Pack)—Size: Contains 64K bytes with Lithium Iodide battery.

12RS11 (32K EPROM Pack)—Size: Contains 32K bytes (no EPROMs included). Requires four 68764s or 68766s.

12RS12 (32K EPROM Pack)—Size: Contains 32K bytes. Comes with four 68764s or 68766s.

Microprocessor Support

12RMXX (Mnemonic Disassembly)—Formats: State, Absolute, Hardware, Software. Provides printer support for all four display formats when 1200C01 (for serial printer interface) or 1200C11 (for parallel printer interface) is installed.

COMM Packs

1200C01 (RS-232C)—Baud Rate: 110 to 9600. Bits/Character: Eight, including parity bit. Protocol: Asynchronous full duplex. Stand alone with host for remote control, with 12RC01 for printers with serial interface, with 12RC02 and 12RC02 Option 01 for master/slave, with 12RMXX for printers with serial interface.

1200C02 (GPIB)—Full listener/talker capabilities. Meets IEEE Standard 488.1-1987. Compatibility: Stand alone with host for remote control.

ORDERING INFORMATION

1240 Logic Analyzer Mainframe **$4,500**
Includes: Accessory pouch (016-070-00); front panel cover (200-2780-00); operator manual (070-4340-01); reference guides (070-4641-01).

1241 Color Logic Analyzer Mainframes **$6,000**
Includes: Same as above

Option 05—Rackmount Adaptor **+$400**

1241NMP MICROPROCESSOR ANALYSIS SYSTEM CONFIGURATIONS

SYSTEM CONFIGURATIONS

1241NMP Microprocessor Analysis System **$9,950**
Incudes: 1241 Logic Analyzer with one 12R01 Performance Analysis Pack, one 12RS02 RAM Pack, one 1200C11 Parallel Printer COMM Pack, plus microprocessor specific support—probing, acquisition, and disassembly.

OPTIONS

Option 01—8080 Support	**NC**
Option 02—8085 Support	**NC**
Option 03—6800 Support	**NC**
Option 04—6801/3 Support	**NC**
Option 05—6802 Support	**NC**
Option 06—6805E2 Support	**NC**
Option 07—6805E3 Support	**NC**
Option 08—6808 Support	**NC**
Option 09—6809 Support	**NC**
Option 10—Z80 Support	**NC**
Option 11—6502/C02 Support	**NC**
Option 12—NSC800 Support	**NC**
Option 13—6301/3 Support	**NC**
Option 14—GM ECM Support	**+$600**
Option 15—1802/4/5/6 Support	**NC**
Option 16—8031/51 Support	**NC**
Option 17—68HC11 Support	**NC**
Option 21—8086 Support	**NC**
Option 22—8088 Support	**NC**
Option 23—80186 Support	**NC**
Option 24—80188 Support	**NC**
Option 25—80286 Support	**NC**
Option 26—68000 (DIP) Support	**NC**
Option 27—68000 (PGA) Support	**NC**
Option 28—68008 Support	**NC**
Option 29—68010 (DIP) Support	**NC**
Option 30—68010 (PGA) Support	**NC**
Option 31—68020 Support	**NC**
Option 32—Z8001/3 Support	**+$3,700**
Option 33—Z8002/4 Support	**+$3,700**
Option 34—64180R0/R1 Support	**+$3,700**
Option 35—F9450 Support	**+$3,700**
Option 36—8096/7 Support	**+$3,700**
Option 37—68030 Support	**+$1,000**
Option 41—TMS32010 Support	**NC**
Option 42—TMS32020/C25 Support	**+$3,700**
Option 43—DSP56000/1 Support	**+$3,700**
Option 44—ADSP2100 Support	**+$3,700**
Option 47—VAXBI Support	**+$4,000**
Option 48—GPIB Support	**NC**
Option 1B—Basic Analysis System	**NC**

Option 1B substitutes one 12RC01, and two 1240D2's with four P6460s for the microprocessor specific support.

STANDARD SYSTEM CONFIGURATIONS

8-BIT

1240N08 8-Bit Microprocessor Analysis System $11,160
Includes: 1240 Logic Analyzer with two 1240D2 modules with four P6460 probes, 12RS02 RAM Pack.
1241N08 8-Bit Microprocessor Analysis System $9,950
Includes: Same as above except the 1241 Logic Analyzer.

OPTIONS

Options 01 thru 09—Microprocessor Specific Support (Includes: 12RMXX Microprocessor Disassembly ROM Pack, 12RMXX Option 01 Configured Probe Interface).
Option 01—Support for 8080
(1240N08) +$540
(1241N08) +$600
Option 02—Support for 8085
(1240N08) +$540
(1241N08) +$600
Option 03—Support for 6800
(1240N08) +$540
(1241N08) +$600
Option 04—Support for 6802
(1240N08) +$540
(1241N08) +$600
Option 05—Support for 6808
(1240N08) +$540
(1241N08) +$600
Option 06—Support for 6809
(1240N08) +$540
(1241N08) +$600
Option 07—Support for Z80
(1240N08) +$540
(1241N08) +$600
Option 08—Support for 6502
(1240N08) +$540
(1241N08) +$600
Option 09—Support for NSC800
(1240N08) +$540
(1241N08) +$600

16-BIT

1240N16 16-Bit Microprocessor Analysis System $12,600
Includes: 1240 Logic Analyzer with three 1240D2 Option 1D modules without probes, P6460 probe, 12RS02 RAM Pack
1241N16 16-Bit Microprocessor Analysis System $9,950
Includes: Same as above except the 1241 Logic Analyzer

OPTIONS

Options 01 thru 09—Microprocessor Specific Support (Includes: 12RMXX Microprocessor Disassembly ROM Pack, 12RMXX Option 02 or Option 04 Personality Module).
Option 01—Support for 8086 +$2,500
Option 02—Support for 8088 +$2,500
Option 03—Support for 80186 +$2,500
Option 04—Support for 80188 +$2,500
Option 05—Support for 68000 (DIP) +$2,500
Option 06—Support for 68000 (PGA) +$2,500
Option 07—Support for 68008 +$2,500
Option 08—Support for 68010 (DIP) +$2,500
Option 09—Support for 68010 (PGA) +$2,500

GENERAL PURPOSE

1240NGP General-Purpose Analysis System $14,110
Includes: 1240 Logic Analyzer with 1240D1 module with P6460 probe; two 1240D2 modules with four P6460 probes; 12RS02 RAM Pack.
1241NGP General-Purpose Analysis System $12,900
Includes: Same as above except the 1241 Logic Analyzer.

BUS ANALYSIS

1240NBA Bus Analysis System $18,560
Includes: 1240 Logic Analyzer with four 1240D2 modules with eight P6460 probes, 12RS02 RAM Pack.
1241NBA Bus Analysis System $17,350
Includes: Same as above except the 1241 Logic Analyzer.

HIGH-SPEED ANALYSIS

1240NHS High-Speed Analysis System $16,800
Includes: 1240 Logic Analyzer with four 1240D1 modules with four P6460 probes, 12RS02 RAM Pack.
1241NHS High-Speed Analysis System $18,300
Includes: Same as above except the 1241 Logic Analyzer.

1240NMM

Manufacturing Rackmount System, includes: 1240 Logic Analyzer (rackmounted) with one 1240D1 Module with no P6460 probes, one 1200C02 GPIB COMM Pack. Option 01 adds one P6460 probe. $8,300

SERVICE ACCESSORIES

12RD01—Diagnostic ROM Pack $1,500
Diagnostic Lead Ser—Order 012-0556-00 $65
Extender Card—Order 670-7539-02 $465
Service Manual—Order 062-7124-02 $150
Service Maintenance Kit—Includes the above service accessories. Order 067-1103-03 $2,020

CART

K212—Portable Instrument Cart. See Cart section. $350

OPTIONAL ACCESSORIES ACQUISITION CARDS

1240D1—9-Channel Data Acquisition Card, 100 MHz, includes one P6460 Data Acquisition Probe. $2,950
Option 1D—Deletes one P6460 Data Acquisition Probe. −$700
1240D2—18-Channel Data Acquisition Card, 50 MHz, includes two P6460 Data Acquisition Probes. $3,700
Option 1D—Deletes two P6460 Data Acquisition Probes. −$1,400
Option 2S—Substitutes two P6462 Data Acquisition Probes for two P6460 Data Acquisition Probes. −$720

DATA ACQUISITION PROBES

P6460—9-Channel Data Acquisition Probe. $700
P6462—9-Channel Data Acquisition Probe, fixed threshold TTL. $340

COMMUNICATION INTERFACES (COMM PACKS)

1200C01—RS-232 COMM PACK $750
1200C02—GPIB COMM PACK $850
1200C11—Parallel Printer COMM Pack $500

Note: To order cables for these COMM Packs, see the Logic Analyzer Accessories Section.

ROM PACKS

Analysis
12R01—Performance Analysis ROM Pack. $800
Communication Functions
12RC01—Printer Support ROM Pack $300
12RC02—Master/Slave ROM Pack. $500
Option 01—Modem. +$600
Microprocessor Mnemonic Disassembly
12RMXX—See Microprocessor Support for ordering information.
Storage
12RS02—64K RAM Pack $500
12RS11—32K EPROM Pack (Empty) $85
12RS12—32K EPROM Pack $300

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

NEW 1230 Logic Analyzer

GPIB IEEE-488

The 1230 complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

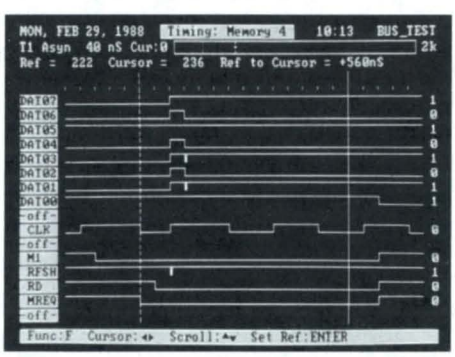
- **Modular, 16 to 64 Channels**
- **Supports 8- and 16-bit uP Disassembly**
- **100 MHz Asynchronous Sampling**
- **25 MHz Synchronous Sampling**
- **Four Nonvolatile 2K-deep Memories**
- **Memory Comparison, Single or Repetitive**
- **Glitch Triggering and Capture**
- **Optional Onscreen Help Notes in Foreign Languages**
- **Optional Battery-powered Configuration**
- **RS-232, GPIB, and Parallel Printer Options**

The 1230 Logic Analyzer is a modular, general-purpose logic analyzer that supports hardware, microprocessor, and system integration applications. The 1230 mainframe provides 16 to 64 channels at 25 MHz, 8 to 72 channels at 50 MHz (asynchronous), or 4 to 16 channels at 100 MHz (asynchronous).

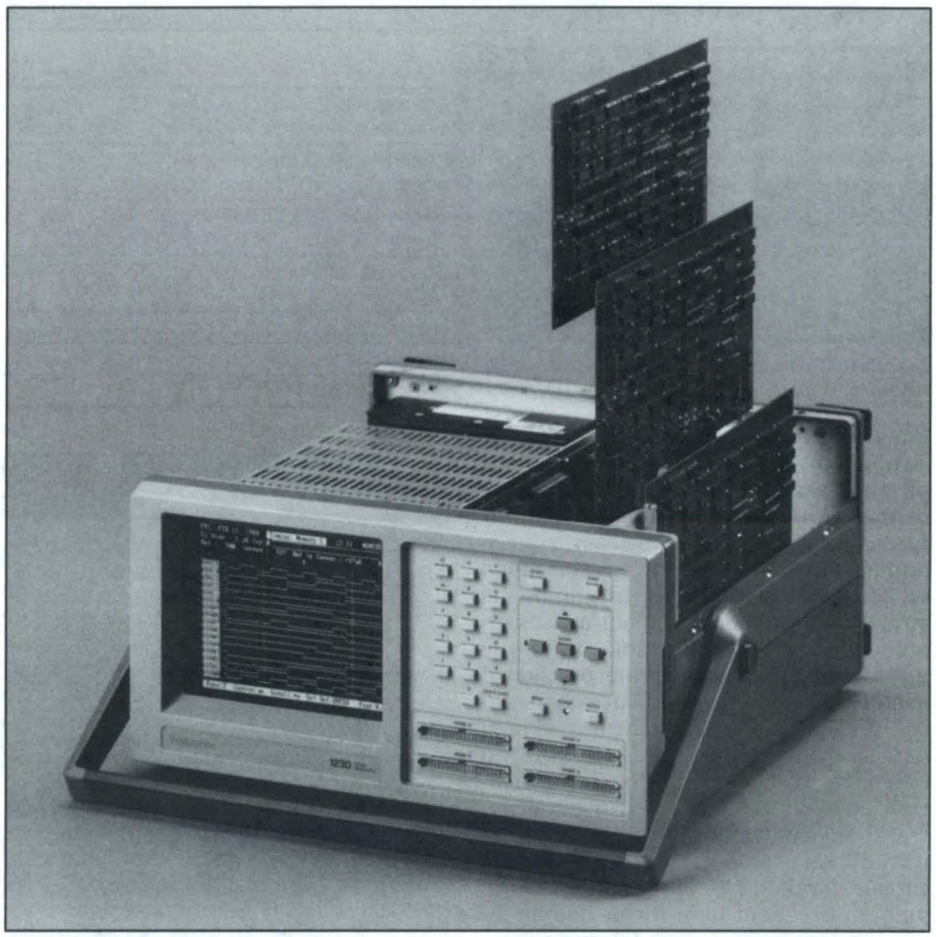
Modular

As the costs for purchasing digital test equipment have risen, users have pursued ways to extend the capabilities of the instruments they purchase. Modularity allows the user to meet current instrumentation needs, while being flexible enough to expand for future requirements. Modularity also allows a single instrument to fit a wide variety of applications ranging from education to engineering or manufacturing environments. The 1230 Logic Analyzer satisfies these requirements by offering a highly-configurable logic analysis mainframe at an affordable price.

The basic 1230 Logic Analyzer is a portable, self-contained unit offering a base of 16 data acquisition channels. Up to three 1230E1 16-channel expander cards



Intensified areas indicate captured glitches.

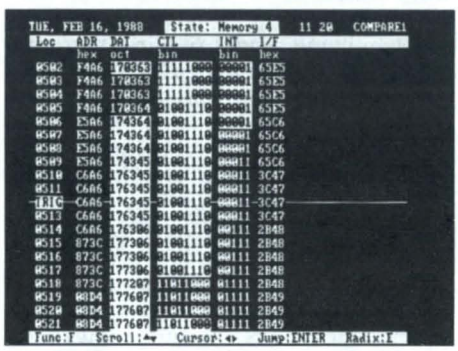


1230 Logic Analyzer

can be added to the 1230 to increase the number of channels to 32, 48, or 64. (Refer to the 1230 Configuration Chart on the following page.) The user can install 1230E1 expander cards in minutes so that the system can be quickly reconfigured without returning the logic analyzer to a service center.

Deep Memory

As system architectures have become increasingly complex, locating problems has become a more difficult challenge. A very useful tool for the design engineer, technician, or student attempting to locate the problem is a deep acquisition memory. With four 2K-bit memories behind every acquisition channel, the 1230 Logic Analyzer allows the user to capture many samples of acquisition or reference memory data. Comparisons can be made between memories to locate irregularities between expected and actual data. The 1230 lets the user make comparisons based on a single or repetitive acquisitions. The auto-compare mode makes repeated acquisitions without manually restarting the logic analyzer. This is a particularly valuable



State Table Display — Highlighted areas indicate memory comparison differences.

feature when attempting to isolate random or intermittent system malfunctions.

Microprocessor Support

The 1230 supports a growing list of popular 8- and 16-bit microprocessors: (See Ordering Information for microprocessor support.) Disassembled microprocessor instructions may be displayed in either hardware or software disassembly display modes to save time in analyzing the acquired data.

```
TUE, FEB 16, 1988  Disasm Memory 1   10:24   -DEFAULT
 Loc   Addr   Data  68000 Disassembly      Md Cycle  Stat
 1071  0F1FC2 1028 ?MOVE.B @010(A0),D0     S  OPC FT
 1072  0F1FB0 1210  MOVE.B (A0),D1         S  OPC FT
 1073  0F1FB2 0201  ANDI.B #10,D1          S  OPC FT
 1074  FFFF03 --C5                        S  vRD.L
 1075  0F1FB4 0010                        S  RD.E
 1076  0F1FB6 6600  BNE    0F1E88         S  OPC FT
 1077  0F1FB8 FED0                        S  RD.E
-1078--0F1FBA-1210--MOVE.B (A0),D1--------S--OPC FT-------
 1079  0F1FBC 0201  ANDI.B #02,D1          S  OPC FT
 1080  FFFF03 --C5                        S  vRD.L  IRQ=3
 1081  0F1FBE 0002                        S  RD.E   IRQ=3
 1082  0F1FC0 67EE  BEQ    0F1FB0         S  OPC FT IRQ=3
 1083  0F1FC2 1028 ?MOVE.B @010(A0),D0     S  OPC FT IRQ=3
 1084  0F1FB0 1210  MOVE.B (A0),D1         S  OPC FT IRQ=3
 1085  0F1FB2 0201  ANDI.B #10,D1          S  OPC FT
 1086  FFFF03 --C5                        S  vRD.L
 1087  0F1FB4 0010                        S  RD.E
 1088  0F1FB6 6600  BNE    0F1E88         S  OPC FT
 1089  0F1FB8 FED0                        S  RD.E
 1090  0F1FBA 1210  MOVE.B (A0),D1         S  OPC FT
Func: F  Scroll: ↑↓   Cursor: ←→   Jump: ENTER
```

Disassembly display for 68000 μP is available with optional probe.

Ease of Use

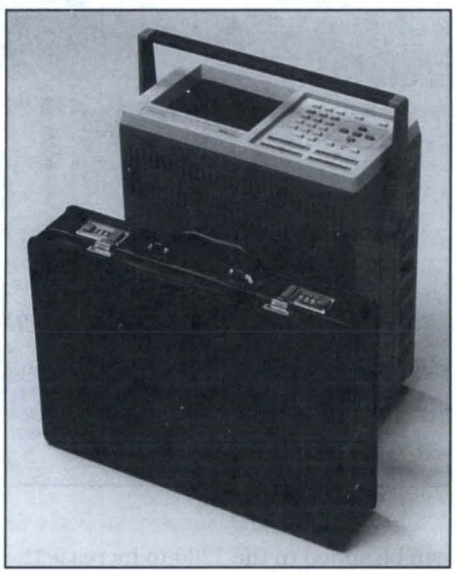
To allow the engineer or student to focus on the task at hand instead of being distracted by a cumbersome user interface, an instrument must be easy to learn and easy to use. The 1230 was designed with these key factors in mind. Its straightforward pop-up menus are selectable with a single keystroke from the main menu. Prompts at the bottom of each menu guide the user through menu-specific operations. A system of on-screen notes available in several foreign languages provides additional clarification when needed. Self-instruction workbooks, a training test card, and an introductory videotape round out the support for the 1230. These materials provide an excellent base for development of a logic analysis educational curriculum.

Triggering

Defining the events that surround the problem being sought requires versatile, powerful triggering capabilities. From observing basic hardware phenomena to tracking sophisticated software routines, the logic analyzer must be able to identify precise triggering conditions. The 1230 Logic Analyzer provides two triggering modes, Basic and Advanced, that span these requirements. Basic mode provides the most commonly used instruction format with IF. . .THEN statements. Advanced mode expands on these triggering capabilities with IF. . .THEN. . .ELSE statements that are useful for creating two-way branches and for qualifying data storage. With a single keystroke, the user can select the most suitable mode for his application.

1230 CONFIGURATION CHART

	1230	1230 with 1 1230E1	1230 with 2 1230E1s	1230 with 3 1230E1s
Channels at 25 MHz sync, async	16	32	48	64
Channels at 50 MHz async	8	16	24	32
Channels at 100 MHz async	4	8	12	16
Channels with glitch capture	8	16	24	32
Nonvolatile memories	4	4	4	4
Nonvolatile setups	8	8	8	8
Memory depth/channel	2048	2048	2048	2048



The 1230 is compact and portable; an optional bag makes transportation of accessories convenient.

System Level Debug

Integration of hardware and software often requires simultaneous monitoring of data from several different parts of the system. The 1230 has four independent timebases allowing the user to gather both synchronous and asynchronous data within the same acquisition. With four timebases, data can be correctly clocked for that particular section of circuitry. For example, with a 64-channel configuration, you can synchronously monitor a 16-bit microprocessor while simultaneously observing other signals with an asynchronous timebase.

Portable, Rugged, Quiet

The 1230's lightweight and rugged design makes it very practical for onsite service needs, or situations where several engineers must share one instrument. Its compact size allows it to fit easily into any workspace. Since it has no fan, the user can concentrate undisturbed. A battery-powered version of the 1230 Logic Analyzer (1230B) lets you perform servicing at remote sites without the need for a conventional power source.

PHYSICAL CHARACTERISTICS

	1230		1230B	
Dimensions	**mm**	**(in)**	**mm**	**(in)**
Width*	376	(14.8)	376	(14.8)
Height*	190	(7.5)	190	(7.5)
Depth*	489	(19.3)	552	(21.7)
**Handle folded back*				
Weight ≈	**kg**	**(lb)**	**kg**	**(lb)**
Net	86	(19)	12.2	(29)

ORDERING INFORMATION

1230 Logic Analyzer $2,795
Includes: P6444 16-Channel probe, with lead sets and grabber tips; Operator's Manual; Quick Reference Guides (3); Training videotape (VHS format); Training workbooks (2); Training test circuit; Power Cord.

1230B Logic Analyzer*3
Includes: same contents as 1230 Logic Analyzer.

1230E1 16-channel expander card, includes one P6444 probe. $1,200

OPTIONS*1

Option 1S—Substitute P6443 probe for P6444. −$200
Option 01—RS-232 interface. +$495
Option 02—Parallel printer port. +$195
Option 03—GPIB interface. +$595
Option 04—International notes. +$195
Option 05—Rackmount hardware. +$400
Option 06—Accessory bag. +$65
Option 07—GPIB acquisition leadset. +$195
Option 08—A6740G serial probe. +$1,500
Option 21—1230 service manual. +$200
Option 22—1230 service maintenance kit. +$1,500

INTERNATIONAL POWER PLUG OPTIONS

Option A1—230V/6A 50 Hz Universal Euro
Option A2—230V/6A 50 Hz U.K.
Option A3—230V/6A 50 Hz Australian
Option A4—230V/6A 60 Hz North American
Option A5—230V/6A 50 Hz Swiss

PROBES*1

P6444 16-channel, programmable-threshold (+1-9V) active probe. $700
P6443 16-channel, fixed TTL/CMOS threshold active probe. $500

FIELD-INSTALLED OPTIONS*1

1230F01 Field-installable RS-232 interface. $495
1230F02 Field-installable parallel printer port. $195
1230F03 Field-installable GPIB interface. $595
1230F04 Field-installable international notes. $195
1230F05 Field-installable rackmount hardware. $400

MICROPROCESSOR SUPPORT

1230DPA Disassembly Probe Adapter, required for certain disassembly probes. $400
DP68KD*2 68000/010 (DIP) Disassembly Probe. $1,200
DP68KP*2 68000/010 (PGA) Disassembly Probe. $1,200
DP8086D*2 8086/8087/8088 (DIP) Disassembly Probe. $1,500
DP8031D 8031/8087 (DIP) Disassembly Probe.*3
DPHC11*2 68HC11 (DIP) Disassembly Probe.*3
PM402 Z80 Disassembly Probe. $800
PM403 6502/C02/C802 Disassembly Probe. $800
PM404 8085 Disassembly Probe. $800
PM405 STD Bus Analysis Probe. $800
PM406 6809/6809E Disassembly Probe. $800
PM407 6800/6802 Disassembly Probe. $800

CONFIGURED SYSTEMS

1230C32 32-channel system with parallel printer port. $4,175
1230B32 Same system with battery power option.*3
Both include: 1230 with Opt 02, 1 1230E1 expander card.

1230C48 48-channel system with parallel printer port. $5,375
1230B48 Same system with battery power option.*3
Both include: 1230 with Opt 02, 2 1230E1 expander cards.

1230C64 64-channel system with parallel printer port. $6,575
1230B64 Same system with battery power option.*3
Includes: 1230 with Opt 02, 3 1230E1 expander cards.

CONFIGURED SYSTEM OPTIONS

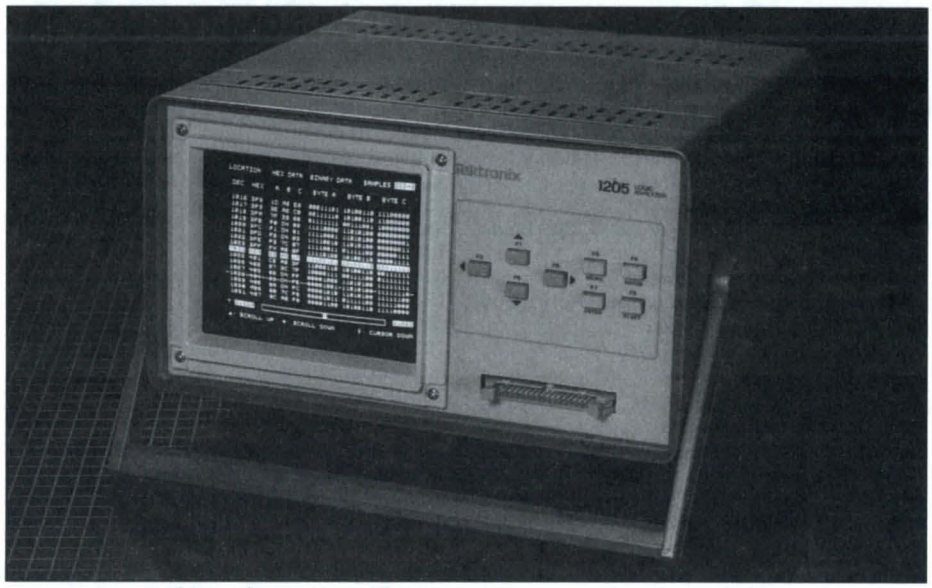
Same as 1230 and 1230B Options except no Option 02.

*1 *Applies to 1230 and 1230B.*
*2 *Requires 1230PDA.*
*3 *Contact your local sales office.*

1205 Logic Analyzer

- **Affordable**
- **Easy-to-read Display**
- **Easy to Learn and Use**
- **Ideal for Education Applications**
- **Timing up to 100 MHz**
- **Captures Glitches**
- **Supports μP Disassembly**
- **Video Output Port**

The 1205 Logic Analyzer provides the lowest cost solution for your basic logic analysis needs. An easy-to-learn menu interface, onscreen instructional notes, and large display make it the ideal choice for first-time logic analyzer users in education environments. The 1205 supports hardware, software, and some microprocessor analysis. Its full-featured support and versatility exposes students to various aspects of digital technology. A single probe connector accepts probes specific to the logic analysis application. Each probe reconfigures the menu interface to display only the appropriate selections, allowing the student to grasp concepts and avoid confusion.



1205 Logic Analyzer

State Analysis

For analyzing software execution, the P6440 24-channel state probe provides the connection for 24 data channels and three external clocks (or qualifiers). Each input can be selected for positive- or negative-going edges. The maximum clock repetition rate is 9 MHz, while the minimum clock pulse width is 5 ns.

Timing Analysis

The large, clear display of the 1205 helps the user easily explore acquired data when analyzing hardware interactions. The P6441 provides 8 data channels, one external clock input, and one external trigger input. Using 8 channels, data can be sampled up to 25 MHz. If a greater sampling rate is desired, width can be traded for speed by selecting four channels at 50 MHz or two channels at 100 MHz. Glitches can be captured using up to four channels.

Microprocessor Analysis

The 1205 accepts dedicated personality modules for two of the most popular microprocessors: the Z80 and the 6502. Whenever a personality module is attached, a display of the disassembled data is available. Proper logic analyzer clocking is handled automatically; no user interaction is required. There is also a user-configurable interface probe which acquires 40 channels of data with advanced triggering capabilities.

Deep Memory

With ample memory depth per channel, the 1205 stores many locations of the target data. For timing displays, depth per channel is 6144 locations in most cases, 12288 at 50 MHz, and 24576 at 100 MHz. For state displays, depth per channel is 2048 locations. For disassembly displays, depth per channel is 1024 locations.

ORDERING INFORMATION

1205 Logic Analyzer **$1,845**
Includes: P6440 State Probe (24 channels); P6441 Timing Probe (8 channels); Demo Test Circuit; Black flying lead set (174-0752-00); White flying lead set (174-0764-00); Red flying lead set (174-0763-00); 24 Grabber tips; Power cord, Operator manual.

OPTION

Option 1D—Deletes standard P6440 and P6441 probes. **– $600**
Option 10—Deletes demo test circuit. **– $50**

PROBES

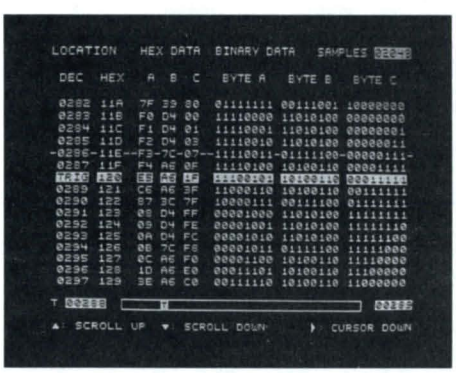
P6440 24-channel State Probe **$300**
P6441 8-channel Timing Probe **$300**

PERSONALITY MODULES

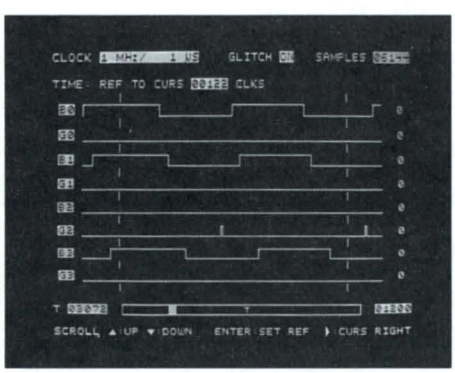
PM301 40-channel General Purpose **$700**
PM302 Z80 Microprocessor **$700**
PM303 6502 Microprocessor **$700**

INTERNATIONAL POWER PLUG OPTIONS

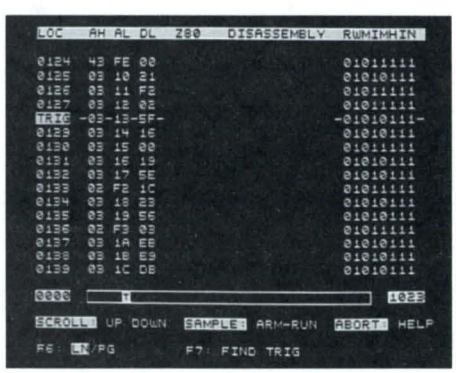
Option A1—Universal Euro 220 V, 50 Hz
Option A2—UK 240 V, 50 Hz
Option A3—Australian 240 V, 60 Hz
Option A4—North American 240 V, 50 Hz
Option A5—Switzerland 220 V, 50 Hz



1205 State Display showing data in Binary and HEX.



Timing Display Showing Glitches on Trace G2



1205 Z80 Disassembly Display

ACQUISITION PROBES

P6440 State Probe—24 Channels of Data Acquisition, 3 Clocks/Qualifiers, External Trigger. For use with 1205 Logic Analyzer. Order P6440 **$300**

P6441 Timing Probe—8 Channels of Data Acquisition, 1 External Clock, 1 External Trigger. For use with 1205 Logic Analyzer. Order P6441 **$300**

P6443 TTL-Threshold Probe—16 Channels of Data Acquisition, 4 Clocks, 2 Qualifiers, 2 External Trigger Inputs. For use with 1230 Logic Analyzers. Order P6443 **$500**

P6444 Programmable-Threshold Probe—16 channels of Data Acquisition, 2 Clocks, 1 Qualifier, 1 External Trigger Input. For use with 1230 Logic Analyzers. Order P6444 **$700**

P6452 8-Channel Data Acquisition Probe—For use with DAS 9100 mainframes, DAS 91A32/91A08. Order P6452 **$730**

P6453 4-Channel Data Acquisition Probe—High-speed probe for DAS 91A04A/91AE04A. Order P6453 **$1,560**

P6460 8/9-Channel Data Acquisition Probe—For use with 1240D1, 1240D2, DAS 91A24/91AE24. Order P6460 **$700**

P6462 8/9-Channel TTL Only Data Acquisition Probe—For use with 1240D2, DAS 91A24/91AE24/91A32. Order P6462 **$340**

P6461/P6461E 8-Channel Data Acquisition Probe—For use with DAS 92A16/92A16E (P6461E has no clock or Qualifier Channels).
Order P6461 or **$1,570**
P6461E **$1,370**

PATTERN GENERATOR PROBES

P6455 TTL/MOS Pattern Generator Probe 8-Channels—For use with DAS 91P16/91P32. Order P6455 **$575**

P6456 ECL Pattern Generator Probe 8-Channels—For use with DAS 91P16/91P32 modules. Order P6456 **$575**

P6457 TTL/MOS Pattern Generator Probe, 4-Channels, Individually Tri-Stateable—For use with DAS 91P16/91P32. Order P6457 **$575**

P6463 TTL/CMOS Pattern Generator Probe—9-Channels at 50 MHz or 16-Channels at 25 MHz. For use with 91S32/92S32. Order P6463 **$1,000**

P6464 50-MHz Pattern Generator Probe—For use with DAS 91S16/92S32. Order P6464 **$1,350**

P6465 50-MHz Pattern Generator Probe—8 Data Channels, 1 clock and 1 Rz/Rl strobe for use with DAS 92S16/92S32. Order P6465 **$1,680**

OTHER PROBES

P6454 100-MHz Clock Probe—For use with DAS 91A08 (max of one P6454 per DAS system). Order P6454 **$265**

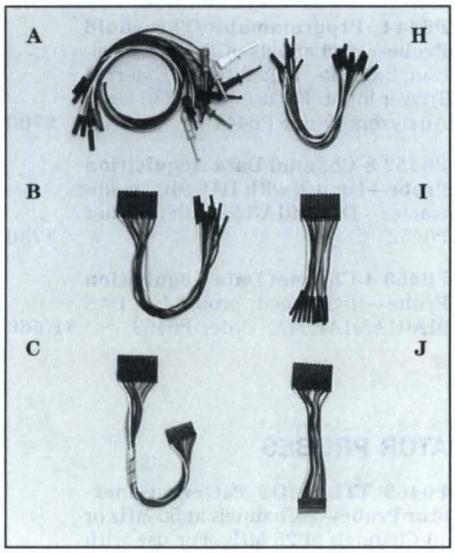
P6041 Passive Probe—Used as Sync out cable, 50 Ω Termination. Order P6041 **$70**

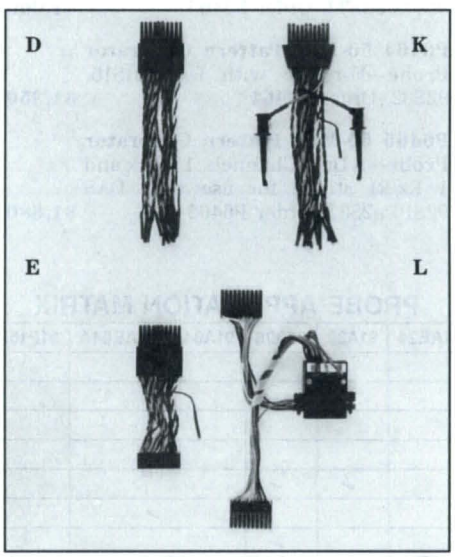
Controlled-Width Probelet—Use with DAS 91S16/91S32 to create programmable pulses. Requires two P6464 channels to create one programmable channel. Order 020-1392-00 **$150**

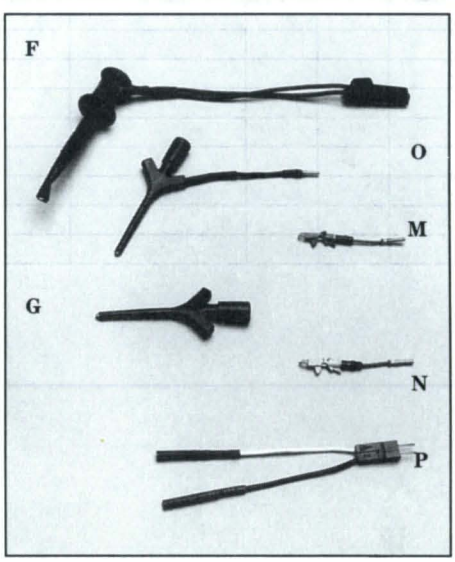
PROBE APPLICATION MATRIX

PRODUCT	92A16, 92A16E	92S16, 92S32	91A24, 91AE24	91A32	91A08	91A04A, 91AE04A	91P16, 91P32	91S16, 91S32	1240D1	1240D2	1205	1230
P6440											✓	
P6441											✓	
P6443												✓
P6444												✓
P6452				✓	✓							
P6453						✓						
P6454					✓							
P6455							✓					
P6456							✓					
P6457							✓					
P6460	✓		✓						✓	✓		
P6461/E	✓											
P6462			✓	✓						✓		
P6463		✓						✓				
P6464		✓						✓				
P6465		✓										

LEAD SETS







A. Individual Hook-Tip Lead Set—10 leads, 16 inch, color coded with E-Z-Micro Hook Tips. Order 012-0670-00 **$90**

B. Flying Lead Set—10-wide comb, 10 inch, color coded, connects to 0.025-inch square pins, grabber tips not included. Order 012-0747-00 **$40**

C. Harmonica Lead Set—10-wide comb to 10-position single-row connector, for 0.025-inch square pins on 0.1-inch centers, 10 inch, color coded. Order 012-0800-00 **$36**

D. Pattern Generator Lead Set—10 + 2-wide comb, 9 inch, twisted pairs, color coded, connects to 0.025-inch square pins, grabber tips not included. Used with P6455, P6456, P6457 pattern-generator probes. Order 012-0926-00*2

E. High-Speed Pattern Generator Lead Set—10 + 2 wide comb to 20-position double-row connector, for 0.025-inch square pins on 0.15-inch centers, 5 inch, color coded. Used with P6455, P6456, P6457 pattern generator probes. Order 012-0551-00 **$130**

F. Sense Leads—Package of ten, 2-wide comb to Pomona Hook Tip, 5 inch, black for ground or VL. Order 012-0989-01 **$125**

G. Grabber Tip—Package of 12, for general-purpose probing with various lead sets.
(Single-sided grabber tips)
Order 020-1386-00 **$41**
(Double-sided grabber tips)
Order 020-1456-00 **$90**

*1 **Flying Lead Set**—10 inch, 10 channel, color coded. For use with the P6440 and P6441 Data Acquisition Probes.

Lead Set with Black Ends—Order 174-0752-00 **$30**

Lead Set with Red Ends—Order 174-0763-00 **$30**

Lead Set with White Ends—Order 174-0764-00 **$30**

*1 **Flying Lead Set**—10 inch, 10 channel, color coded. For use with the P6443 and P6444 Data Acquisition Probes.

Lead Set with Black Ends—Order 174-1264-00 **$30**

Lead Set with Red Ends—Order 174-1265-00 **$30**

Lead Set with White Ends—Order 174-1266-00 **$30**

*1 *Not shown.*
*2 *Contact your local sales office for information.*

H. Individual Lead Set—10 leads, 8 inch, color coded, connects to 0.025-inch square pins, grabber tips not included. Order 012-0655-02 **$190**

*1 **Individual Lead Set**—10 leads, 16 inch, color coded, connects to 0.025-inch square pins, grabber tips not included. Order 012-0655-01 **$175**

I. Flying Lead Set—10-wide comb, 5 inch, color coded, connects to 0.025-inch square pins, grabber tips not included. Order 012-0987-00 **$46**

J. Harmonica Lead Set—10-wide comb to 10-position single-row connector, for 0.025-inch square pins on 0.1-inch centers, 5 inch, color coded. Order 012-0968-00 **$105**

K. Pattern Generator Lead Set—10 + 6-wide comb with VH and VL Pomona Hook Tips, 9 inch, twisted pairs, color coded, connects to 0.025-inch square pins, grabber tips not included. Used with P6455, P6456, P6457 pattern generator probes. Order 012-1053-00 **$135**

L. GPIB Adapter—Two 10-wide combs to IEEE Standard 488 Bus Connector, 10 inch. Order 103-0209-00 **$235**

M. High-Speed Grippers—Package of ten, 1.75 inch, for flat packages with 0.05-inch lead spacing, use with P6453 or P6454.
Order 195-1943-06 **$150**

N. High-Speed Grippers—Package of ten, 1.75 inch, for Dip packages with 0.1-inch lead spacing, use with P6453 or P6454.
Order 195-2234-06 **$150**

O. High-Speed Clock Lead—With grabber tip, package of two, for use with P6453 or P6454.
Order 195-3659-02 **$16.50**

P. Lead Set—For use with Podlets. Acquisition probes P6461/E and HS8. Order 196-3047-00*2
Pattern generator probes P6464/P6465. Order 196-2963-00 **$9.75**

*1 **Pattern Generator Flying Lead Set**—10 inch, 17 twisted pair leads, color coded. For use with the P6463 Pattern Generator Probe. Order 012-1236-00 **$39**

CABLES

RS-232 Cable—Male-to-female, 20 inch, wires: 1-1, 2-2, 3-3, 4-4, 5-5, 6-6, 7-7, 8-8, 11-11, 12-12, 15-15, 17-17, 19-19, 20-20, 22-22. Used with 1200C01 modem interface DAS 9200 mainframe to terminal or DAS 9100 line printer and communications interface. Order 012-0911-00 **$100**

RS-232 Cable—Male-to-female, 2 meter, 25 wires: 1-1, 2-2, 3-3, thru 25-25. General purpose. Order 012-0815-00 **$85**

Null Modem Cable—Female-to-female, 60 inch, wires: 1-1, 2-3, 3-2, 4-5, 5-4, 7-7, 8-20, 11-11, 12-12, 19-19, 20-8. General purpose. Order 012-0820-00 **$405**

Null Modem Cable—Female-to-female, 60 inch, wires: 1-1, 2-3, 3-2, 4-8, 5-8, 6-20, 7-7, 8-4, 8-5, 20-6. Used with 1200C01 Serial Printer interface. Order 012-0530-00 **$90**

Parallel Interface Cable—Two meter, for Centronix-type printer interface. Order 012-0997-00 **$80**

GPIB Cable—Two meter. Order 012-0630-01 **$105**

75 Ω Coaxial Cable—BNC to BNC, 42 inch, used with video hard copy interface. Order 012-0074-00 **$19.75**

75 Ω Coaxial Cable—BNC to BNC, 120 inch, used with video hard copy interface. Order 175-2753-00 **$28**

Sync Out Cable—Miniature Phone Plug to BNC, 79 inch, for 91A24 sync output. Order 175-8165-00 **$38**

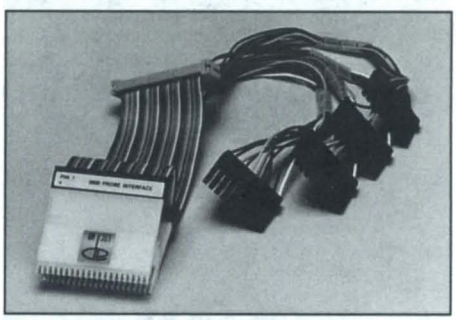
91AE04A Coaxial Jumper Cables Replacements—3 inch , SMA connectors to connect 91A04A to 91AE04A. Order 175-6425-00 **$18.50**

91AE24 Jumper Cable Replacements—Package of seven, twisted pair, 2-position connectors, 3 inch. Order 175-8167-00 **$4.80**

Probe Extender Cable—Male to Female 34-position double-row connectors compatible with P6452, P6463, P6455, P6456, P6462, 6 feet. Order 012-1012-01 **$125**

Flat Cable Mounts—Adhesive Back for securing and organizing probes with flat ribbon cables. Order 343-1048-00 **$.95**

IC CLIPS & ADAPTERS/CONNECTORS



A. UPIK 40, Universal Probe Interface Kit—For 40-pin dip packages. Allows user to configure interconnect from 6 probes or less to a clothespin style 40-pin IC clip. Order UPIK 40 **$175**

40-Pin Male Adapter—40-position double row header with 0.025-inch square pins on 0.1-inch centers, interfaces the PM 101 or flying lead sets to low-profile dip clip above. Order 380-0560-05 **$16.50**

40-Pin Dip Socket Female Adapter—40-position double-row head with 0.025-inch square pins on 0.1-inch centers to 40-pin dip socket, for interfacing 40-pin low-profile dip clips to PM 100 series probes. Order 380-0647-01 **$40**

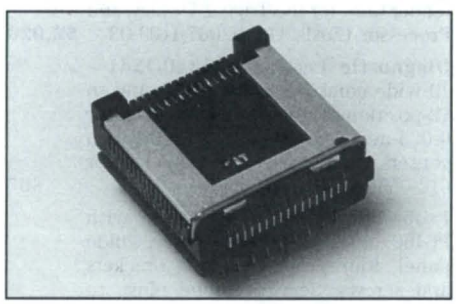
IC Clip—16-pin dip, clothespin style. Order 003-0709-00 **$15.50**

IC Clip—24-pin dip, clothespin style. Order 003-0823-00 **$34**

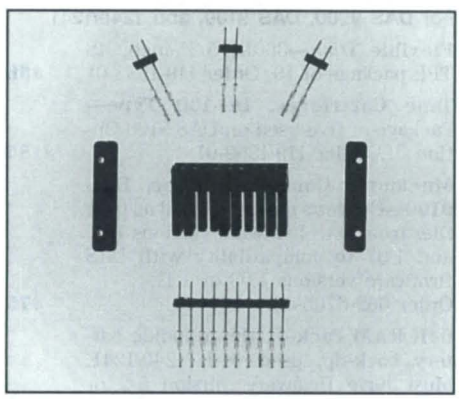
IC Clip—40-pin dip, clothespin style. Order 003-0801-00 **$50**

Low Profile Dip Clip—40-pin dip to 40-position double row connector, for 0.025-inch square pins on 0.1-inch centers, 4 inch (requires male adapter below). Order 015-0339-02 **$49**

Low-Profile Dip Clip—40 pin, same as above except 12 inch. Order 015-0339-00 **$49**



B. LCC (Leadless Chip Carrier) to PGA (Pin Grid Array) Adapter—68-pin package, for adapting 80286 (LCC) packages to 80286 (PGA) package. Order 015-0494-00. **$36**



C. Circuit Board Mounted Probe Connector Kit—10+6-wide comb to 0.025-inch square pins on 0.15-inch centers, with mounting tabs, for PC mounting, mounting hole dimensions 0.80 inch wide X0.95 inch long. Interfaces to the following probes: P6452, P6455, P6456, P6457, P6460, and P6462. Seven piece kit. Order 020-1027-00 **$36**

DAS 9200

Cable Clamp—RS-232 Cable Grounding Clamp. Used for EMI shielding. Order 334-0399-00*1

Circuit Board Ejector Tools—For removal of circuit boards from the DAS 9200 Mainframe (2 required). Order 105-0985-00 **$2.50**

Deskew Adapter—For use with the DAS 92A60/90, to deskew the channel groups. Order 010-0456-00 **$150**

Training Aid Board—For use with DAS 9200, connects acquisition probe leadset to pattern generation leadset*1

General Purpose Leadset—For use with the DAS 92A60/90, flying leads can be connected to 0.025 square pins or optional grabber tips. Order 012-1165-00 **$450**

Podlet Gang Connector—For use with P6461/P6461E, 10 wide, pkg of 2, NOT for use with P6464 or P6465. Order 020-1442-00 **$35**

Retainer Clamps—Kit of 4. (P6461E) Order 020-1483-00 (P6460/P6464/P6465, DAS 9200. Order 020-1484-00 **$35**

MEDIA

For DAS 9200, DAS 9100, and 1240/1241.

Flexible Disk—360K, 5.25-inch, 48 TPI, package of 10. Order 119-1583-01 **$36**

Tape Cartridges, DC-100 Type—Package of five used on DAS 9100 Option 01. Order 119-1350-01 **$185**

Mnemonic Conversion Tape, DAS 9100—Converts mnemonic and all type files from DAS firmware versions 1.05 and 1.07 to compatibility with DAS firmware versions 1.09 or 1.11. Order 062-6705-00 **$75**

64K RAM Pack—Lithium iodide battery back-up, used with 1240/1241. Must have firmware version 5-2 or higher. Order 12RS02 **$500**

32K EPROM Pack—Used with 1240/1241. EPROMSs not included. Order 12RS11 **$85**

32K EPROM Pack—Used with 1240/1241, four 68764 or 68766 EROMs included. Order 12RS12 **$300**

DAS 9100

Service Maintenance Kit—Includes board and cable extenders for DAS modules, power supplies, CRT, and keyboard. Order 067-0980-01 **$1,375**

Set-Up and Hold-Time Test Fixture—Order 067-1037-00 **$1,285**

High-Speed Acquisition Test Fixture—For verification of DAS 91A04, DAS 91AE04, DAS 91A04A, and DAS 91AE04A modules. Order 067-1139-00 **$280**

*1 *Contact your local sales office for information.*

Circuit Board Ejector Tool—For removing DAS 9100 module cards. Order 214-3154-00 **$5.75**

High-Speed Lead Connectors—Package of ten, gold-plated contact pins that interface to podlet lead receptacles on P6453 or P6454. Order 131-2729-02 **$30**

Diagnostic Lead Set—10-wide comb to 10-wide comb, and two-wide ground jumper, 10-inch, for connecting pattern generator probes to data acquisition probes. Order 012-1000-00 **$80**

RACKS AND RACKMOUNT KITS

Rackmount Kit—For DAS 9100. Order 016-0463-00 **$220**

Rackmount Kit—For DAS 9200. Order 016-0845-00 **$450**

Rackmount Kit—For 1240/41. Order 016-0789-00 **$430**

Rackmount Kit—For 9XHS8. Order 016-0884-00 **$300**

Rackmount Kit—For 1230. Order 1230F05 **$400**

Rack—Instrumentation Rack with 115 or 220-V power controller. For use with all rackmountable Logic Analyzers. For 115 V. Order 437-0241-00*1 For 220 V. Order 437-0244-00*1

Panels—Blank Panels for Instrument Rack.
1¾ inch. Order 333-1351-00 **$18.50**
3½ inch. Order 333-0997-00 **$27**
5¼ inch. Order 333-0999-00 **$15.25**
7 inch. Order 333-1352-00 **$21**
8¾ inch. Order 333-0998-00 **$16.50**
10½ inch. Order 333-0996-00 **$17**

1240/1241

Service Maintenance Kit—Includes 1240 Service Manual with 1241 Service Addendum, 12RD01 Diagnostic ROM Pack, Diagnostic Lead Sets, Extender Card for Acquisition Cards, and Extender Card for the Trigger, Display, and Processor Cards. Order 067-1103-03 **$2,020**

Diagnostic Lead Set, 1240/1241—10-wide comb with 2-wide ground to 12-position double-row connector, for 0.025-inch square pins on 0.1-inch centers, 10 inch, color coded. Order 012-0556-00 **$65**

Probe Retainer Kit—(For use with P6460 only) Includes a probe guide panel, four probe retaining brackets and screws. Secures probe plugs to probe guide panel on the side of 1240/1241. Order 020-1678-00 **$50**

1230/1205

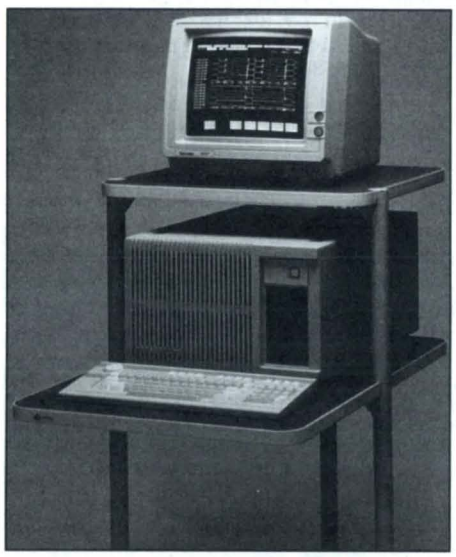
Demo/Test Circuit—For use with 1205 and 1230. A convenient tool to aid in gaining experience and confidence with the use of a logic analyzer. Can also be used to do a simple demonstration of the uses of a logic analyzer. Order 671-0049-00 **$50**

Service Maintenance Kit—Includes 1230 Service Manual, Extender Card for 1230E1 module, and cable assemblies. Order 020-1674-00 **$1,500**

CARTS

92Cart—AnthroCart for DAS 9200. Order 92Cart **$355**

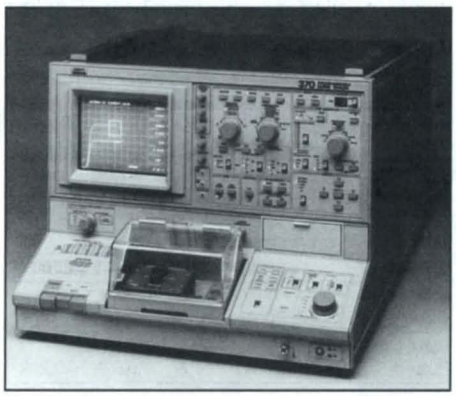
K217 Cart—See Cart section for complete description. For DAS 9100, 1240/1241, and 1230. Order K217 **$510**



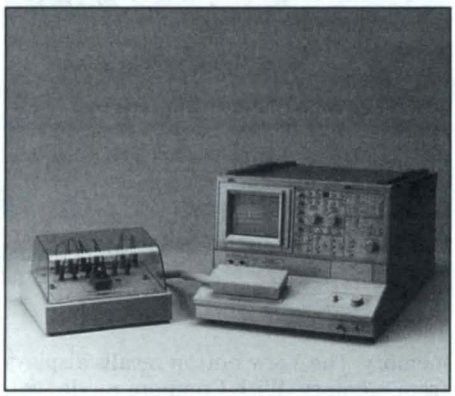
OTHER ACCESSORY

Accessory Pouch—Convenient for carrying manual and other accessories. Order 016-0707-00 **$70**

CURVE TRACERS



370 Programmable Curve Tracer



371 High Power Curve Tracer

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Programmable Curve-Tracer Systems **359**
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Failure Analysis System **364**
577/177 Curve-Tracer System **366**
178 Linear-IC Test Fixture **367**
Socket Adapters **368**

Tektronix Curve Tracer Systems deliver comprehensive information for accurate design, analysis, and evaluation for a multitude of semiconductor devices and integrated circuits. These dynamic parametric testers quickly measure and display the characteristics curves of a wide variety of two, three, and four terminal devices including diodes, transistors, thyristors, and optoisolators, and the full range of linear ICs including operational amplifiers, comparators, differential amplifiers, and voltage regulators.

The 370 Programmable Curve Tracer delivers comprehensive information on a range of semiconductor devices and integrated circuits—from two-, three-, and four-terminal devices such as diodes (signal, rectifier, zener); transitors (bipolar, FET); thyristors (SCR, UJT, Triac) to optoelectronic (optoisolator, photodetector), and ICs.

The 371 Programmable High-Power Curve Tracer gives fast, repeatable design and troubleshooting data on a wide variety of semiconductor devices. In particular, the 371 is optimized for testing high-power devices and for making relatively high-power tests on more conventional devices, such as bipolar transistors, and FETs. The 371 is ideal for testing solid-state switches and control devices in applications like switching regulators and motor controls. Pulsed power supplies allow testing devices at peak power limits without overheating or damaging the device under test.

Like other curve tracers, the 370 and 371 reveal more than pinpointed parameters. They 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.

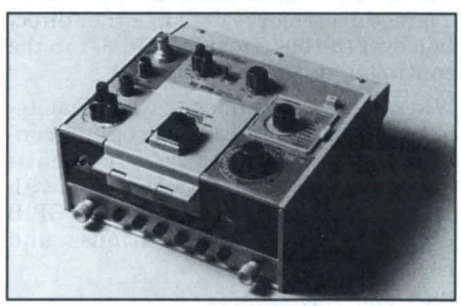
In addition, the 370 and 371 offer all the benefits of programmable instrumentation, from curve storage to precise repetition of test parameters and data; from automatic test sequencing to various comparisons of device behavior at different points in time—all with the added capability of computerized control and analysis.

The S370FA IC Failure Analysis System (FAS) isolates failures on packaged ICs. The FAS speeds the detection and classification of IC inter-pin failures by measuring and characterizing the voltage/current relationships between each pin and designated reference pins.

The S370WP Wafer Probing System provides automatic solutions for wafer fab processing. It includes device test software for accurate, automatic testing of wafer test keys—greatly reducing wafer test time.

577/177 Curve Tracer

The 577 Curve Tracer uses plug-in test fixtures for a variety of low- or high-current applications. The 177 Standard Test Fixture is for general-purpose application. The 178 Linear-IC Test Fixture is designed for testing op-amps, comparators, differential amps, and voltage regulators.



178 Linear-IC Test Fixture

The following Curve-Tracer System descriptions will help you choose the system that best meets your requirements. Additional information is available. Contact your local Tektronix Sales Engineer.

370/371

Programmable Curve Tracers

GPIB IEEE-488

The 370 and 371 comply with IEEE Standard 488.1-1987, and with Tektronix *Standard Codes and Formats.*

TYPICAL APPLICATIONS

- **Automated Semiconductor Test**
- **Manufacturing Processes**
- **Incoming Inspection**
- **Production Device Testing**
- **Semiconductor R&D**
- **High-Power Semiconductor Evaluation (371)**

FEATURES

- **Digitized Waveforms**
- **Bubble-Memory Storage**
  - **Store 16 Test Set-Ups**
  - **Store 16 Families of Curves**
- **GPIB and Plotter Interfaces**
- **Test Sequencing Without Controller**
- **Waveform Comparisons**
- **Display/Waveform Cursors**
- **Displays 24 Text Characters**
- **On-Screen Readout of Control Settings/Cursor Values**
- **3 kV Test Voltage (2 kV for 370)**
- **Vertical Sensitivity 100 pA/Div (1 pA Resolution) (370)**
- **3 kW Collector Power-Supply Capability (371)**
- **20-A or 50-V Base Drive (371)**

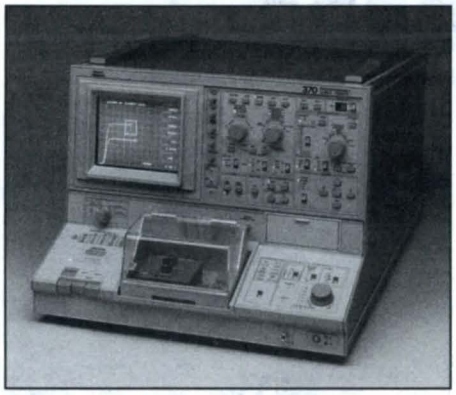
Program Control

The 370/371 are programmable via the IEEE Standard 488 General Purpose Interface Bus (GPIB). This interface provides remote control and automated acquisition of curve data. You can send characteristic-curve data in either direction over the bus (from the 370/371 to the controller, or vice versa).

When using a controller, you can remotely control the front panel except for controls intended for local use only (such as Intensity). The GPIB complies with Tektronix' Interface Standard for GPIB Codes, Formats, Conventions, and Features.

Digitized Waveforms

Display modes are selected by pushbuttons labeled Nonstore, Store, Compare, View, and Enter. When you select Nonstore, the 370/371 operate like conventional curve tracers. When you choose Store, the 370/371 display digitized characteristic curves with a bright, flicker-free trace. The Enter button lets you put the digitized display into bubble memory. The View button recalls displays from memory. With Compare mode, you contrast characteristic curves by displaying Store and View curves simultaneously.



370 Programmable Curve Tracer

Bubble Memory

The 370/371 provide nonvolatile memory via a bubble-memory cassette plugged into a front-panel opening. Each cassette can store 16 families of curves and 16 front-panel set-ups. This storage technology is virtually impervious to the dust and grime that impair other storage-media performance, making the 370/371 ideal for harsh environments like factory floors and incoming-inspection areas.

Front-Panel Set-Up

The 370/371 can store 16 sets of front-panel-control settings and recall them later. Pressing the Save button saves all current front-panel settings in bubble memory. Pressing Recall restores the front-panel settings that were previously saved.

With stored set-ups, you can easily cycle through a series of tests—either semi-automatically, by pressing front-panel controls to begin each test, or automatically, under program control.

Test Sequencing

You can sequence through as many as 16 device tests from the front panel without using a controller.

Performance Conditions

The following electrical and environmental characteristics are valid for instruments operated at ambient temperatures from +10 to +40 °C after an initial warm-up period of 20 minutes, when previously calibrated at a temperature from +15 to +25 °C.

See page 364 for 371 characteristics.

370 CHARACTERISTICS

COLLECTOR SUPPLY

Polarity/Modes—Select from these seven modes of collector-supply operation: AC at line frequency; + (positive full-wave rectified); – (negative full-wave rectified); +DC (positive dc); –DC (negative dc); +Leakage (positive dc, emitter current); –Leakage (negative dc, emitter current).

Maximum Peak Voltage and Voltage Accuracy—Peak open-circuit voltage on all ranges within +10%, –0%, at Max Peak Power of 50 W.

Range	16 V	80 V	400 V	2000 V
Max Peak Current	10 A	2 A	0.4 A	0.05 A
Peak Current Pulsed	20 A	4 A	0.8 A	0.2 A
Min Series*1 Resistance (Ω)	0.26	6.4	160	20K
Max Series*1 Resistance (Ω)	800	20K	500K	12.5M

*1 *Series resistance: available from 0.26 Ω to 12.5 MΩ (±5% or ±0.1 Ω).*

Peak Power—0.08, 0.4, 2, 10, 50, and 220 W.

Variable Collector Supply—0 to 100% in 0.1% increments.

Safety Interlocks—A protective cover must be in place over test terminal and lid shut before you can apply collector voltage.

Step-Generator Display—Range is 1 or 10 steps/div, or 1 step/10 div. Unmagnified and magnified accuracy are within 3%.

Display Offset—Vertical offset of display centerline value up to 10 div in 21 half-div steps.

STEP GENERATOR

Current Mode—Amplitude Range: 50 nA to 200 mA in 1-2-5 sequence in 21 steps, selected by Step/Offset Ampl. Max current is 20X step amplitude, except for 2 A when switch is set to 200 mA. Max voltage is at least 10 V. Max opposing offset current is 10X step amplitude. Max opposing volts are less than 7 V. Ripple plus noise is less than 0.5%X step amplitude +1 nA.

Voltage Mode—Amplitude Switch Range: 50 mV to 2 V, in 1-2-5 sequence. Max Voltage: 20X step amplitude. Max Current: At least 2 A at 10 V or less, or 10 mA at 40 V.

Accuracy (Current or Voltage Steps Including Offset)—Incremental 2%. Absolute is less than 2%X total output +3%X amplitude setting.

Offset Control—Variable from –10 to +10X step amplitude, with 0.1% resolution.

Short-Circuit Current Limiting—Selected by current-limit switch: 20 mA, 100 mA, 500 mA, 2 A (+50%, –20%).

Maximum Opposing Offset Volts—10X step amplitude.

Maximum Opposing Current—Less than 10 mA.

Step Rates—2X line frequency (1X line frequency in ac collector supply). Steps occur at 0 collector voltage.

Pulsed Steps—80 or 300 μs wide ±10%.

Steps and Offset Polarity—Same as collector-supply polarity when step-generator polarity invert is disabled. Opposite to collector-supply polarity when step-generator polarity invert is selected or configuration switch is set to base grounded. If configuration is set to base grounded, step-generator polarity invert is disabled.

Number of Steps—Selectable from 0 to 10.

Auxiliary Supply—Range: −40 to +40 V with 20-mV resolution. Accuracy: Less than 50 mV +2% of total output. Output Current: At least 100 mA ±20 V; at least 10 mA ±40 V.

Nonstore Mode—Collector Current: Range is 1 μA to 2 A/div in a 1-2-5 sequence of 20 steps. X10 Mag extends max sensitivity to 100 nA/div (1 nA resolution). Both unmagnified and magnified accuracy are within 3%. Emitter Current: Range is 1 nA to 2 mA/div in 1-2-5 sequence of 20 steps. X10 Mag extends max sensitivity to 100 pA/div. Both unmagnified and magnified accuracy are within 3%.

Digital-Storage Vertical Acquisition—A/D Converter: Resolution is 10 bits for 10.24 divisions, 100 counts per division. Maximum data points are 1024. Maximum sampling rate is line frequency X1024. Minimum sampling rate is line frequency X2. Collector Current: Range is 1 μA to 2 A/div in a 1-2-5 sequence of 20 steps. X10 mag extends max sensitivity to 100 nA/div (1-nA resolution). Unmagnified accuracy is within 1.5% of readout +0.03 div of setting with dot cursor. Magnified accuracy is within 0.5% of readout +0.03 div of setting with dot cursor. Emitter Current: Range is 1 nA to 2 mA/div in a 1-2-5 sequence of 20 steps. X10 mag extends max sensitivity to 100 pA/div (1-pA resolution). Unmagnified accuracy is within 1.5% of readout +0.03 div of setting +1 nA with dot cursor. Magnified accuracy is within 0.5% of readout +0.03 div of setting with dot cursor.

Nonstore Horizontal-Deflection System—Collector Volts: Range is 50 mV to 500 V/div in a 1-2-5 sequence of 21 steps. X10 mag extends max sensitivity to 5 mV/div (50-μV resolution). Unmagnified and magnified accuracy are within 3%. Base/Emitter Volts: Range is 50 mV to 2 V/div in a 1-2-5 sequence of 6 steps. X10 mag extends max sensitivity to 5 mV/div (50-μV resolution). Unmagnified accuracy are within 3%. Step Generator Display: Range is 1 or 10 steps/div, or 1 step/10 div. Unmagnified and magnified accuracy are within 3%. Display Offset: Horizontal offset of display centerline value up to 10 div in 21 half-div steps.

Digital-Storage Horizontal Acquisition—A/D Converter Acquisition: Resolution is 10 bits for 10.24 div, 100 counts per div. Sampling rate is 2 to 1024X line frequency. Collector Volts: Range is 50 mV to 500 V/div in a 1-2-5 sequence of 21 steps. X10 mag extends max sensitivity to 5 mV/div (50-μV resolution). Unmagnified accuracy is within 1.5% of readout +0.03 div of setting with dot cursor. Magnified accuracy is within 0.5% of readout +0.03 div of setting with dot cursor. Base/Emitter Volts: Range is 50 mV to 2 V/div in a 1-2-5 sequence of 6 steps. X10 mag extends max sensitivity to 5 mV/div(50-μV resolution). Unmagnified accuracy is within 1.5% of readout +0.03 div of setting with dot cursor. Magnified accuracy is within 0.5% of readout +0.03 div of setting with dot cursor. Acquisition Modes (Normal, Envelope, and Average): Envelope is vertical or horizontal. Average is moving average with weight of $^1/_4$ or $^1/_{32}$.

DIGITAL STORAGE SYSTEM

Resolution—100 points/div or 1024 points maximum, horizontally and vertically.
Sample Rate—0.125X line frequency to 1024X line frequency.

CRT

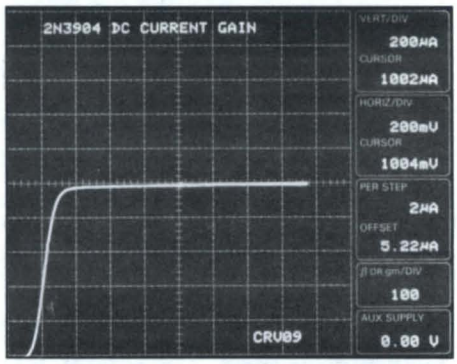
CRT—7-in. diagonal (173 mm), electrostatic deflection, GH (P31) phosphor.
Readout—Automatic on-screen display. Overrange is shown by a flashing display. 100 pA to 2 A/vertical div; 5 mV to 500 V/horizontal div; 5 nA to 200 mA and 5 mV to 2 V per step.
BETA or g_m/Division—500 nano to 400 mega for Beta and 50 nS to 400 S for g_m. Cursor is 4-digit horizontal and vertical values without X10 mag, 5-digit with mag. Offset is 4-digit value. Auxiliary supply is −40 to +40 V.
Text Display—Text characters are alphanumeric fonts 1, accessible via GPIB; SP,!, . . . A,B, . . . 0,1,9,/, . . . a,b, . . . y,z, . . . ; u is recognized as micro. Or: Alphanumeric fonts 2, accessible via front panel; A,B, . . . , Y,Z,(space), m,u,n,p,,,0,1, . . . 9,-,/,*,(,); u is recognized as micro.
Maximum Text Characters—24 letters.
Character Size—Approximately 3 mm high, 2 mm wide.

POWER REQUIREMENTS

Line-Voltage Ranges—115 or 230 V ac. High: 107 to 132 V ac, 214 to 250 V ac. Low: 90 to 110 V ac, 180 to 220 V ac.
Line-Frequency Range—48.0 to 66.0 Hz.
Power Consumption—Maximum: 400 W, 3.5 A at 132 V, 60 Hz. Typical: 120 W, 1.3 A at 115 V, 50 Hz.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	429	16.9
Height	332	13.1
Depth	637	25.1
Weight ≈	**kg**	**lb**
Net, standard	35.0	77.0
Net, with Option 1R, Rackmount	36.0	79.2



Dot Cursor Mode—Position an intensified dot cursor to any point on the waveform and read out the vertical and horizontal coordinates. The dot cursor is also useful when sending data over the GPIB.

ORDERING INFORMATION

370 Programmable Curve Tracer **$17,900**
Includes: Blank adapter, Kelvin Sense (A1001); In-line transistor adapter, Kelvin Sense (A1002); Axial lead diode, Kelvin Sense (A1005); 4 and 6 lead dual width transistor/FET (A1007); bubble memory cassette (020-1310-00); protective cover (337-3344-00); spare fuses 125 V/4 amp (159-0259-00); slow blow 250V/2 amp (159-0260-00); power cord (161-0066-00); Operator's manual (070-6064-00); Instrument Interfacing Guide (070-6067-00); Pocket Reference Guide (070-6066-00).

OPTIONS

Option 1P—HC100 plotter. **+$900**
Option 1R— Rackmount **+$450**
Option 25—PEP301 System Controller.*1
Option 26—Utility Software.*1
Option 27—Device Test Software.*1

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

*1 *Contact your local sales office.*

370 OPTIONAL ACCESSORIES

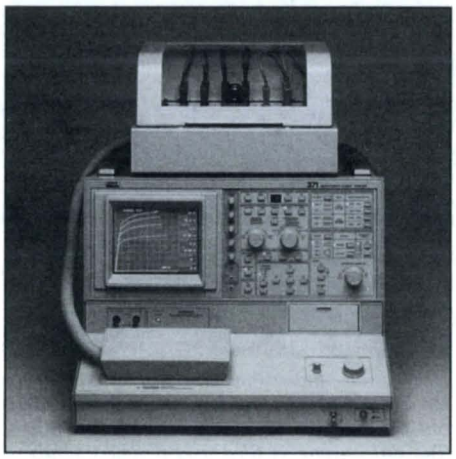
Service Manual—Order 070-6065-01 **$55**
Calibration Fixture—370 Maintenance. Order 067-1286-00 **$405**
Socket Adapters—See Curve-Tracer Socket Adapters in this section.
370 Rackmount Kit—016-0930-00 **$415**

CAMERAS

C-59A, C-5C, C-7 and Camera Mounting Adaptors—See Instrumentation Documentation Devices, page 501.

CART

Cart—K217. See Cart section. **$510**



371 High-Power Programmable Curve Tracer

371 CHARACTERISTICS

COLLECTOR SUPPLY

Modes/Polarity—High-Current: +pulses, – pulses. High Voltage: + rectified sine wave, – rectified sine wave.

Maximum Peak Voltage and Voltage Accuracy

Peak Power Range (W)	3 k*1	300*1	30*2	3*2
Collector Current Available (A)	400	40	40 m	4 m
Maximum Peak Collector Voltage (V)	30	30	3 k	3 k
Accuracy (%)	+10, −5	+10, −5	+10, −0	+10, −0

*1 *Pulsed collector supply.*
*2 *Sine-wave collector supply.*

Pulsed Collector Supply—250 μsec ±10% pulse width; 0.25X line-frequency repetition rate.

STEP GENERATOR

Current Mode—Normal step, 1 μA to 2 mA in 1-2-5 sequence with Peak Power at 30 or 3 W. Pulsed Step, 1 mA to 2 A in 1-2-5 sequence with Peak Power at 3 kW or 300 W. Maximum current is 10X step amplitude ±2%. Maximum voltage is 12 V ±20%.
Voltage Mode—200 mV to 5 V in 1-2-5 sequence. Maximum current is 100 mA. Maximum voltage is 10X Step Amplitude.
Step Rate—0.25X line frequency at 3 kW and 300 W. 1.0X line frequency at 30 and 3W.
Pulsed Current Steps—Pulse width, 500 μsec ±10%; rise and fall times, ≤40 μsec.

VERTICAL DISPLAY SYSTEM

Collector Current—Range, 500 mA to 50 A/div in 1-2-5 sequence at 3 kW and 300 W or 10 μA/div in 1-2-5 sequence at 30 and 3 W. Accuracy, ±0.1 div. Cursor accuracy, ±2% of readout +0.2 div in Nonstore mode and ±1.5% of readout +0.1 div in Store mode.

HORIZONTAL DISPLAY SYSTEM

Collector Supply—500 mV to 5 V/div in 1-2-5 sequence at 3 kW and 300 W or 50 to 500 V/div in 1-2-5 sequence at 30 and 3 W.
Step Generator—100 mV to 5 V/div in 1-2-5 sequence.
Accuracy—±0.1 div.
Cursor Accuracy—Within 2% of readout +0.2 div in Nonstore mode or 1.5% of readout +0.1 div in Store Mode.

DIGITAL STORAGE SYSTEM

Resolution—100 points/div or 1024 points maximum, horizontally and vertically.
Sample Rate—0.125X line frequency to 1024X line frequency.

CRT AND READOUT

CRT—7-in. diagonal, electrostatic display, P31 phosphor. 1000×1000 total addressable pixels.
Readout—Automatic on-screen display of scale factors and Beta or g_m/div. 24 characters of text can be displayed and updated via GPIB to annotate test.

INTERFACES

GPIB—IEEE Standard 488.1-1987 implemented as: SH1, AH1, L4, SR1, RL1, PP0, DC1, DT0, and L0.
Plotter—8-bit parallel (Centronix) supporting HPGL-compatible plotters.

TEST FIXTURING

The Test Fixture Unit is a standard accessory that provides a safety enclosure for the device under test (DUT). It prevents the operator from contacting dangerous voltages while the DUT is being tested. The Test Fixture Unit accommodates devices as large as 8×5×4.75 inches (203×127×120 mm), and connects to the main unit via a cable/plug assembly. Kelvin sensing adapters A1001 through A1005 (see page xxx) plug into the Test Fixture Unit.

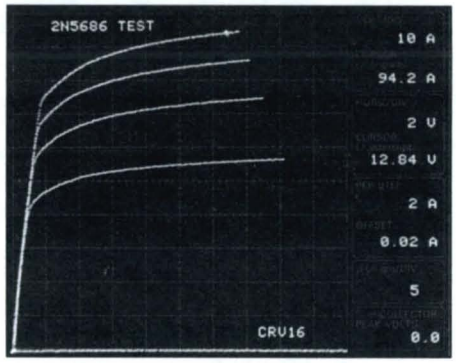
Users wishing to construct their own fixturing should order the optional Field Wiring Cable (cable/plug assembly without test fixture enclosure).

POWER REQUIREMENTS

Line-Voltage Ranges—90 to 132 V ac or 180 to 250 V ac.
Line-Frequency Range—48 to 63 Hz.
Maximum Power—400 W, 2 A.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	332	13.1
Width	429	16.9
Depth	637	25.1
Weight ≈	**kg**	**lb**
Standard	36	79.4



Bipolar-transistor family of curves created using the 371's sweep mode.

ORDERING INFORMATION

371 High-Power Curve Tracer. **$20,600**
Includes: Power cord (161-0066-00); bubble-memory cassette (020-1310-00); test fixture unit; in-line transistor adapter, Kelvin Sense (A1002); To-3/To-66 adapter, Kelvin Sense (A1003); operator's manual (070-6839-00); Pocket Reference Guide (070-6841-00).

OPTION

Option 1P—HC100 Plotter. **+$900**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
OPtion A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

OPTIONAL ACCESSORIES

Service Manual—070-6840-00. **$55**
GPIB Cable—012-0991-00. **$160**
Field Wiring Cable—198-5628-00. **$370**
Calibration Fixture—067-1345-00. **$2,890**
Service Maintenance Cable—174-1001-00. **$65**
Service Maintenance Kit—067-1286-00. **$405**
371 Rackmount Kit—016-0930-00. **$415**

Note: EMC and U.L. specifications are not applicable to rackmounted 371.

CAMERAS

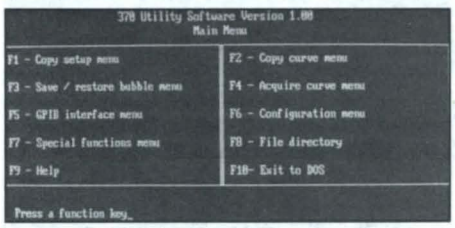
C-59A, C-5C, C-7, and **Camera Mounting Adapters**—See Instrumentation Documentation Devices section, page 501.

CART

K217—See Cart section. **$510**

370 UTILITY SOFTWARE

- **Archives Curves, Front-Panel Settings, and Bubble Memory Contents to Disk**
- **Displays and Plots Acquired Curves**
- **Generates Test Programs Without Programming Skills**
- **Hard-Copy Dump of Numerical Test Results**
- **Example Test Programs Included**
- **Basic Source Code Available**



The 370 Utility Software links the 370 Curve Tracer to the IBM PC. Its menus provide easy-to-use access to features that simplify curve-tracer operations. Users can easily create customized device tests using their own test algorithms.

The 370-to-PC link offers unlimited mass storage for device test setups and displays. A complete test-setup library can be stored on disk. Curves can be stored on disk as well as displayed on the PC monitor or graphed to an HP-GL compatible plotter.

A powerful feature of the utility software is its built-in test-program generator. Programming skills are not needed to create automatic device-test programs. Numerical test results can be displayed on the PC, sent to a printer for hardcopy, and recorded in a log file. Example programs are included that can easily be modified to test a broad range of device types. Writing and debugging test programs is easy with the use of an optional ASCII text editor.

HARDWARE

Required Hardware

IBM PC/XT/AT; DOS 2.0 or higher with 640K memory; dual floppy drive or 1 floppy and 1 hard disk; IBM color graphics card or EGA adapter (or compatible); National Instruments PC2 or PC2a GPIB card; GPIB cable.

ORDERING INFORMATION

370 Utility Software

Order S48P104 Option 01 **$695**

Includes: Software on 5¼ DS/DD disks and Manual.

370 DEVICE TESTING SOFTWARE

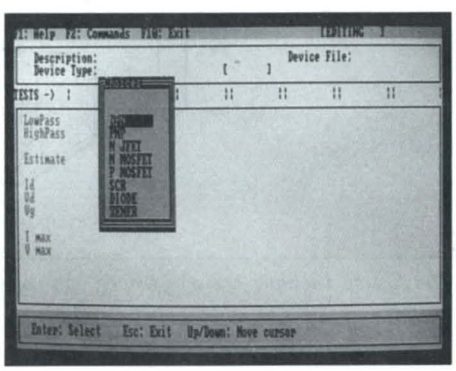
- **Automatic Measurement of BJT, FET, Diode, and MOSFET Characteristics**
- **Built-in Test Algorithms Eliminate the Need for Programming**
- **Minimizes Hands-On Curve-Tracer Operation**
- **Hard Copy Of Test Results**

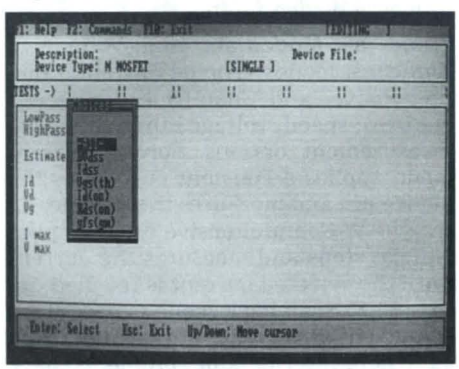
The 370 Device Testing Software automates semiconductor testing. Test algorithms are built into the software, so there is no need to write test programs. Also, curve tracer knowledge is not necessary to begin device testing; the controller takes over the task of operating the 370. Running a complete device test is as simple as entering the device type; test results are only seconds away.

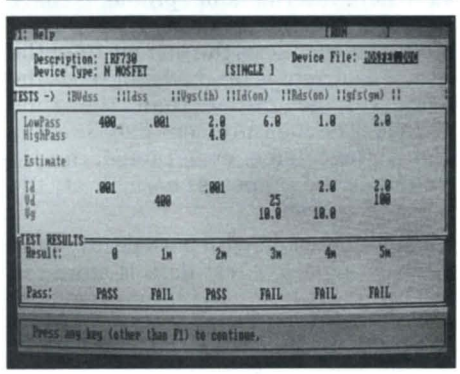
Pop-up windows prompt the user to select from a list of common device types such as bipolars, FETs, diodes, etc. Once a device type is specified, a number of common dc tests can be selected. Conditions and limits for each test are input using a spreadsheet format. Test files can be stored indefinitely on disk and reloaded simply and quickly. Once a test file is called, parameters like gain, breakdown voltage, and leakage are measured automatically.

By reducing setup and test time, the device-testing software offers significant labor savings in incoming inspection. Test-setup time is minimized because 370 front-panel setup and operation is not required. Shorter setup times make it practical to completely test one device before going on to the next. This eliminates the need for parallel testing and extra device handling.

Because the tests are automatic, the time per test is also reduced. Except for device insertion, virtually all other operator intervention is eliminated. Automatic and repeatable measurements provide high-quality device testing at a low cost per test.







ORDERING INFORMATION

370 Device Testing Software—

Order S48P401 Option 01. **$1,750**

Includes: Software on 5¼ DS/DD disks and Manual.

SYSTEMS

The new 370 software makes systems solutions possible for IC manufacturing process control areas.

Automatic GPIB Wafer Probing—Use the Device Testing Software with a GPIB Wafer Prober for automatic performance verification of IC test keys.

Failure Analysis on Multi-Pin Packages—Use the 370 and a TSI 8150 to automatically scan all pins of a packaged IC and determine which pins have faulty circuitry attached.

For information on Tektronix programmable measurement instruments or systems contact your local Tektronix Sales Representative.

NEW S370FA

IC Failure Analysis System

- **Automatic Pin-to-Pin Leakage Measurement**
- **Matrix Switching up to ± 80 V**
- **Multiplexing for up to 189 Pins**
- **Menu-driven Test Generation**
- **Resident Data Base For Statistical Analysis**
- **Statistical Measurement Limits**

IC failure analysis labs examine ICs that have failed in final test, life test, or in the field. Each pin of the defective device is tested to detect abnormal electrical characteristics. This is a tedious job that can take hours of hand testing. The S370FA system can reduce this test time to minutes.

Software Saves Setup Time

System software controls the 370 measurement modes as well as the switching matrix for proper IC pin scanning and measurement. Tests are easily set up using menus displayed on the screen of the PEP 301 System Controller.

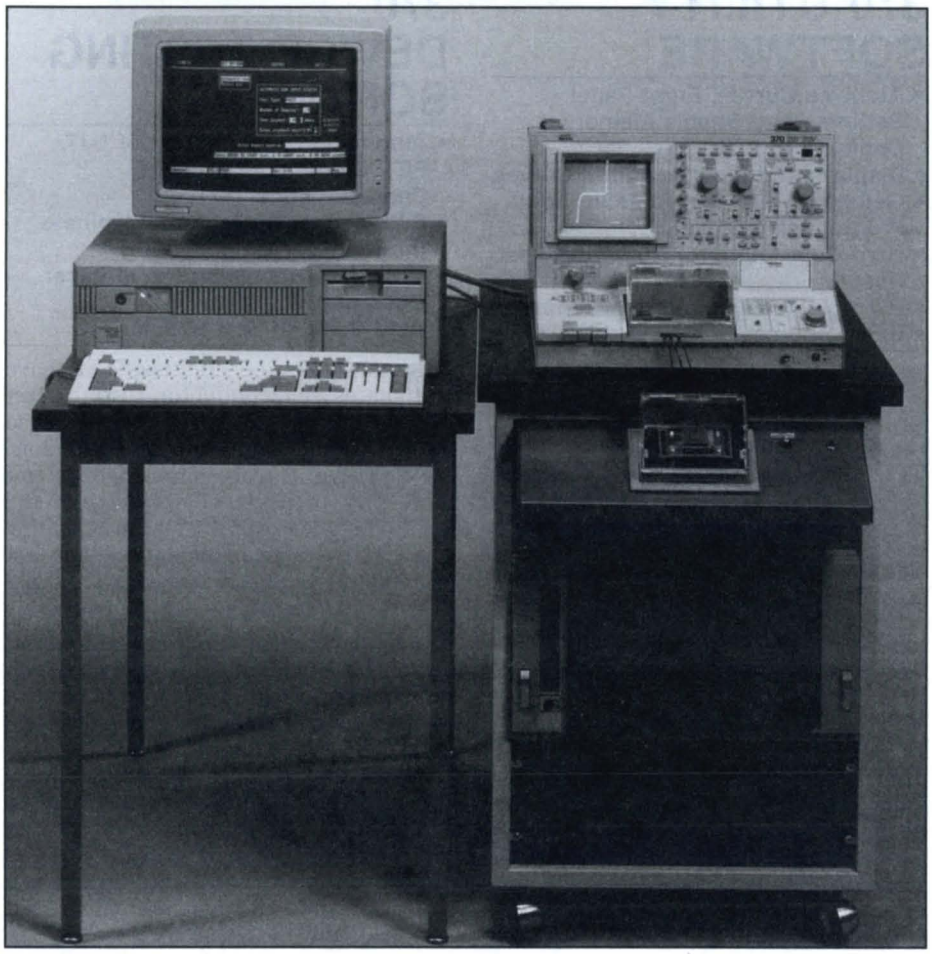
Time Savings Using Automated Testing

Manual pin-to-pin measurement is replaced by automatic measurement. Measurement data can be logged at approximately one second per pin. Rapid device testing frees the failure analyst to spend more time on determining the cause and prevention of failure. Less skilled personnel can operate the system to locate device faults.

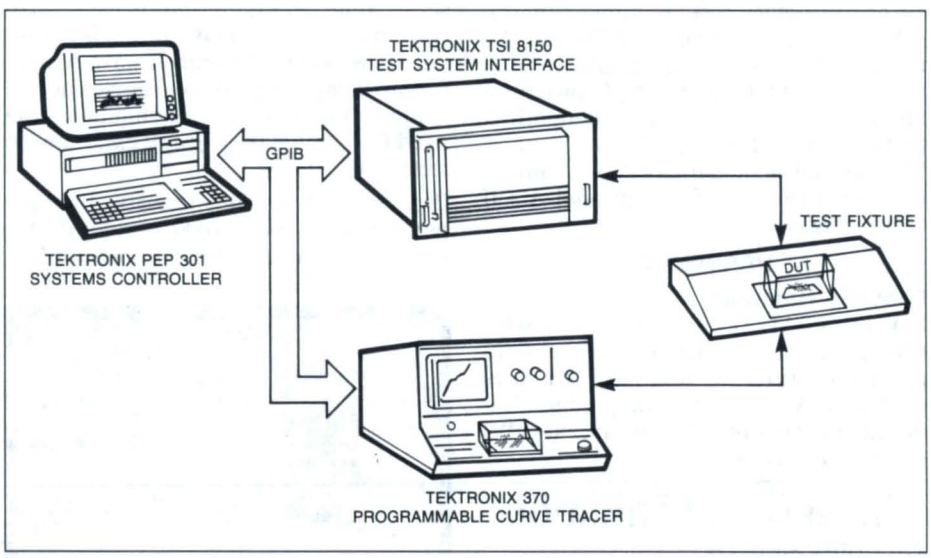
Three Test Modes and High Voltage

Three test modes—Forced Current, Comprehensive, and Snap-back—provide a choice of speed, voltage range, and peak measurement options. Forced Current mode applies a constant current to the device pin and measures the voltage, up to ±10 V. Comprehensive mode applies voltage steps and measures the current until the selected current is reached, up to ±80 V. Snap-back mode is used if intermittent devices are anticipated, such as when intermetallic problems have caused an open circuit. The Snap-back mode also increases the voltage until the selected current is reached, but reads the peak voltage rather than the final voltage. The measurement data shows a high voltage defect even though the pin characteristic appears normal at the selected current.

All pins are tested with both positive and negative polarity. Test data is stored in test files.



S370FA IC Failure Analysis System



The system includes a curve tracer, controller, and a switching matrix.

Part: 155-8328-00 SUB
Number of pins: 24
Number of samples: 7
Measurements in volts

Run date: 06/07/88
Test Type: Comprehensive
Current: 10 u Amps
* reject data

Pin	Sample1	Sample2	Sample3	Sample4	Sample5	Sample6	Sample7
1	1.220	> 80.000*	1.215	1.205*	1.210	1.215	> 80.000*
2	> 80.000	> 80.000	> 80.000	> 80.000	> 80.000	> 80.000	> 80.000
3	19.700	19.700	19.850	19.500	19.950	19.700	19.550
4	19.700	19.600	19.750	19.650	19.950	19.700	19.650
5	19.650	19.450	19.800	19.500	19.950	19.700	19.650
6	19.700	19.600	19.800	18.150	15.100*	19.700	19.650
7	0.730	0.725	0.725	0.725	0.725	0.725	0.720
8	19.700	19.700	19.800	17.650	19.900	19.700	19.700
9	19.650	19.700	19.800	19.600	19.950	19.700	19.700
10	19.800	19.900	19.950	19.750	20.200	19.800	19.900
11	19.650	19.600	19.750	15.600*	18.600	19.650	19.650
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	0.755	0.750	0.755	0.750	0.750	0.755	0.750
14	0.740	0.735	0.740	0.730	0.735	0.740	0.730
15	0.915	0.910	0.910	0.905	0.910	0.910	0.905
16	0.910	0.905	0.905	0.905	0.905	0.910	0.905

Add or remove flags? (Y/N) N

Data for seven devices is displayed pin-by-pin. Note the defects flagged by asterisks on pins 1, 6, and 11.

Easy Detection of Defects

When tests are completed, the measurement data for up to seven devices can be displayed in columns, pin-by-pin. This enables a rapid visual scan to pick out unusual readings. The readings can also be automatically compared with previous measurements stored in a database.

Database Provides Reference Data

The statistical database provides test reference data and standard deviation for each device pin. Pin-to-reference-pin measurements are automatically compared to the standard deviation range. Measurements that are outside the range are flagged. Hard-copy printouts of both test results and reference data is easily obtained from the database.

The database is created by merging device test data. Abnormal measurements for any pin can be flagged so that the data for that pin of the device will not be included in the database.

DUT Fixtures for All ICs

Three IC adapters enable testing all ICs:

- A 40-pin dual-in-line socket adapter for devices with 0.3 and 0.6 inch lead spacing, up to 40 pins.
- A grid array adapter for most popular pin-grid array devices to 132 pins.
- An interface board for custom wiring to a variety of sockets: up to 189 pins. Custom sockets attached to the interface board test all devices with the same pin configuration.

System Versatility

The system includes a full function 370 Programmable Curve Tracer and an 80386-based PEP 301 System Controller. These can be used separately or together, apart from the S370FA system, for further analysis of defective ICs. For example, the 370 can be used to hand probe decapsulated devices, or can be connected to a wafer prober to check device characteristics.

Safety Features

Low test currents are used to prevent further damage to the device when testing. Additional precautions are included in the adapter connected to the 370 to limit maximum voltage and current for operator safety.

CHARACTERISTICS

Max Peak Volts—±80 V.
Current Range—1 μA to 100 mA.
Max Peak Power—0.4 W.

ORDERING INFORMATION

S370FA 93-Pin System. **$48,800**
Includes: Operators Manual (070-6852-00); 40-pin dual in-line adapter (018-0222-00).

OPTIONS

Option 01—Deletes PEP 301 controller. **−$5,000**
Option 02—Pin expansion to 189 pins. **+$6,350**
Includes: 108/132 pin grid array adapter (018-0223-00); 189-Pin Interface (018-0221-00).

OPTIONAL ACCESSORIES

Service Manual—Order 070-6853-00.*1
16-Pin Expansion—
Requires one each of the following: TSS40, TSS48 Opt 2/10, 40-conductor ribbon cable (174-0169-00), and 50-conductor ribbon cable (174-1182-00)*1

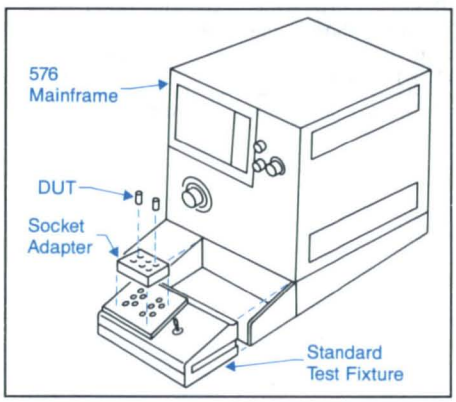
*1 *Contact your local sales office.*

576/176

- **Tests Two- and Three-Terminal Discrete Semiconductors**
- **Power Capability Up to 220 Watts**
- **Convenient Scale-Factor Readout**
- **Test Fixture (Optional) for Testing Power Devices to 1000 Watts**

TYPICAL APPLICATIONS

- **Semiconductor R & D**
- **Production-Device Testing**
- **Incoming Inspection**



176 High-Current Test Fixture (Optional)

The Tektronix 576 Curve-Tracer System continues to hold the title "standard of the industry." This general-purpose curve-tracer system 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 W peak to the device under test. The step generator can deliver up to 2 A in both its current and voltage modes of operation. With the 176 High-Current Test Fixture, the 576 is capable of pulsed-collector operation up to 200-A peak.

Alphanumeric indicators provide readout of vertical and horizontal deflection factors, step amplitude, and Beta/div or g_m/div. The Beta or g_m readout saves the operator from the arithmetic usually necessary to arrive at these parameters. These indicators also provide a permanent record of major knob settings in 576 CRT photographs.

Other features of the 576 Curve Tracer include: calibrated display offset; adjustable current limiting in the step generator; either 300 or 80 μs pulse width in pulsed-base operation; pushbuttons to check display zero and calibration; and an illuminated graticule.

A safety interlock protects the operator from dangerous voltages.

576 With Standard Test Fixture

576 CHARACTERISTICS

COLLECTOR SUPPLY

Modes/Polarity—Norm: AC (at line frequency); positive or negative full-wave rectified ac. DC: Positive or negative dc. Leakage: Emitter-current rather than collector-current measurements. 1000X increase in vertical-deflection sensitivity (1 nA/div).

Voltages[*1]

Range (V)	15	75	350	1500
Max Continuous Peak Current (A)	10	2	0.5	0.1
Peak Pulse Current (A)	≥20	≥4	≥1	≥0.2

[*1] *Peak open-circuit voltages within +35% and −5% of indicated range.*

Series Resistance—From 0.3 Ω to 6.5 MΩ in 12 steps, all within 5% or 0.1 Ω. Peak Power Limit Setting: 0.1, 0.5, 2.2, 10, 50, and 220 W.
Safety Interlock—Protects operator from dangerous voltages.

STEP GENERATOR

Current Mode—Step/Offset Amplitude Range: 5 nA/step (with X0.1 Mult) to 200 mA/step, 1-2-5 sequence. Maximum Current (Steps and Aiding Offset): X20 amplitude setting, except X10 (2 A) at 200 mA/step and X15 (1.5 A) at 100 mA/step. Maximum Voltage (Steps and Aiding Offset): At least 10 V. Maximum Opposing Offset Current: X10 amplitude setting or 10 mA, whichever is less. Maximum opposing voltage is limited at 1 to 3 V.
Voltage Mode—Step/Offset Amplitude Range: 5 mV/step (with X0.1 Mult) to 2 V/step, 1-2-5 sequence. Maximum Voltage (Steps and Aiding Offset): X20 amplitude-switch setting, 40 V maximum. Maximum Current (Steps and Aiding Offset): At least 2 A at 10 V, derating to 10 mA at 40 V. Short-Circuit Current Limiting: 20, 100, 500 mA +100%, −0%; 2 A +50%, −0%. Maximum Opposing Offset Voltage: X10 amplitude setting. Maximum Opposing Current: Limited between 5 and 20 mA.

Accuracy—Incremental: Within 5%, between steps, within 10% with X1.0 Mult. Absolute: Within 2% of total output including offset, or 1% of amplitude setting, whichever is greater. Offset Multiplier: Continuously variable from 0 to X10 the amplitude setting, either aiding or opposing the step polarity.
Step Rates—Selectable at X1, X2, or X4 line frequency.
Pulsed Steps—≈80 or 300 μs width.
Step/Offset Polarity—Same as Collector-Supply polarity and positive in ac position. Polarity can be independently inverted with Step/Offset Polarity control or from the test fixture.
Step Family—Repetitive or single family.
Number of Steps—Selectable from 1 to 10.
Vertical-Deflection Factor—Collector Current: 1 μA to 2 A/div, 20 steps in 1-2-5 sequence (0.1 μA/div with X10 magnification). Emitter Current: 1 nA to 2 mA/div, 20 steps in 1-2-5 sequence. Step Generator: 1 step/div.
Horizontal-Deflection Factor—Collector Volts: 50 mV to 200 V/div, 12 steps (5 mV/div with X10 magnification). Base Volts: 50 mV to 2 V/div, 6 steps (5 mV/div with X10 magnification). Step Generator: 1 step/div.

POWER REQUIREMENTS

Voltage Ranges—90 to 136 V ac or 180 to 272 V ac (six positions).
Line Frequency—48 to 66 Hz.
Maximum Power Consumption (Including DUT Power)—305 W. Standby Power: ≈60 W.

ENVIRONMENTAL AND SAFETY

Ambient Temperature—Operating: +10 to +40°C. Nonoperating: −40 to +65°C.
Altitude—Operating: To 3000 m (10,000 ft). Nonoperating: 15 000 m (50,000 ft).
Vibration—Operating: 15 minutes along each of the three major axes. 0.04 cm (0.015 in) p-p displacement 10 to 50 to 10 Hz in one minute cycles. Held for three minutes at 50 Hz.
Shock—Nonoperating: 30 g's, ½ sine, 11-ms duration in each direction along each major axis. Total of six shocks.
Safety—CSA Certified (CSA 556 B).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	299	11.8
Height	381	15.0
Depth	591	23.3
Weight ≈	**kg**	**lb**
Net	32.0	70.5
Shipping	48.5	107.0

STANDARD TEST FIXTURE (650-0459-01)

A plug-in fixture with two sets of five-pin test terminals, the Emitter Grounded or Base Grounded switch, Left-Off-Right switch, Step Gen Output, Ext Base or Emitter input, and the Safety Shield. The test terminals accept either the six-pin universal adapters, three-pin adapters, or the high-power transistor adapters with Kelvin contacts.

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

CRT—165-mm (6.5 in.) rectangular with 10×10-cm divisions (12 cm usable horizontal) parallax-free, illuminated graticule, GH (P31) phosphor standard. Accelerating potential is 4.0 kV.
Readout—The readouts, adjacent to CRT, are digital indicators of the following parameters: Per Vert Div from 1 nA to 2 A/div; per Horiz Div from 5 mV to 200 V/div; Per Step from 5 nA to 2 A/step, 5 mV to 2 V/step; A (Beta) or gm, per Div from 1 μ to 500 k calculated from Current/Div, X10 Mag, Step Amplitude, and X0.1 Mult.

The 176 Pulsed-High-Current Fixture provides the 576 Curve Tracer with pulsed-collector operation to 200 A peak and pulsed-base steps to 20 A peak. When selected, the step offset 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 overdissipation. The 176 Test Fixture fits in place of the 576 Standard Test Fixture. The collector pulse is slaved to the step generator in regard to width and repetition rate.

CHARACTERISTICS

COLLECTOR SUPPLY (PULSED)

Width—300 or 80 μs determined by 576.
Repetition Rate—Power-line frequency.
Polarity—± determined by 576 polarity control.
Amplitude—Ranges: 15, 75, 350 V nominal, controlled by Max Peak Volts switch on 576. Current (minimum available at low line into shorted load): 15-V range, 200 A; 75-V range, 40 A; 350-V range, 8 A.
Maximum Peak Watts—Three illuminated pushbuttons select 10, 100, or 1000 W maximum peak power.

STEP GENERATOR

Current Ranges (X10 Step Selected)—Step/Offset Amplitude Range: 100 mA to 2 A, 5 steps, 1-2-5 sequence. Maximum Current (Steps and Aiding Offset): 200×576 Amplitude setting or 20 A, whichever is less. Maximum Voltage (Steps and Aiding Offset): At least 5 V up to 10 A and 2 V up to 20 A.
Accuracy (Current Steps Including Offset)—Incremental: Within 5% between any two steps; within 10% with X0.1 Step Mult. Absolute: Within 3% of total output ±1% of one step or within 3% of one step, whichever is greater.
576 Offset Multiplier—0 to 100×576 Amplitude switch setting.
Step Rate—Power-line frequency.
Pulsed Steps—300 or 80 μs wide.
Step/Offset Polarity—Same as Collector-Supply polarity. Polarity can be independently inverted with Step/Offset Polarity control.

VERTICAL AMPLIFIER

Deflection Factor (X10 Vert Selected)—1 to 20 A/div, 5 steps in a 1-2-5 sequence.

ORDERING INFORMATION

576 Curve Tracer
With Standard Test Fixture **$17,050**
Includes: Standard test fixture (650-0459-01); transistor adapter A1007; FET adapter A1009; TO-3/TO-66 adapter A1003 Opt. 01; axial lead diode adapter A1005; stud diode adapter (013-0110-00); Kelvin sensors for large and small plastic transistors A1002 Opt. 01; safety shield (337-1194-02); power cord (161-0066-00); instruction manual (070-0905-01).

OPTION

Option 01—Deletes the auto scale-factor readout module but maintains provisions for insertion of the module (020-0031-00) at any time. **−$975**

CONVERSION KIT

Auto Scale-Factor Readout Module—Order 020-0031-00 **$1,735**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

OPTIONAL ACCESSORIES

Test Set-Up Chart—Package of 250. Order 070-0970-01 **$10**
Test Fixture—176 **$6,800**
Socket Adapters—In this section.
Camera—C-59A and adapter.
See Instrumentation Documentation Devices section, page 501.
Cart—K217. **$510**

176 Pulsed High-Current Fixture

ORDERING INFORMATION

176 Pulsed-High-Current Fixture **$6,800**
Includes: TO36 adaptor (013-0112-00); stud diode adaptor (013-0110-00); safety shield (337-1194-02); instruction manual (070-1073-00).

577/177

TYPICAL APPLICATIONS

- **Incoming Inspection**
- **Semiconductor R&D**

FEATURES

- **Test Two-Terminal and Three-Terminal Discrete Semiconductors**
- **Storage Capability (Model D1)**
- **Power Capability Up to 100 Watts**

The 577/177 is a low-cost, general purpose, non-programmable Curve Tracer System designed for testing semiconductor devices at power levels up to 100 Watts. Maximum continuous current is 10 amps (20 amps in pulsed mode). the 577 can be ordered with either a split-screen, bistanble-storage CRT (577/D1), or with a conventional non-storage CRT (577/D2).

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 ICs such as op amps may be tested with the 577 by using the 178 Linear-IC Test Fixture.

CHARACTERISTICS

All characteristics are for the 577 Curve-Tracer Mainframe operating with a 177 Standard Test Fixture.

COLLECTOR SUPPLY

Modes/Polarity—Norm: AC (at line frequency); positive or negative full-wave rectified ac. DC: Positive or negative dc.

Voltage[*1]

Range (V)	6.5	25	100	400	1600
Max Continuous Peak Current (A)	10	2.5	0.6	0.15	0.04
Peak Pulse Current (A)	20	5	1.25	0.30	0.08

[*1] *Peak open-circuit voltages within +35% and −5% of indicated range.*

Series Resistance—From 0.12 Ω to 8 MΩ in 14 steps, all within 15%, ±0.1 Ω. Peak Power Limit Setting: 100, 30, 9, 2.3, 0.6, and 0.15 W.
Safety Interlock—Protects operator from dangerous voltages.

STEP GENERATOR

Current Mode—Step/Offset Amplitude Range: 5 nA/step (with X0.1 Mult) to 200 mA/step, 1-2-5 sequence. Maximum Current (Steps and Aiding Offset): X20 amplitude setting, except X10 (2A) at 200 mA/step and X15 (1.5 A) at 100 mA/step. Maximum Voltage (Steps and Aiding Offset): At least 7 V. Maximum Opposing Offset Current: X10 amplitude setting or 10 mA, whichever is less. Maximum opposing voltage is limited at 1 to 5 V.
Voltage Mode—Step/Offset Amplitude Range: 5 mV/step (with X0.1 Mult) to 2 V/step, 1-2-5 sequence. Maximum Voltage (Steps and Aiding Offset): 20 times amplitude-switch setting. Maximum Current: At least 100 mA at 0 V. Short-Circuit Current Limiting: Not more than 200 mA. Maximum Opposing Offset Voltage: X10 amplitude-switch setting. Maximum Opposing Current: Limited between 10 and 20 mA (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. Within 4% with X.01 mult. Offset Multiplier: Continuously variable from 0 to X10 the amplitude setting, either aiding or opposing the step polarity.
Step Rates—Selectable at X1, X2, or X4 line frequency.
Pulsed Steps—≈300 μs width.
Step/Offset Polarity—Same as Collector-Supply polarity and positive in the ac position. Polarity can be independently inverted with Step/Offset Polarity control or from the test fixture.
Step Family—Repetitive or single family.
Number of Steps—Selectable from 1 to 10 full-amplitude steps. Selectable up to ≈95 steps when using Step X0.1 multiplier.

DEFLECTION CONTROLS

Display Accuracies[*1]

Display Mode	Normal	
Norm and DC Modes	**(unmagnified)**	**Magnified**
Vertical Collector Current	3% ±1 nA	4% ±1 nA
Horizontal Collector Volts	3%	4%
Horizontal Base Volts	3%	4%
Step-Generator Mode		
Horizontal Mode	4%	5%

[*1] *As a percentage of highest on-screen value.*

Vertical-Deflection Factor—Collector Current: 2 nA to 2 A/div, 28 steps in 1-2-5 sequence (0.2 nA to 0.2 A/div with X10 magnification).
Horizontal-Deflection Factor—Collector Volts: 50 mV to 200 V/div, 12 steps in 1-2-5 sequence (5 mV to 20 V/div with X10 magnification). Base Volts: −50 mV to 2 V/div, 6 steps in 1-2-5 sequence (5 mV 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 165 mm (6.5 in.) with an 8×10 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 GJ (P1). The D2 display unit has a nonstorage CRT with GH (P31) phosphor standard. Accelerating potential is 3.5 kV.
Beam Finder—Compresses off-screen trace to within graticule area.

POWER REQUIREMENTS

Line-Voltage Ranges (±10%)—100, 110, 120 or 200, 220, 240 V ac.
Line Frequency—50 to 60 Hz.
Power—155 W max at 110 V ac, 60 Hz.

PHYSICAL CHARACTERISTICS

	577		177	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	224	8.8	201	7.9
Height	503	19.8	102	4.0
Depth	584	23.0	152	6.0
Weights ≈	**kg**	**lb**	**kg**	**lb**
Net	18.1	40.0	1.1	2.5
Shipping	22.7	50.0	2.7	6.0

When the 577 and 177 are ordered together, their combined shipping weight is ≈24 kg or ≈53 lb (domestic).

178 Linear-IC Test Fixture

- **Tests Single, Dual, or Quad: Operational Amplifiers, Comparators, Differential Amplifiers, Regulators, and More**

Since linear ICs 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 and 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 that interfaces the system to the device-under-test.

OP-AMP CARDS

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 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 Hardwire Card is designed for applications where there is an advantage in preparing indivdual cards for specific devices so that they may be quickly switched to accommodate a change in the type of device-under-test.

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 next page.

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 three-terminal regulators are the same as the Kelvin Sensing Adapters used on the standard curve tracer. See next page.

CHARACTERISTICS

VERTICAL AMPLIFIER

Display Accuracies/Deflection Factor

Vertical*1	Normal	Magnified
Input Voltage or ΔInput Voltage	10 μV to 50 mV/div	1 μV to 5 mV/div
Accuracy*2	3%	4%
Input Current	50 pA to 0.2 mA/div	5 pA to 20 μA/div
Accuracy*2	3% ±50 pA	4% ±50 pA
Power-Supply Current	0.1 μA to 50 mA/div	10 nA to 5 mA/div
Accuracy*2	3% ±0.1 μA	4% ±0.1 μA
Collector-Supply Current	1 nA to 50 mA/div	0.1 nA to 5 mA/div
Accuracy*2	3% ±1 nA	4% ±1 nA

*1 *1-2-5 sequence.*
*2 *Percentage of highest on-screen values.*

POWER SUPPLIES

Voltage—Positive and negative supplies are adjustable from 0 to 30 V. Voltage of both supplies can be adjusted from a single calibrated control. Accuracy is within 2% ±100 mV. Negative supply can be independently adjusted by an uncalibrated control.
Current—At least 150 mA with adjustable current limiting.

SWEEP GENERATOR

Frequency Range—Adjustable from 0.01 Hz to 1 kHz. Sinusoidal signal controls output, common-mode input, or power-supply voltages of device-under-test.
Amplitude—Adjustable from 0 to 30 V peak.

SOURCE RESISTANCE

Resistor Values—Two each, 50 Ω, 10 kΩ, 20 kΩ, 50 kΩ, or external resistors. When vertical deflection factor is in 1 through 50 mV/div positions, add 550 Ω to all values.

LOAD RESISTANCE

Resistor Values—One each, 100 Ω, 1 kΩ, 2 kΩ, 5 kΩ, 10 kΩ, 20 kΩ, 50 kΩ, or external resistors.

COLLECTOR SUPPLY

The 25- 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.)

THREE-TERMINAL-REGULATOR TEST-CARD CHARACTERISTICS

DUT Input Supply—Input Voltage (Two Ranges): 0 to 30 V is within 2% ±200 mV of dial setting. 0 to 60 V is within 2.5% ±300 mV of dial setting. Regulation: Within 200 mV. Input Sweep Frequency: DC to 1 kHz. 300-μs Pulsed Current: 5 mA to 2 A.

Short Duration DC Current*1

Supply Voltage (V)	Current (mA)
0 to 10	700
10 to 20	350
20 to 40	350
40 to 60	120

*1 *One minute duration.*

DUT Current Load—5 mA to 2 A within ±3%, ±1.25 mA.
DUT Comparison Output DC Voltage Accuracy—0 to 10 V Range: Within 1% ±20 mV. 0 to 100 V Range: Within 1% ±150 mV.

ORDERING INFORMATION

577/D1 Storage Curve-Tracer Mainframe (Without Test Fixture). **$7,500**
577/D2 Nonstorage Curve-Tracer Mainframe (Without Test Fixture). **$6,500**

OPTION

Option 10—10×10-cm graticule. **+$98**

TEST FIXTURES

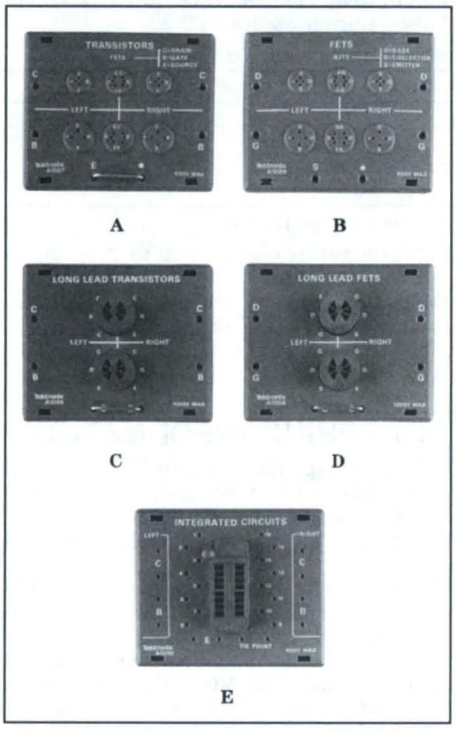
177 Standard **$1,540**
Includes: Transistor adapter for most bipolar transistors and some MOS FETs A1007; axial lead diode adapter with Kelvin sensing terminals A1005; safety shield for test connection area (337-1194-02); instruction manual (070-1436-00).
178 Linear-IC Test Fixture. **$3,900**
Includes: 16 DIP IC sockets (136-0442-00); standard Op Amp Card with cover and ten patch cords (013-0149-02); interchangeable nomenclature panel for function switch (333-1770-00); instruction manual (070-1977-00).

577 OPTIONAL ACCESSORIES

Test Set-Up Chart—Package of 250. Order 070-1639-00. **$7.50**
Device Adapter Sockets—See socket adapters in this section.
CRT Implosion Shield—Clear. For 577D1. Order 337-1440-00. **$3.75**
Camera—C-5C. **$495**
See Instrumentation Documentation Devices section, page 501.
Cart—K213. **$625**
See Cart section.

178 OPTIONAL ACCESSORIES

2 Inch Patch Cord—Package of 10. Order 012-0200-00. **$5.75**
Cards—
(Standard Op Amp) One included with 178. Order 013-0149-02. **$260**
(Hardwire) Order 013-0150-02. **$130**
(Multiple Op Amp) Order 013-0155-01. **$750**
(Positive Regulator) Order 013-0147-00. **$1,735**
(Negative Regulator) Order 013-0148-00. **$1,545**



DUAL WIDTH ADAPTERS

The following accessories fit the side-by-side terminals on test fixtures of the 370, 576, and 577/177 Curve Tracers.

A. Transistor Adapter—Useful for most single and dual bipolar transistors and some MOS FETs. Order A1007 **$230**

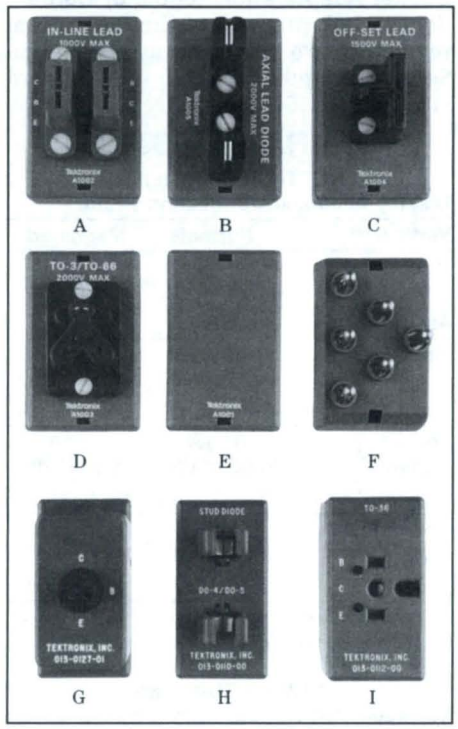
B. FET Adapter—Useful for most single and dual FETs. Order A1009 **$230**

C. Long-Lead Transistor Adapter—Accepts dual or single transistors with untrimmed leads. Order A1006 **$200**

D. Long-Lead FET Adapter—Accepts dual or single FETs with untrimmed leads. Order A1008 **$255**

E. Integrated-Circuit Adapter—Allows connection to multipin device packages. 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. Includes one each lead for connecting auxiliary supply to tie points (196-3067-00); six each 4-inch test leads (012-0310-00). Order A1010 **$380**

SOT-23 Adapter—Contact your local Tektronix Sales Office.



KELVIN SENSING ADAPTERS

The following accessories fit the test fixtures of the 370, 371, 576/176, and 577/177 Curve Tracers.

Note: The standard version of adapters A1001 through A1004 have 6 terminals as shown in F above. These adapters are designed for use in the 370 and 371 only. The Option 01 version of adapters A1001 through A1004 have the base/gate sense terminal removed to permit their use in the 576 and 577 test fixtures. Adapter A1005 has 4 terminals and can be used in the 370, 371, 576, and 577.

A. In-line Adapter—Accepts large and small TO-220 transistors with in-line leads. The adapter will accept devices with approximate spacing between terminals of 0.06 in. up to 0.18 in. It is wired for both B-C-E and C-B-E terminal configurations. Order A1002 Option. 01 **$120**

B. Axial-Lead Diode Adapter—Order A1005 **$115**

C. Offset-Lead Adapter—Used for power transistors. Order A1004 Opt. 01 **$125**

D. TO-3/TO-66 Adapter—Used for power transistors. Order A1003 Opt. 01 **$125**

E. Blank Adapter—For mounting special sockets. Order A1001 Opt. 01 **$70**

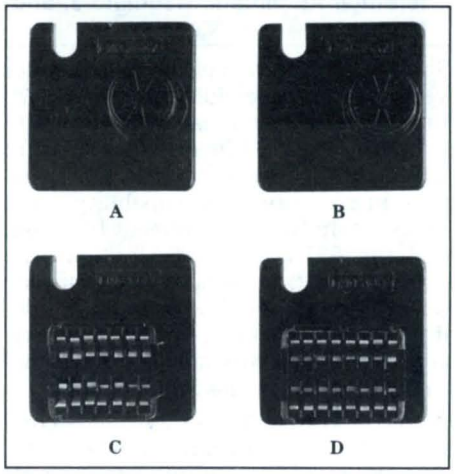
F. Example showing 6th pin for Base/Gate Kelvin Sensing

NOTE: Adapters G, H, I are not recommended for use with the 370 or 371, as they can remove the gold plating from the test fixture receptacles; however, they will physically fit.

G. Transistor Adapter—Accepts long- or short-lead transistors. Can be rewired to fit nonstandard configurations. Order 013-0127-01. **$90**

H. Stud Diode Adapter—Order 013-0110-00 **$110**

I. TO-36 Adapter—Order 013-0112-00 **$110**



MULTILEAD SOCKETS

These sockets are used with the 178 Test Fixture.

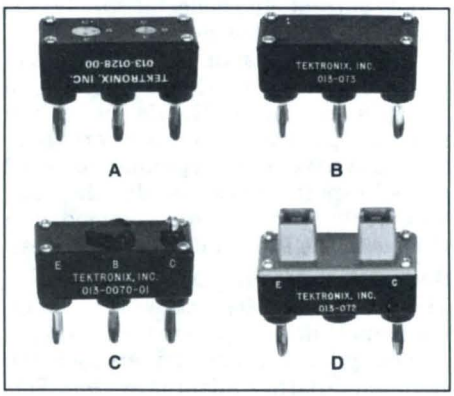
A. 8-Lead TO Package—Order 136-0444-00 **$60**

B. 10-Lead TO Package—Order 136-0441-00 **$60**

C. 14-Lead Dual In-Line Package—Order 136-0443-00 **$60**

D. 16-Lead Dual In-Line Package—Order 136-0442-00 **$55**

These four sockets are the most commonly required in curve-tracer applications. Additional socket configurations, including zero-insertion style, are available from Textool Products, Inc., 1410 W. Pioneer Dr., Irving, TX 75061.



3-PIN ADAPTERS

The 3-pin adapters may be used with any of the Tektronix curve-tracer products. They do not have Kelvin sensing contacts.

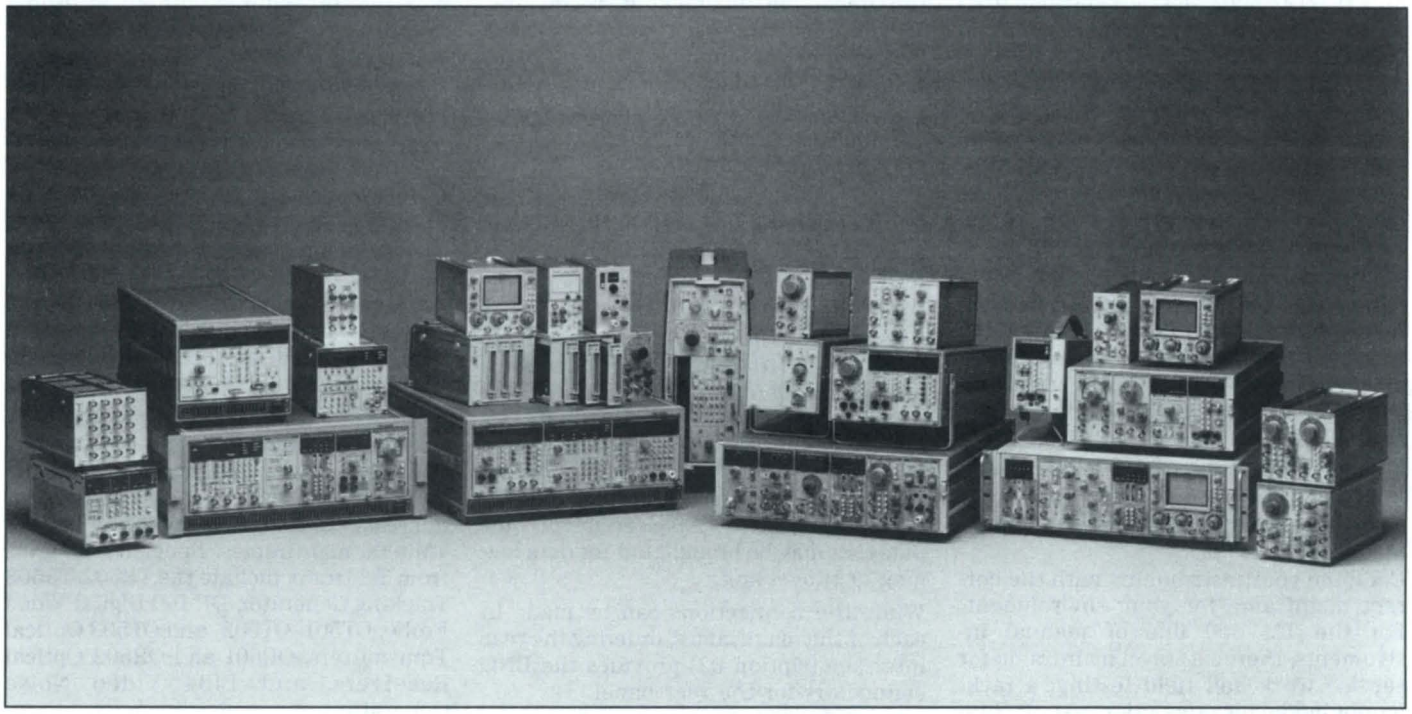
A. TO5 and TO18—Transistor Adapter. Order 013-0128-00 **$42**

B. Blank Adapter—For mounting special sockets. Order 013-0073-00 **$21**

C. TO3 or TO66—Transistor Adapter. Order 013-0070-01 **$60**

D. Diode Test Adapter—Holds axial-lead diodes. Order 013-0072-00 **$100**

MODULAR TEST INSTRUMENTS



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Manual and GPIB-Programmable Instruments That Perform in Hundreds of Combinations

Functionality, configurability, and ease of use are all hallmarks of the TM 500/TM 5000 Series of modular instruments. These instruments provide the answers to a broad range of test and measurement needs. You can choose from over sixty compact plug-ins to create multifunction packages for a wide range of applications, or to solve unique application problems.

The full line includes distortion analyzers and low distortion oscillators, digital counter/timers, digital multimeters, function generators, pulse generators, modular oscilloscopes, oscilloscope calibration instruments, power supplies, blank plug-ins for customizing special functions, mainframes, and DUT interfacing products that include programmable scanners, D/A and A/D converters, and a programmable user-configurable development card. These modular instruments can function individually or as part of an integrated, computer-controlled network.

With over 50 cost effective plug-ins from which to choose, the Tektronix TM 500 line of manual instruments lets you create just the system you need. And all TM 500 instruments are electrically and mechanically compatible with the TM 5000 GPIB programmable instruments, so they can be used in TM 5000 mainframes side-by-side with the TM 5000 programmables. This compatibility yields cost effective solutions to system applications where not all functions or measurements need to be programmable.

The TM 5000 programmable instruments are designed for ease of use and flexibility in automated testing and measurement applications. You get the benefits of advanced programming capability, complex interfacing, and compactness as standard features.

Programming is simple because TM 5000 instruments are GPIB compatible and support Tek's *Standard Codes and Formats*, assuring that the language and syntax between instruments is consistent and easy to use. Standardized instrument-data formats open up the lines of bus communication and make your test and measurement system easy to set up and operate. Test and control functions are changed quickly and easily. Common error codes among instruments greatly simplify error handling routines.

Most front panel functions are GPIB programmable. And each TM 5000 instrument (with the exception of the AA 5001 and the DC 5004) has a front-panel ID button that can be programmed to generate an SRQ, or to allow operator intervention in an ongoing test. Conversely, the SRQ-generation capability can be programmed off to prevent inadvertent interruption of a test. Plus, the entire front panel of each instrument can be locked out to further prevent operator interference with a test or instrument set-up.

All of the TM 5000 instruments have diagnostics capability built right in. Each instrument performs an extensive diagnostic self-test on power up, or on command and, in case of a fault, displays and/or sends over the GPIB an error message indicating the nature of the fault.

The Right Solution Requires the Right Mainframe

Combine your instruments with the correct mainframe for your environment. For the TM 500 line of manual instruments, there's a travel mainframe for service work and field testing; a rack-mount model for production test; or standard mainframes, compact and convenient for bench or desk, that accept one to six instrument. Rollabout carts are available for lab configurations with Tek oscilloscopes.

The TM 5000 instruments operate in either TM 5003 or TM 5006 mainframes to form compact, configurable, automated test systems that occupy less than half the rack space of ordinary rack-mounted equipment and decreases the number of GPIB cables and power outlets. One cable and one power cord per mainframe is all that's required. The TM 5003 has three compartments, the TM 5006 has six. all of the current TM 5000 instruments are double-width, with the exception of the single-width DC 5004, DC 5009 and PS 5004, and triple-width CG 5001, AFG 5101, PFG 5105, and DM 5120.

With the introduction of the AFG 5501, the PFG 5505, and the DM 5520 the TM 5000 line expands into the monolithic arena. These instruments are standalone versions of the AFG 5101, the PFG 5105, and the DM 5120 respectively, and come equipped with a power module and GPIB. Based on the popular plug-in modules, these instruments can be included in any GPIB system.

Adherence to standard form and fit means that any TM 500/TM 5000 instrument can be replaced in a system without the uncabling, unstacking, restacking, and recabling that is necessary with most instruments. Rebuilding the system for different task takes seconds, not hours.

The TM500/TM5000 line of modular instruments 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.

With the exception of the new AFG 5101, DM 5120, and PFG 5505, 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 that may be brought out for data logging or processing.

While the connections can be made in each of the mainframes, ordering the rear interface (Option 02) provides the BNC connectors for the rear panel.

All TM 5000 and many of the TM 500 instruments are UL listed.

Application and Construction Notes

The TM 500 and TM 5000 instrument lines are supported by a series of Application and Construction Notes that communicate up-to-date technical information. Application Notes outline the steps necessary to solve complex problems, or to achieve optimal performance and versatility from your instruments. Subjects include: integration, v-to-f conversion, generating delayed pulses, and transducer measurements.

Construction Notes provide information to build custom circuits using a blank plug-in kit and standard components. These notes are developed from the actual construction of more common special circuits, and include parts lists, schematics, and other construction details. Some of the available notes include power-supply circuits, thermal true RMS converter, and analog multipliers.

Software Support is EZ

Tektronix's EZ-TEST PC Test Procedure Generator was developed with GPIB modular instrument systems in mind. EZ-TEST PC can reduce the time required for test procedure generation from days or weeks to hours. Using this menu-driven, high-level software package, even the inexperienced programmer can create complex test procedures without writing a line of code. No knowledge of the test language is required. You simply need an IBM compatible PC such as the Tektronix PEP 301.

And Tek's experienced software specialists can help you develop a unique software package for your specialized applications. Utilizing EZ-TEST PC, or a variety of high-level languages the Tek specialist can build test procedure software that's easy to learn and to use. System startup time will be kept to a minimum. And all software documentaiton, including the application source code, will be provided.

Auxilary Instruments

Several specialty plug-ins are available both through Tektronix and other vendors that are compatible with the TM500/TM5000 mainframes. Specialty plug-ins from Tektronix include the TR502/TR503 Tracking Generator, DP-100 Digital Video Probe, OT501, OT502, and OT503 Optical Transmitters, OR501 and OR502 Optical Receivers, and 1434 Video Noise Generator.

Other vendors selling TM500 compatible plug-ins include: Argos, Efratom, Lasertron, Metrotek, Nortek, Spectracom, and Pulse Instruments.

Create Your Own Application Package

The New Electronic Bench Series (EBS) packages link the versatility of the modular instrument offering with a portable scope, which allows you to specify a grouping of instruments to fit your application.

With EBS packages you can select a compliment of stimulus, measurement, and power supply modules to fit your application along with one of the three, four, or six-wide mainframes (and save 10% off the catalog price).

Versatile and Cost-Effective

Versatility and cost efficiency is as important a part of the TM 500/TM 5000 modular concept as solving applications problems. With the Tektronix TM 500/TM 5000 Modular Instruments you can assemble a highly versatile test system that fits your particular application. And you can upgrade performance capabilities as needed, using the same mainframe and power supply as before, with complete assurance of total compatibility and Tek reliability.

NEW TM500/TM5000

Modular Packages

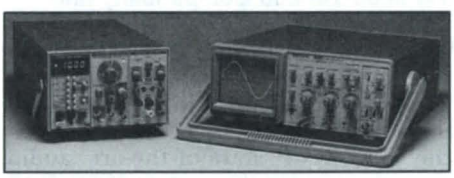
Now you can buy a complete solution in a package and save 10% of the catalog price of the component instruments. The NEW Electronic Bench Series (EBS) packages offer a way to save money by selecting the right set of plug-ins to fill the one, three, four, or six-wide TM500 or TM5000 mainframes. And you get to choose the configuration.

For most of the packages the core consists of a power supply, digital multimeter, function generator and oscilloscope. These instruments support the requirements of a basic engineering bench, whether it is in an R&D lab, at a technician's workstation, in the field as a portable test station, or in a school lab for electronic training.

The core package, an EBS501, includes a PS503A, DM501A, and FG503 in a TM503A mainframe along with the 2225 Oscilloscope. Since customer requirements are diversified, Tektronix lets you configure your package based on your own performance and price requirements by providing the flexibility of selecting from the entire line of TM500 and TM500 plug-ins.

To simplify the selection process Tektronix offers a series of packages configured around mainframe sizes and manual or programmable capabilities. The adjacent matrix illustrates some of the possibilities. However, if you have a different requirement, call your local Tektronix representative for a quote. The possibilities are unlimited.

Our "basic" benchtop solution, the EBS 501, includes a DM 501A Digital Multimeter, a FG 503 Function Generator, a PS 503A Power Supply, a TM 503A Mainframe, and a 2225 50 MHz Oscilloscope.

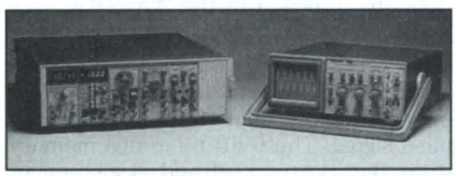


The EBS 502 *intermediate* modular system adds a counter, the DC 504A, and a 4-slot TM 504 mainframe to the basic EBS 501 configuration.

The EBS 503 *advanced* package adds a pulse generator, the PG 501, and the TM 5006 6-slot mainframe.

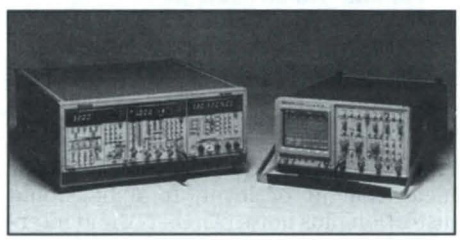
PACKAGE OFFERS		EBS 501 (Basic)	EBS 502 (Intermediate)	EBS 503*2 (Adv/Digital)	EBS 5001 Basic GPIB	EBS 5002
FUNCTION	Mainframe	TM 503A	TM 504	TM 506A	TM 5006	TM 5006
	Power Supply	PS 503A	PS 503A	PS 503A	PS 5010	—
	Function Generator	FG 503	FG 503	FG 503	FG 5010	AFG 5101
	Digital Multimeter	DM 501A	DM 501A	DM 501A	DM 5010	DM 5010
	Digital Counter	—	DC 504A	DC 504A	—	DC 5009
	Pulse Generator	—	—	PG 501	—	—
	Oscilloscope	2225	2225	2225	2430A	—
PKG Price		$3,340	$4,260	$5,175	$16,595	$7,865
Option 01		Delete Scope −$895	Delete Scope −$895	Delete Scope −$895		
Option 02					Delete Scope −$7,155	
Option 03*1 (Sub. 2220 for 2225)		+$1,800	+$1,800	+$1,800		
Option 10 (Sub. FG 501A for FG 503)		+$225	+$225	+$225		
Option 11 (Sub. FG 502 for FG 503)		+$380	+$380	+$380		
Option 12 (Sub. DM 502A for DM 501A)		+$60	+$60	+$60		
Option 13 (Sub. FG 504 for FG 503 016-0362-02)				+$2,260		
Option 14 (Sub. PS 501-1 for PS 503A		−$45	−$45	−$45		
Option 15 (Sub. DC 503A for DC 504A)			+$610	+$610		
Option 16 (Sub. DC 509 for DC 504A)			+$1,025	+$1,025		
Option 17 (Sub. PG 502 for PG 501)				+$2,005		
Option 18 (Sub. DM 504A for DM 501A		−$300	−$300	−$300		

*1 *Other scopes can be substituted at catalog price.*
*2 *016-0362-02 tool box included.*



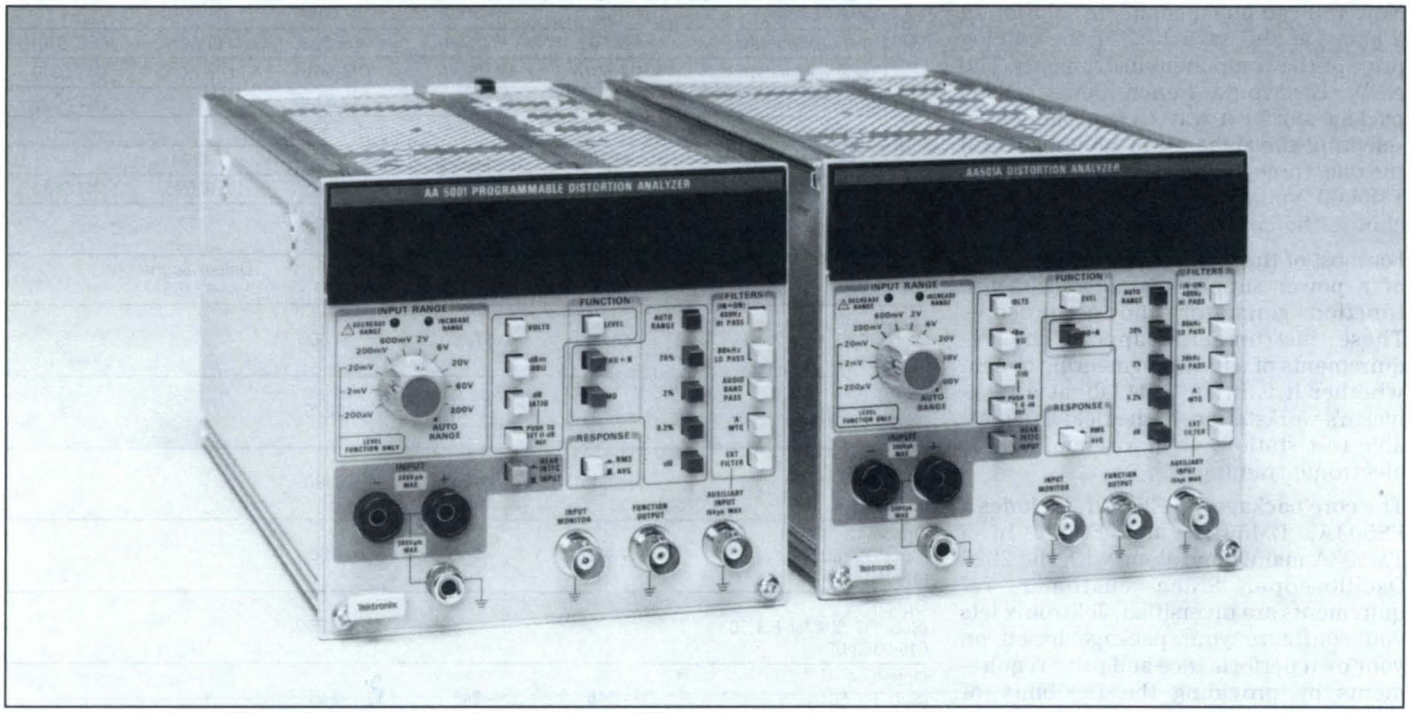
The EBS 5001 package fits those applications requiring programmability. It includes a DM 5010 Programmable Digital Multimeter, a FG 5010 Programmable Function Generator, a PS 5010 Programmable Power Supply, a TM 5006 Mainframe, and a 2430A 100 MHz Digital Storage Oscilloscope.

The EBS 5002 measurement/stimulus package includes the New AFG 5101 Arbitrary/Function Generator for waveform generation and DM 5010 Digital Multimeter and DC 5009 Universal Counter/Timer for system measurements.



The flexibility of each EBS package configuration lets you substitute the instrument you need for your application. With more than fifty plug-ins to choose from, countless configurations are possible. Call your local Tek Sales Representative for prices and configurations.

DISTORTION ANALYZERS



AA 5001/ NEW AA 501A

Distortion Analyzers

GPIB IEEE-488

The AA 5001 complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

- **Fully Automatic: No Level Setting, Tuning, or Nulling**
- **Level, Total Harmonic Distortion, and dB Ratio Measurements**
- **Total System Harmonic Distortion plus Noise ((THD+N) <0.0025% (with companion SG 5010/SG 505 Oscillators)**
- **Residual Noise ≤3.0 μV**
- **Digital Readout plus Analog-Like Bar Graph for Peaking and Nulling**
- **IMD to SMPTE, DIN, and CCIF (Option 01)**

The AA 5001/AA 501A Distortion Analyzers provide fully automated measurement of level, total harmonic distortion plus noise (THD+N), and intermodulation distortion (Option 01 for the AA 501A). The AA 5001 adds GPIB compatibility plus programmability.

Fully Automatic

Automatic measurement means that once the mode is selected and the test signal is applied, the operator simply reads the accurate result on the 3-digit display. Functions such as level setting, tuning, and nulling are fully automatic.

The AA 501A Option 1 adds intermodulation distortion measurement capability conforming to SMPTE, DIN, and CCIF standards. Internal circuitry automatically identifies the signal being used and performs the measurement, making IMD measurements as automatic as harmonic distortion measurements. These capabilities are standard in the AA 501A.

Advanced Performance

The AA 5001/501A provides dB-ratio measurement referencing either to 774.6 mV (1 mW in 600 ohms) or to a selected applied signal. The 0 dB reference memory stores the selected level, and all subsequent measurements are referenced to it.

The user can choose true RMS or average response. While true RMS is generally more accurate, the averaging feature is convenient for comparison of new data with data taken on older instruments where averaging was the only mode available.

The fundamental frequency range is 10 Hz to 100 kHz, with harmonic measurements to 300 kHz. Any one of four built-in frequency-weighting filters can be switched into the signal paths for input signal preconditioning. External filters can be simply connected for special applications such as stereo pilot tone rejection, rejection of continuous tone squelch signals in mobile radio systems, or for selection of individual harmonics instead of total harmonic distortion measurements.

An Input-Monitor connector and a Function-Output connector permit oscilloscope display of the input signal or the filtered signal input used in THD+N measurement.

TM 5000/TM 500 Compatibility and Configurability

As members of the TM 5000/500 series, the AA 5001/501A distortion analyzers are designed to be used together with the SG 5010/505 Oscillators respectively as the nuclei of state-of-the-art audio analysis systems. The AA 5001/SG 5010 setup provides the heart of a programmable automated audio testing system, while the AA 501A/SG 505 setup can be rack-mounted for ease of use at the plant for manual operations or can be easily removed and placed in a portable mainframe for use in the field.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

CHARACTERISTICS

HARMONIC DISTORTION FUNCTION

Fundamental Frequency Range—10 Hz to 100 kHz, automatically tuned to input frequency.

Distortion Ranges—Auto (100%), 20%, 2%, 0.2%, and dB (autoranging).

Accuracy—20 Hz to 20 kHz is ±1 dB. 10 Hz to 100 kHz is +1, −2 dB. (Accuracy is limited by residual THD + N and filter selection.)

Typical Fundamental Rejection—At least 10 dB below specified residual THD + N or actual signal THD, whichever is greater.

Minimum Input Level—60 mV (−22 dBm).

LEVEL FUNCTION

Autoranging digital voltmeter displays input-signal level in volts, dBm, or dB ratios.

Modes—Volts, dBm (600 Ω), or dB ratio with push-to-set 0 dB reference.

Level Ranges—200 μV full scale to 200 V full scale in ten steps, manual or autoranging.

Accuracy

Frequency	Volts	dBm or dB Ratio
20 Hz to 20 kHz	±2% ±1 count	±0.3 dB*[1] +0.5% of reading
10 Hz to 100 kHz	±4% ±2 counts	±0.5 dB*[1] +0.5 % of reading

*[1] *$V_{in} \geq 100$ μV, level ranging indicators extinguished. ±0.2 dB at 1 kHz only. Flatness is 0.1 dB, 20 Hz to 20 kHz, and ±0.3 dB, 10 Hz to 100 kHz.*

Bandwidth—≥300 kHz.

Residual Noise—

≤3 μV (−108 dBm) with 80-kHz and 400-Hz filters, RMS response.

≤1.5 μV (−114 dBm) with "A" weighting filter, RMS response (standard instrument only).

≤5 μV (−104 dBm) with CCIR weighting filter, quasi-peak response (Option 02 instrument only).

INTERMODULATION DISTORTION FUNCTION

Fully automatic SMPTE, DIN, and CCIF difference tone measurements. Minimum input level 60 mV (−22 dBm). Accuracy ±1 dB.

SMPTE and DIN Tests—Lower Frequency Range: 50 to 500 Hz. Upper Frequency Range: Usable from 3 to 163.8 kHz. Level Ratio Range: 1:1 to 4:1 (lower:upper). Residual IMD: See System Specifications.

CCIF Difference Frequency Test—Frequency Range: Usable from 4 to 163.8 kHz. Difference Frequency Range: 80 Hz to 1 kHz. Residual IMD: See System Specifications.

ALL FUNCTIONS

Display—3½-digits resolution at ≈3 readings/s.

Detection—Average or true RMS for waveforms with crest factors ≤3. Option 02 replaces average detector with quasi-peak detector complying with CCIR Recommendation 468-2 and DIN 45405.

Filters—

400 Hz High Pass: −3 dB at 400 Hz ±5%; 18 dB/octave slope, at least 40 dB rejection at 60 Hz.

80 kHz Low Pass: −3 dB at 80 kHz ±5%; 18 dB/octave slope.

Audio Bandpass: −3 dB at 22.4 Hz and 22.4 kHz, both ±5%. Complies with CCIR Recommendation 468-2 and DIN 45405.

"A" Weighting: Meets specifications for Type one sound-level meters (ANSI S1.4, IEC Recommendation 179). Option 02 replaces "A" weighting filter with CCIR weighting filter complying with CCIR Recommendation 468-2 and DIN 45405.

Ext: Allows connection of external filters.

Input Type—Balanced (full differential).

Input Impedance—100 kΩ ±2%, each side to ground.

Maximum Input—300 V peak, 200 V RMS either side to ground or differentially. Fully protected on all ranges.

Common-Mode Rejection—≥ 50 dB at 50 or 60 Hz. Typically ≥40 dB to 300 kHz.

PROGRAMMABILITY (AA 5001 ONLY)

Function (Level or THD or IMD). Level Mode (Volts or dBm). Input Level and Distortion Ranges (Auto-range or default to range selected by front-panel switches).

Detector Type (RMS or AVG; or RMS or Q-PK on Option 02).

Filter Selection (400-Hz Hi Pass, 80-kHz Low Pass, 22.4 Hz to 22.4 kHz Band-Pass, "A" Weight (or CCIR WTG on Option 02, Ext Filter).

GPIB Interface Function Subsets Implemented—SH1, AH1, T6, L4, SR1, RL1, PP0 , DC1, DT0 , C0.

FRONT-PANEL SIGNALS

Input Monitor—Provides constant-amplitude version of signal applied to input. Output Voltage: 1 V RMS ±10% for input signals >50 mV. Source Impedance: 1 kΩ ±5%.

Function Output—Provides a scaled sample of selected function signal. Output Voltage: 1 V RMS ±3% for 1000 count display. Source Impedance: 1 kΩ ±5%.

Auxiliary Input—Provides input to detector circuit when Ext Filter button is depressed. Sensitivity: 1 V RMS ±3% = 1000 count display. Impedance: 100 kΩ ±5%, ac coupled.

REAR-INTERFACE SIGNALS

Duplicates of all front-panel inputs and outputs are provided to allow external filter connections or oscilloscope monitoring within same mainframe without exposed cables. Detector outputs with specified scale factors also available to drive analog chart recorders, storage oscilloscopes, or similar devices.

ORDERING INFORMATION

AA 5001 Programmable Distortion Analyzer **$3,550**

Includes: Instruction manual (070-4598-01); instrument interface guide (070-4788-00); reference guide (070-4597-00).

AA 501A Distortion Analyzer **$2,600**

Includes: Instruction Manual (070-2958-00).

OPTIONS

Option 01—(AA 501A only) Intermodulation Distortion. **+$750**

Option 02—CCIR/DIN Includes Option 01.

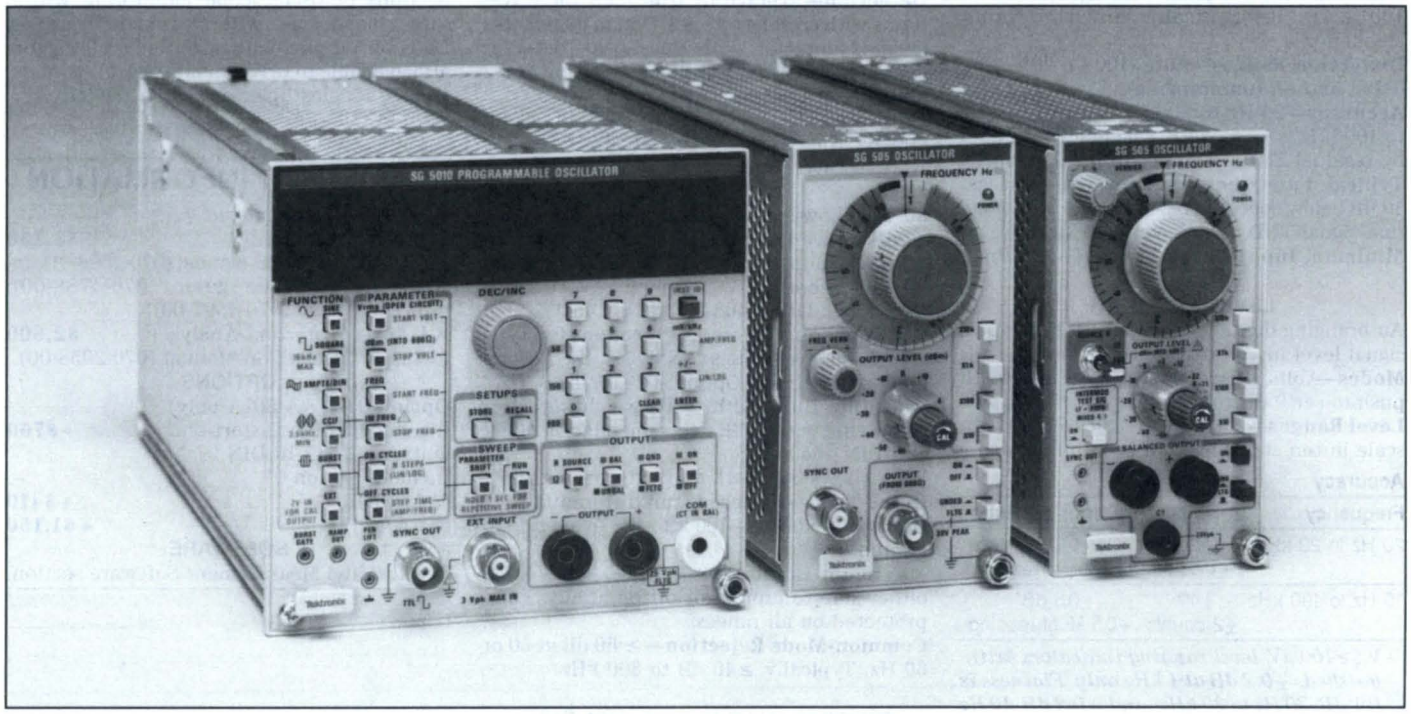
(AA5001) **+$410**

(AA501A) **+$1,150**

SOFTWARE

See Test and Measurement Software section.

LOW-DISTORTION OSCILLATORS



SG 5010
SG 505 Option 01/Option 02

GPIB IEEE-488

The SG 5010 complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

- **10-Hz to 100-kHz Sine Wave Output**
- **Ultra-Low Distortion: <0.0008% THD (Typically 0.0003%)**
- **Floating or Grounded Output**
- **600-Ω Source Impedance**
- **Vernier Frequency Control**
- **Fully Balanced Output to +28 dBm (SG 505 Option 02)**
- **Selectable Source Impedance (SG 505 Option 02)**
- **Intermodulation Test Signal (Options 01 and 02)**

The SG 5010 and SG 505 Oscillators generate an ultra-low distortion sine wave from 10 Hz to 163.8 kHz (SG 505 to 100 kHz) with less than 0.0008% and 0.0032% THD respectively. The THD is typically less than 0.0003% in the 20 Hz to 20 kHz range.

The SG 5010 offers the full benefits of TM 5000 configurability, GPIB compatibility, and compliance with Tektronix *Standard Codes and Formats.* It generates five waveforms: sine wave, square wave, SMPTE/DIN intermodulation test signal, CCIF intermodulation test signal, and sine wave burst. All of these signals may by swept in frequency or amplitude. The five-digit LED display indicates parameter values and units plus indicators for the remote and addressed states. Three source impedances are selectable and the output signal can be grounded or floating, balanced or unbalanced. Output amplitude is programmable from 0.2 mV to 21.2 V peak equivalent V rms, supplying up to 28 dBm into a 600 ohm load.

On the SG 505 a FREQUENCY Hz dial provides frequency adjustment within each band. A FREG VERNIER control permits extremely fine frequency adjustment (to Z ±1%) range. The dial setting distortion is less than or equal to 0.0008% from 20 Hz to 20 kHz. An OUTPUT LEVEL switch, calibrated in 10 dBm into a 600 ohm load, selects eight level steps at the OUTPUT. The SYNC OUT connector provides approximately 200 mV rms fixed amplitude and ground-referenced sine wave signal at the same frequency as the OUTPUT.

The SG 505 Option 01 adds an intermodulation test function. The Intermodulation Test Signal pushbutton mixes an internally selectable 60 or 250 Hz sine wave with the normally selected frequency in a 4:1 amplitude ratio. The composite peak-to-peak amplitude is calibrated to be identical with the peak-to-peak amplitude of the OUTPUT signal in the normal oscillator mode.

The SG 505 Option 02 adds the Option 01 (intermod) and changes the SG 505 to have a balanced output with an amplitude range of +22 dBm to −68 dBm; the variable attenuator provides a continuous adjustment from CAL. A front panel control selects a source resistance of 600, 150, or 50 ohms.

CHARACTERISTICS (SG 5010)

AVAILABLE FUNCTIONS

Sine wave, square wave, SMPTE/DIN 4:1, SMPTE DIN 1:1, CCIF, Sine-Wave Burst, IHF Burst (±20 dB or Off between bursts), External Input (Amplifier Mode).

FREQUENCY RANGE AND ACCURACY

Sine Wave, Sine-Wave Burst—SMPTE/DIN: 10 Hz to 163.80 kHz ±0.01%. CCIF Center Frequency: 2.500 to 163.80 kHz ±0.01%. Square Wave: 10 Hz to 16.380 kHz ±0.01%.

Resolution in Above Functions—10.00 to 163.80 Hz: 0.01 Hz. 163.9 Hz to 1.6380 kHz: 0.1 Hz. 1.639 to 16.380 kHz: 1.0 Hz. 16.39 to 163.80 kHz: 10.0 Hz.

SMPTE Lower Tone, CCIF Offset From Center Frequency—Selectable From: 40, 50, 60, 80, 100, 125, 250, 500 Hz, all ±2%.
Sine Distortion (Load ≥600 Ω, THD Including 2nd Through 5th Harmonics)—20 Hz to 20 kHz: 0.001% (−100 dB). 20 to 50 kHz: 0.0032% (−90 dB). 10 to 20 Hz and 50 to 100 kHz: 0.01% (−80 dB). 100 to 163.8 kHz: 0.032% (−70 dB) any individual harmonic.
Sine Flatness—20 Hz to 20 kHz: 0.05 dB. 10 Hz to 163.8 kHz: 0.2 dB.
Square-Wave Rise Time—1.5 μs ±10%.
Burst Range—1 to 65535 cycles On. 1 to 65535 cycles Off. Off Level either −20 dB or zero. All switching at sine-wave zero crossing. Triggered, gated, or free-running burst modes available.

OUTPUT LEVEL RANGE AND ACCURACY

Balanced—Into Open Circuit: 200 μV to 21.2 V RMS. Into 600 Ω: −72.45 to +28.05 dBm.*1
Unbalanced—Into Open Circuit: 200 μV to 21.2 V RMS. Into 600 Ω: −72.45 to +22.05 dBm.*1
Resolution—0.05 dB in dBm mode, 0.25% or better in volts mode.
Level Accuracy (Sine Wave)—20 Hz to 20 kHz ±2% (0.2 dB). 10 Hz to 163.8 kHz ±3 (0.3 dB).

*1 *R_s = 50 Ω. For R_s = 150 Ω, subtract 1.25 dBm; for R_s = 600 Ω, subtract 5.35 dBm.*

OUTPUT IMPEDANCE AND CONFIGURATION

50 Ω ±3%, 150 Ω ±2%, or 600 Ω ±1%, balanced or unbalanced, floating or grounded.

EXTERNAL INPUT

A floating single-ended input is provided for accessing the variable-gain stage and high-level output amplifier, enabling the use of custom test signals. Input impedance is 20 kΩ; a 2-V RMS input (2.83 V peak maximum) provides a calibrated output.

SYNC OUTPUT

A ground referenced TTL-compatible signal is provided that allows stable oscilloscope display of all functions. In sine- and square-wave modes, the output is at the signal frequency. In the IM modes, the sync output is at the lower or offset frequency. In both burst modes, the sync signal follows the burst envelope.

SWEEP MODE

Linear or logarithmic sweep of amplitude or frequency in any function. Sweep is composed of discrete steps. The following sweep functions are programmable via GPIB or from the front panel: swept parameter (frequency or amplitude), linear or log sweep, number of steps up to 99, time per step from 0.1 to 25 s, start frequency or voltage, and stop frequency or voltage. Start and stop frequencies or voltages can be anywhere within the range of the generator, and sweep direction can be upward or downward. Pen lift and ramp outputs are available for interface to an analog plotter.

STORED SETUPS

Ten different complete front-panel setups can be stored in the nonvolatile internal memory and recalled from front-panel pushbuttons or via the GPIB. Additionally, the front-panel settings at power down are retained and used at power up.

PROGRAMMABILITY

All functions, parameters, and modes can be controlled over the GPIB using simple English-like commands. All settings can be interrogated, with the resulting response usable as a command to return the instrument to that setting (Learn mode). The GPIB address can be displayed and changed from the front panel.
GPIB Interface Function Subsets Implemented—SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0.

CHARACTERISTICS (SG 505)

MAIN OUTPUT

The following characteristics are common to the standard SG 505 and Option 01.
Frequency Range—10 Hz to 100 kHz in four overlapping bands. Accurate within 3% of dual setting (with Vernier at center). Vernier Range is at least ±1% of frequency setting.
Calibrated Output—Selectable from +10 to −60 dBm into 600 Ω in eight 10-dB steps. Accurate to within 0.2 dB at 10 dBm and 1 kHz. Step accuracy is ±0.1 dB/10 dB step. An uncalibrated control provides continuous variation from at least +2.2 dB to < −10 dB from calibrated positon.
Amplitude Response—Level flatness ±0.1 dB from 10 Hz to 20 kHz (1-kHz ref); within 0.2 dB from 20 to 100 kHz (excluding > −60-dB output-level range).
Harmonic Distortion—<0.0008% (−102 dB) THD from 20 Hz to 20 kHz (typically 0.0003%); 0.0018% (−95 dB) THD from 10 to 20 Hz, and from 20 to 50 kHz; 0.0032% (−90 dB) THD from 50 to 100 kHz (R_L ≥ 600 Ω).
Output Impedance—600 Ω ±2%; floating or grounded through ≈30 Ω. Output impedance does not change with Output On/Off selection. Maximum floating voltage ±30 V peak.
Maximum Output Voltage—At least 6 V RMS open circuit; 3.16 V RMS (+10 dBV or +12.2 dBm) into 600 Ω.

SYNC OUTPUT

Signal—200 mV RMS ±20% sine wave to 20 kHz, at least 120 mV RMS at 100 kHz.
Frequency—Same as main output.
Impedance—Nominally 1 kΩ, ground referenced and isolated from main output.

REAR INTERFACE SIGNALS

Buffered Main Output—Buffered version of actual output signals from front-panel connector. ≈600 Ω Output impedance.
Sync Output—Same as front-panel Sync Output except output impedance is ≈50 Ω.

(SG 505) OPTION 01 IM Test Signal

Selecting the IM Test Signal causes an LF sine wave to be mixed with the normal oscillator signal in a 4:1 amplitude ratio.
LF Frequency—Internally selectable 60 Hz (±1 Hz) or 250 Hz (±3 Hz).
Main Output—Composite p-p output within 0.2 dB of normal oscillator mode output.
Residual IMD—Typically <0.0005% from 2.5 to 10 kHz.
Sync Output—LF signal component only, 200 mV RMS ±20%.

(SG 505) OPTION 02 Oscillator

MAIN OUTPUT

Calibrated Output—Selectable from +22 to −68 dBm into 600 Ω in ten 10-dB steps. Accurate to within 0.2 dB at +22 dBm and 1 kHz. Step accuracy is ±0.1 dB/10 dB-step or 20-dB-step change. An uncalibrated control provides continuous variation from < −10 to +0.3 dB from calibrated position.
Harmonic Distortion—<0.0008% (−102 dB) THD from 20 Hz to 20 kHz (typically 0.0003%); 0.0018% (−95 dB) THD from 10 to 20 Hz, and from 20 to 50 kHz; 0.0056% (−85 dB) THD from 50 to 100 kHz (R_L ≥ 600 Ω).
Output Impedance Selectable—600 Ω ±2%, 150 Ω ±2% or 50 Ω ±3% floating or grounded through ≈30 Ω. Output impedance does not change with Output On/Off selection. Impedance to CT is ½ the selected impedance. Maximum floating voltage ±25 V peak.
Maximum Output Voltage—At least 21 V RMS open circuit; 19.45 V RMS (+28 dBm) into 600 Ω from 50 Ω.
Balance—≤0.5% mismatch of output open-circuit voltages referenced to CT for f ≤20 kHz with output grounded.

ORDERING INFORMATION

SG 5010 Programmable Oscillator. **$4,195**
Includes: Instruction manual (070-4331-00), instrument interface guide (070-4790-00), reference guide (070-4330-00).
SG 505 Oscillator. **$950**
Includes: Cable assembly for sync output (175-1178-00); instruction manual (070-2823-00).

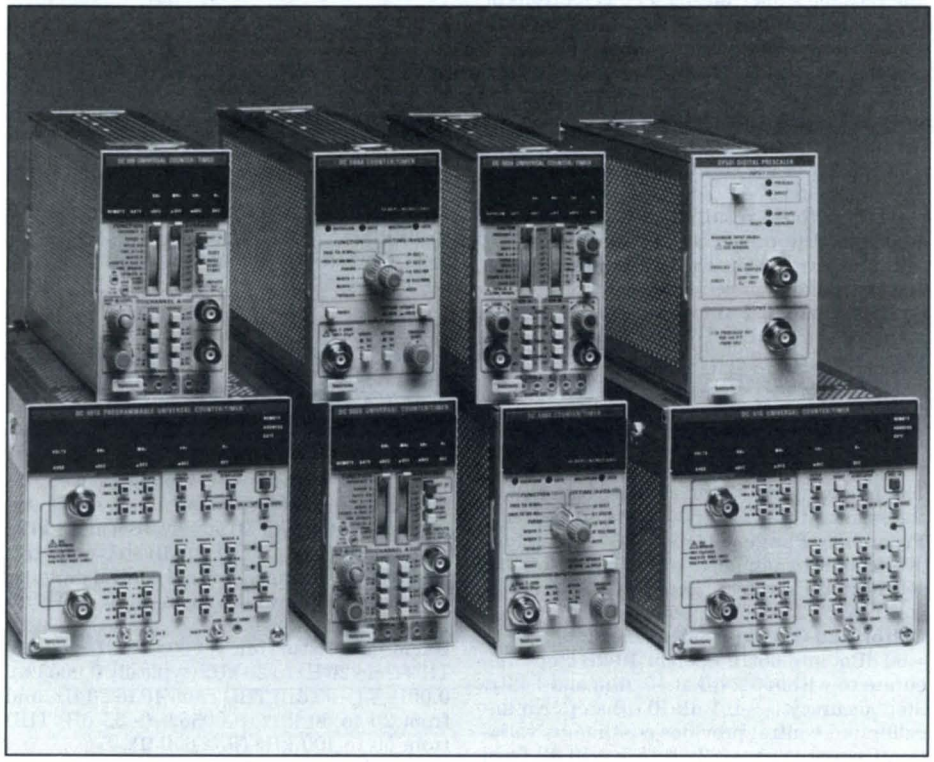
SG 505 OPTIONS

Option 01—IM Test Signal **+$225**
Option 02—Oscillator (+Option 01) **+$730**

RECOMMENDED SOFTWARE

EZ-TEST PC—Order S45F030. **$1,795**
IBM BASICA Programs Available with GURU II Package: AUDIO-DEM BAS, TPG.BAS.
Order S3FG100. **$995**

DIGITAL COUNTER/TIMERS



A Counter for Every Purpose

The TM 500/TM 5000 family of modular instruments includes seven digital counter/timers, which provide a wide variety of price/performance features. The DP 501 digital prescaler extends the frequency measurement capability of most counters to 1.3 GHz.

The 350-MHz DC 5010/DC 510, and the 135-MHz DC 5009/DC 509, are universal counter/timers that feature reciprocal frequency measurements and an especially wide range of other measurement functions, plus features such as autotrigger, auto-averaging, arming, probe compensation, and more. The DC 5004, DC 5010 and DC 5009 are GPIB programmable; this capability can be added to the DC 504A, DC 510 and DC 509 as field modifications. In performance other than programmability, the DC 510 and DC 5010 are equal, as are the DC 5009 and DC 509, the DC 504A and DC 5004.

For versatility in counting, the DC 503A 125-MHz Universal Counter/Timer features eight measurement functions, including period, width, and time-interval averaging. Both input channels have the full 0 to 125-MHz frequency range, 20-mV RMS sensitivity, and separate controls for input coupling, attenuation, trigger level, and trigger slope. The 10-MHz clock provides 100-ns resolution of single-shot time interval measurements, and 10-ps resolution with averaging.

The 100-MHz DC 5004/DC 504A features autorange, period and width averaging, an internal 100X multiplier to provide high resolution of low frequency signals. The DC 5004 adds TM 5000 compatibility, GPIB programmability, and 8-digit resolution over the GPIB. It is an excellent alternative for applications requiring low cost GPIB compatibility.

The DP 501 Digital Prescaler adds 1.3-GHz frequency-counting capability to all of the above counters.

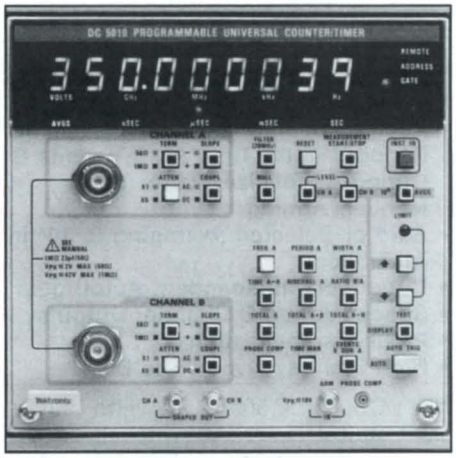
Accessory Probe

An optional accessory probe, the Tektronix P6125, has been especially designed for use with digital counters. The 5X attenuation provides an optimum match between the counter input characteristics and the voltage levels of all common logic families. Low input capacitance permits acquisition of high-frequency signals with minimum loading of the circuits under test.

DIGITAL COUNTERS SELECTION GUIDE

Application/Feature	DC 510/DC 5010	DC 509/DC 5009	DC 503A	DC 5004/ DC 504A
Frequency Range	350 MHz	135 MHz	125 MHz	100 MHz
Number of Digits	9	8	8	*6
Ratio Architecture	✓	✓		
Period Averaging	✓	✓	✓	✓
Width Averaging (Single Input)	✓	✓	✓	✓
Time Interval Averaging	✓	✓	✓	
Autotrigger	✓	✓		
Gated Events Averaging	B during A	B during A	A during B	
Ratio Averaging	✓	✓	✓	
Other	High stability time base, trigger level and shaped outputs, self-test, phase modulated clock, probe compensation, time manual, totalize.	High stability time base, trigger level and shaped outputs, self-test, phase modulated clock, probe compensation, time manual, totalize.	High stability time base trigger level and shaped outputs, time manual, totalize.	Autorange, 100X resolution multiplier*1
IEEE Standard 488.1-1987	DC 5010 only	DC 5009 only		DC 5004 only
Mainframe Compatibility	DC 510 TM 500/ TM 5000 DC 5010 TM 5000 only	DC 509 TM 500/ TM 5000 DC 5009 TM 5000 only	TM 500/ TM 5000	TM 500/ TM 5000 DC 5004 TM 5000 only
Page	379	380	382	381

*1 *8 digits via GPIB (DC 5004).*



DC 5010 Programmable Counter/Timer

DC 5010/DC 510

GPIB IEEE-488 The DC 5010 complies with IEEE Standard 488.1-1987, and with Tektronix *Standard Codes and Formats.*

- **350 MHz both A and B Channels**
- **3.125-ns Single-Shot Resolution**
- **9-Digit Display**
- **1-ps Resolution, with Averaging**
- **Reciprocal Frequency Measurement; Period; Width; Time A→B; Events B During A; Totalize A, A+B, A−B; Ratio; Rise/Fall; Time Manual; Arming; Null**
- **Auto or Selected Averaging to 10^9 in All Modes**
- **Duty-Cycle Independent Autotrigger**
- **DVM Mode for Displaying Trigger-Level Setting**
- **Shaped A and B Channel Outputs**
- **Hysteresis Compensation**
- **Probe Compensation**
- **High Stability Oven Time Base**

The DC 5010/DC 510 Universal Counter/Timers feature reciprocal frequency to 350 MHz, period, ratio, events B during A measurements, and time A to B. The powerful reciprocal technique provides high resolution of low frequency signals much faster than conventional counting techniques.

Timing measurements include time interval, width, and rise and fall time features to 3.125 ns single-shot resolution. Measurements can be averaged up to 1 billion times with usable resolution to 1 picosecond. The pseudo-random, phase-modulated time base provides increased accuracy by eliminating synchronous errors in the time interval and width averaging modes.

Auto trigger senses the applied signal and sets trigger levels to the optimum points. In the DC 5010, trigger levels, the minimum and maximum signal voltage levels, and the trigger voltage are available over the GPIB, and can be viewed on the 9-digit display.

Other features include an arming input that allows measurement of selected inputs from complex waveforms, hysteresis compensation and probe compensation for attenuator type probes.

The DC 510 is upgradeable to the GPIB compatible DC 5010 with a modification kit that can be installed in the field.

CHARACTERISTICS

Display—Nine-digit LED display, automatic decimal point positioning, LED indicators for units, measurement gate, and bus conditions. Overflow is indicated by a blinking display.

CHANNEL A AND CHANNEL B INPUT

Frequency Range—50 Ω termination >0 to ≥350 MHz dc coupled. 100 kHz to ≥350 MHz ac coupled. 1 MΩ termination >0 to ≥300 MHz dc coupled. 16 Hz to ≥300 MHz ac coupled.
Sensitivity—50 Ω termination dc: ≤25 mV RMS sinewave to 350 MHz. ≤70 mV p-p pulse. 1 MΩ termination. DC/AC ≤25 mV RMS to 200 MHz. 42 mV RMS to 300 MHz.
Attenuation—Selectable 1X, 5X.
Impedance—1 MΩ paralleled by 23 pf ±2.2 pF (10%) or 50 Ω ±3% dc.
Dynamic Range—70 mV p-p to 4 V p-p (x attenuation).
Trigger Level Range—≥+2 V to ≤−2 V with 4 mV resolution (X1). ≥±10 V to ≤−10 V with 20 mV resolution (X5).
Trigger Level Accuracy—±1% of F.S. trigger level range, plus ±2% of reading for a dc input V, ±40 mV x attenuator.
Autotrigger Frequency Range—10 Hz to ≥350 MHz.
Independent Controls—Slope ±, Attenuation 1X/5X, Couple ac/dc, Impedance 1 MΩ/50 Ω.
Maximum Input Voltage (1 MΩ input impedance)—1X: ±42 V (dc + peak ac) to 200 kHz; ±2 V (dc + peak ac) 2 to 250 MHz. 5X: ±42 V (dc + peak ac) to 1 MHz; ±10 V (dc + peak ac) 1 to 250 MHz.
In 50 Ω Input Impedance: Signals >±2 V ×attenuator will cause input protection circuitry to switch input to 1 MΩ.
Shaped Out—Shaped replica of signal being measured, aids proper triggering on complex waveforms (≥100 mV typically to 350 MHz into 50 Ω load).
Arming Input—Permits measurements of complex waveforms. A TTL high allows averaging of selected events within a measurement.

FREQUENCY A

Range—≤36 μHz to ≥350 MHz.
Resolution—

$$\pm\text{LSD} \pm 1.4 \times \frac{\text{A Trigger Jitter Error}}{N} \times (\text{Frequency A})^2$$

Accuracy—Resolution ±(Time Base Error × Frequency A).

PERIOD A

Range—3.125 ns to 7.6 hrs.
Resolution—

$$\pm\text{LSD} \pm \frac{1.4 \times \text{A Trigger Jitter Error}}{N}$$

Accuracy—Resolution ±(Time Base Error) ×Period A.

RATIO B/A

Range—10^{-8} to 10^9 (Frequency Range: ≤36 μHz to ≥350 MHz).
Resolution—

$$\pm\text{LSD} \pm \frac{1.4 \times \text{B Trigger Jitter Error} \times \text{Frequency B}}{N}$$

Accuracy—Same as Resolution.

TIME A→B

Range—2.0 ns to 7.6 hrs.
Minimum Dead Time—12.5 ns (stop to start).
Resolution—

$$\pm\text{LSD} + \frac{1}{\sqrt{N}} \times (\pm\text{A Trigger Jitter Error} \pm \text{B Trigger Jitter Error}).$$

Accuracy—Resolution ±(Time Base Error ×TI) ±Channel Delay Mismatch+B Trigger slew error-A Trigger slew error.
Channel Delay Mismatch—<2 ns between front panel inputs.
Resolution—Best time A→B Avg resolution = ±1 ps.
Repetition Rate—≥70 MHz.

[1] Can be removed with "Null."

EVENTS B DURING A

Range—10^{-8} to 10^9.
Maximum B Frequency—≥350 MHz.
Maximum A Frequency—≥80 MHz.
Maximum A Pulse Width—≤4.0 ns.
Minimum Time Between A Pulses—≤8.5 ns.
Minimum Dead Time Between Pulses—≤8.5 ns.
Resolution—

$$\pm\text{LSD} + \frac{\text{Frequency B}}{\sqrt{N}}$$

±(Trigger Jitter Error CH A start edge ±Trigger Jitter Error CH A stop edge).
Accuracy—Resolution +Frequency B (Stop Slew Rate Error−Start Slew Rate Error)+ Frequency B×(5±2 ns).

WIDTH A

Range—≤4 ns to 7.6 hrs.
Minimum Dead Time Between Pulses—1.6 ns.
Resolution—

$$\pm\text{LSD} + \frac{1}{\sqrt{N}} (\pm\text{Start Trigger Jitter Error} \pm \text{Stop Trigger Jitter Error}).$$

Accuracy—Resolution ±(Time Base Error ×Width A)+(Stop Slew Rate Error−Start Slew Rate Error)±2 ns.
Repetition Rate—≥80 MHz.

TIME MANUAL

Range—3.125×10^4 s (≈ 8 hrs).
Resolution—±LSD 100 ms.
Accuracy—±Resolution ±(Time Base Error ×Time).

TOTALIZE A

Range—0 to 10^9 counts.
Repetition Rate—0 to ≥350 MHz.

TOTALIZE A+B

Range—0 to 10^9 counts (A+B≤10^9).
Repetition Rate—0 to ≥350 MHz.

TOTALIZE A−B

Range—-1×10^8 to $+1 \times 10^9$ (either A>10^{12} or B>10^{12} will cause overflow).
Repetition Rate—0 to ≥350 MHz.

RISE/FALL A

Range—5 ns to 10^4 s (50 Ω) 5 ns to 10^4 s (1 MΩ).
Repetition Rate—Minimum time between rising (falling) edges is 12.5 ns (80 MHz).
Input Amplitude—(1.4 to 8 V) 1.4 V p-p min, +4 to −4 V Dc + peak AC max (50 Ω), (0.7 to 4 V) 700 mV p-p min, +2 to −2 V DC + peak AC max (1 MΩ).
Resolution—

$$\pm \text{LSD} + \frac{1}{\sqrt{N}} \ (\pm\text{Start Trigger Jitter Error} \pm \text{Stop Trigger Jitter Error}).$$

Accuracy—Resolution ± (Time Base Error × Risetime/Falltime) ±2 ns ± 4 mV × Slew Rate A Error (near 10%) ± 4 mV Slew Rate A Error (near 90%).

PROBE COMPENSATION

Display—1 or 0 in each channel.
Accuracy—Probe Attenuation × Counter Attenuation × 0.300 (%).

RESOLUTION AND ACCURACY DEFINITIONS

Trigger Jitter Error (Seconds RMS)—

$$\frac{\sqrt{(e_{n1}{}^2 + (e_{n2})^2}\ \text{(Volts RMS)}}{\text{Input Slew Rate at trigger point (V/s)}}$$

Where: e_{n1} *= 140 μV RMS typical counter input noise for 1 MΩ filter on; 250 μV RMS typical for 1 MΩ, filter off and 340 μV RMS typical for 50 Ω.*
e_{n2} *= RMS Noise Voltage of input signal to trigger point measured with 350 MHz bandwidth.*

Slew Rate Error (Seconds)—

$$\frac{\text{Trigger Level Error (V)}^{*1}}{\text{Input Slew Rate at Trigger Point (V/s)}}$$

*1 Trigger level error =

All functions except Width and Events B During A	Positive Slope	Trigger accuracy times ATTN factor
	Negative Slope	(Trigger accuracy ± 10 mV) times ATTN factor
Width A	Start Edge	Trigger accuracy times ATTN factor
	Stop Edge	(Trigger accuracy + hyst) times ATTN factor
	Start Edge	(Trigger accuracy + hyst) times ATTN factor
	Stop Edge	Trigger accuracy times ATTN factor
Events B During A	Same as Width, except each number is multiplied (Frequency B)	

Note: Input hysteresis is typically 50 mV p-p x attenuation.
N = Number of events averaged.

The minimum number of averages is selected by the Averages button and the ↑↓ buttons in decade steps from 1 to 10^9. At Channel A repetition rates above ≈250 Hz, the actual number of averages will be:
N = [Frequency A (Hz) × 4 ms] + Averages.
N = Averages setting (below 250 Hz).

This calculation typically leads to better than expected resolution in the displayed answer for small N with only minimal impact on measurement time. It does nean, however, that Arming must be used where only N = 1 is for signals ≥250 Hz.

In the Auto mode, the counter measures with a fixed measurement time of about 300 ms (or the time for one event, whichever is greater).
N = Frequency A (Hz) × 0.3 s
(N always ≥1).
Time Base Error—The sum of all errors specified for the time based used.

STANDARD HIGH STABILITY TIME BASE

Crystal Frequency—10 MHz.
Temperature Stability—$\pm 2\times10^{-7}$ 0 to +50 °C after warm-up.
Warn-Up Time—$\pm 2\times10^{-7}$ of final frequency in <10 minutes when cold started at 25 °C.
Aging Rate—$\leq 1\times10^{-8}$/day at time of shipment, 4×10^{-8}/week after 30 days of continuous operation, 4×10^{-6}/year after 60 days of continuous operation.
Setability—Adjustable to within $\pm 2\times10^{-8}$.

REAR INTERFACE

Inputs—Arming; reset; external time base (1, 5, or 10 MHz), prescale.
Outputs—1 MHz clock.

OTHER CHARACTERISTICS

Power Consumption—19.3 W.
GPIB Data Output Rate—≈10 readings/s maximum (DC 5010 only).
TM 5000 Power Module Compatibility—The DC 5010 is not compatible with TM 500 Series mainframes; the DC 510 is compatible with both.

ORDERING INFORMATION

DC 5010 Programmable Universal Counter/Timer. **$3,600**
Includes: Shaped output cable (012-0532-00); instruction manual (070-3897-02); instrument interfacing guide (070-4611-00); reference guide (070-3553-00).
DC 510 Universal Counter/Timer **$3,300**

RECOMMENDED PROBE

P6125—5X Passive Probe **$80**

DC 5009 Programmable Counter/Timer

DC 5009/DC 509

GPIB IEEE-488

The DC 5009 complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

- **135 MHz Both A and B Channels**
- **10-ns Single-Shot Resolution**
- **8-Digit Display**
- **5-ps Resolution, with Averaging**
- **Reciprocal-Frequency Measurement; Period; Width; Time A→B; Events B During A; Totalize; Ratio; Time Manual; Arming**
- **Auto or Selected Averaging to 10^8 in All Modes**
- **Duty-Cycle Independent Autotrigger**
- **Shaped A and B Channel Outputs**
- **Probe Compensation**
- **High Stability Oven Time Base**

The DC 5009/DC 509 single-width Universal Counter/Timers provide all of the measurement functions of the higher performance DC 5010/DC 510 except rise time/fall time, null, and totalize A ± B.

The powerful reciprocal-frequency measurement technique allows up to eight digits of resolution of low-frequency signals in one second or less of measurement time. The DC5009/DC509 has the same automatic averaging feature as the DC 5010/DC 510; selected averaging of up to 10^8 events provides usable time-interval resolution of 5 ps.

The TM 5000 rear-interfacing capability allows the operation of the DP 501 to be controlled over the GPIB through the DC 5009 frequencies to 1.3 GHz.

A field-installable modification kit is available to upgrade a manual DC 509 Universal Counter/Timer to a GPIB programmable DC 5009 Universal Counter/Timer.

CHARACTERISTICS

Display—Eight-digit LED display, automatic decimal point positioning, LED indicators for units, and measurement gate. Overflow is indicated by a blinking display.

CHANNEL A AND B INPUT

Frequency Range—>0 to ≥135 MHz dc coupled; ≤10 Hz to ≥135 MHz ac coupled.
Sensitivity—≤20 mV RMS (56.6 mV p-p) to ≥100 MHz, 40 mV RMS (113 mV p-p) to ≥135 MHz, 115 mV p-p at minimum, pulse width of 3 ns.
Attenuation—Selectable 1X, 5X.
Impedance—1 MΩ ±2% paralleled by ≤30 pF.
Trigger Level Range—+3.200 to −3.175 V with 25 mV resolution (X1), +16 to −15.875 V with 125 mV resolution (X5).
Trigger Level Accuracy—±15 mV ±40 μV/°C referenced to 25 °C.
Dynamic Range—−3.2 ≤input voltage ≤+3.2. X1: V_{in} p-p ≤3 V; X5: V_{in} p-p ≤15 V (for input signal risetimes ≤5 ns).
Autotrigger Frequency Range—Sensitivity: ≤125 mV p-p × attenuation; ≤20 Hz to ≥100 MHz. Range: ±3.2 V × attenuation. Resolution: 25 mV × attenuation.
Independent Controls—Slope ±, attenuation 1X/5X, Couple ac/dc, Source Internal/External.

Maximum Input Voltage—1X: ≤200 V peak; ≤400 V p-p from dc to 50 kHz, derate to ≤15 V p-p at 135 MHz.
5X: ≤200 V peak; ≤400 V p-p from dc to 5 MHz, derate to ≤25 V p-p at 135 MHz.
Shaped Out—Shaped replica of signal being measured, aids proper triggering on complex waveforms. Amplitude 0 V to ≥+0.3 V from 50 Ω.
Trigger Level Out—A dc level corresponding to the actual trigger level. Accuracy within ±10 mV of internal trigger level.
Arming Input—Permits measurements of complex waveforms. A TTL high allows averaging of selected events within a measurement.

FREQUENCY A

Range—≤100 μHz to ≥135 MHz.
Resolution—

$$\pm LSD \pm 1.4 \times \frac{\text{A Trigger Jitter Error}}{N} \times (\text{Frequency A})^2$$

Accuracy—Resolution ± (Time Base Error × Frequency A).

PERIOD A

Range—≤7.40 ns to ≥3.05 hrs.
Resolution—

$$\pm LSD \pm 1.4 \times \frac{\text{A Trigger Jitter Error}}{N}$$

Accuracy—Resolution ± (Time Base Error × Period A).

RATIO B/A

Range—10^{-7} to 10^{8} (Frequency Range: CH A to ≥135 MHz; CH B to ≥125 MHz).
Resolution—

$$\pm LSD \pm 1.4 \times \frac{\text{B Trigger Jitter Error} \times \text{Frequency B}}{N}$$

Accuracy—Same as Resolution.

TIME A→B

Range—≤15 ns to ≥3.05 hrs.
Minimum Dead Time—15 ns (stop to start).

Resolution—

$$\pm LSD + \frac{1}{\sqrt{N}} \times (\pm \text{A Trigger Jitter Error} \pm \text{B Trigger Jitter Error}).$$

Accuracy—Resolution ± (Time Base Error × Time A→B) + (B Trigger Slew Error–A Trigger Slew Error) ± (Channel Delay Mismatch).
Channel Delay Mismatch—<2 ns between front panel inputs and <2 ns between rear interface inputs.
Repetition Rate—<35 MHz.

EVENTS B DURING A

Range—10^{-7} to 10^{8}.
Maximum B Frequency—125 MHz.
Minimum A Pulse Width—15 ns.
Minimum Time Between A Pulses—15 ns.
Minimum Time Between "A" Start Edge and First "B" Event—15 ns.

Resolution—

$$\pm LSD + \frac{\text{Frequency B}}{\sqrt{N}}$$

±Trigger Jitter Error CH A start edge
±Trigger Jitter Error CH A stop edge.
Accuracy—Resolution + Frequency B (Stop Slew Rate Error–Start Slew Rate Error).

WIDTH A

Range—≤15 ns to ≥3.05 hrs.
Minimum Dead Time Between Pulses—15 ns.

Resolution—

$$\pm LSD + \frac{1}{\sqrt{N}}$$

(±Start Trigger Jitter Error
±Stop Trigger Jitter Error).
Accuracy—Resolution ± (Time Base Error × Width A) + (Stop Slew Rate Error–Start Slew Rate Error) ± 5 ns.

TIME MANUAL

Range—0 to 3.05 hrs. May be extended with GPIB.
Resolution—±LSD (100 ms).
Accuracy—±Resolution ± (Time Base Error × Time).

TOTALIZE A

Range—0 to 1.09×10^{12} counts. May be extended with GPIB.
Repetition Rate—>0 to ≥135 MHz.

PROBE COMPENSATION

Display—1 or 0 for each channel.
Accuracy—

$$\frac{\text{Probe Attenuation} \times 50 \text{ mV} \times 100\ (\%)}{V_{IN} \text{ at Probe}}$$

(2.5% nominal for X5 probe with 10 V p-p at the probe).

RESOLUTION AND ACCURACY DEFINITIONS

Trigger Jitter Error (Seconds RMS)—

$$\frac{\sqrt{(e_{n1})^2 + (e_{n2})^2}\ (\text{Volts RMS})}{\text{Input Slew Rate at trigger point (V/s)}}$$

Where: e_{n1} = 120 μV RMS typical counter input noise.
e_{n2} = TMS Noise Voltage of input signal at trigger point measured with 150 MHz bandwidth.

Slew Rate Error (Seconds)—

$$\frac{\text{Input Hysteresis}/2}{\text{Input Slew Rate at trigger point (V/s)}}$$

Note: Input hystersis is typically 20 nV p-p. N = Number of Events Averaged.

The minimum number of averages is selected by the averages control in decade steps from 1 to 10^{8}. At channel A repetition rates above ≈250 Hz, the number of events averaged will be:
N = [Frequency A (Hz) × 4 ms] + Averages.
N = Averages setting (below 250 Hz).

In the Auto mode, the counter measures with a fixed measurement time of about 300 ms.
N = Frequency A (Hz) × 0.3 s. (N is always ≥1).
Time Base Error—The sum of all errors specified for the time base used.

STANDARD HIGH STABILITY TIME BASE

Crystal Frequency—10 MHz.
Temperature Stability—$\pm 2 \times 10^{-7}$ after warm-up, 0 to +50 °C.
Warm-up Time—Within 2×10^{-7} of final frequency in <10 minutes when cold-started at 25 °C.
Aging Rate—1×10^{-8}/day at time of shipment, $4 \times 103\text{-}3^{8}$/week after 30 days of continuous operation, 1×10^{-6}/year after 60 days of continuous operation.
Setability—Adjustable to within 2×10^{-8}.

REAR INTERFACE

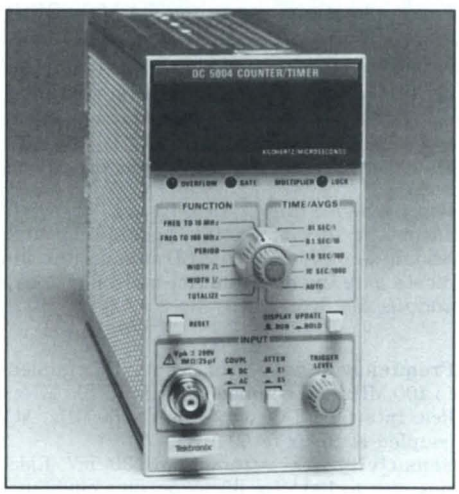
Inputs—Channel A and Channel B input to 50 MHz (50 Ω impedance, maximum input 3.6 V peak); arming; reset; external time base (1, 5, or 10 MHz), prescale.
Outputs—Channel A and Channel B shaped outputs; Channel A and Channel B trigger level outputs; 10 MHz clock; gate out.

OTHER CHARACTERISTICS

Power Consumption—15 W.
GPIB Data Output Rate—≈10 readings/s maximum (DC 5009 only).
TM 5000 Power Module Compatibility—The DC 5009 is not compatible with TM 500 Series mainframes; DC 509 is compatible with TM 500 and TM 5000 mainframes.

ORDERING INFORMATION

DC 5009 Programmable Universal Counter/Timer. **$1,900**
Includes: Tip jack to BNC adapter cable (175-3765-01); instrument interfacing guide (070-4612-00); reference guide (070-3560-01); instruction manual (070-3888-00).
DC 509 Universal Counter/Timer. **$1,600**
Includes: Instruction Manual (070-3464-00).



NEW DC 5004/ DC 504A

GPIB IEEE-488

The DC 5004/DC 504A comply with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats*.

- **DC to 100 MHz**
- **Period and Period Averaging**
- **Width and Width Averaging**
- **Autoranging**
- **100X Resolution Multiplier**

The easy-to-use DC 5004/DC 504A Counter/Timer measures frequency from dc to 100 MHz, with an internal prescaler being used for frequencies above 10 MHz. Both direct and prescaled counting are done through the same input connector; no need to change connectors when changing frequency range. Autoranging permits virtual hands-off operation for most measurements. The 100X resolution multiplier automatically provides 0.01-Hz resolution in one second or 0.001-Hz resolution in ten seconds on signals from 10 Hz to 25 kHz.

The DC 5004/DC 504A features period and width averaging of up to 1000 events. Selectable dc coupling of the input eliminates the potential errors associated with making width measurements on signals of varying duty cycle with counters that are only ac coupled. Input trigger sensitivity is 30-mV RMS across the entire 100-MHz frequency range. The trigger-level range of ±2 V and the selectable 5X attenuator provide a triggering range of up to ±10 volts.

The totalize mode permits totalizing up to 999,999 events—and beyond, with overflow—with a Display Update-Run/Hold control to hold the display while the internal counter continues to advance.

For applications requiring TM 5000/GPIB compatibility, the DC 5004 adds this capability to many of the features of the DC 504A, providing 8-digit resolution over the GPIB.

CHARACTERISTICS

Display—Six-digit LED readout with automatic decimal-point positioning and leading-zero suppression. LED annunciators indicate gate open, resolution multiplier lock, and display overflow.

INPUT

Frequency Range—Front Panel: DC coupled to 100 MHz. AC coupled is 10 Hz to 100 MHz. Rear Interface: DC coupled is 0 to 50 MHz. AC coupled is 10 Hz to 50 MHz.
Sensitivity—1X Attenuation: 30 mV RMS sinewave to 100 MHz; 85 mV p-p (at a minimum pulse width at 5 ns). 5X attenuation accuracy is within 2% at dc.
Attenuation—Selectable 1X, 5X.
Impedance—Front Panel, 1X, 5X: 1 MΩ, paralleled by ≈25 pF. Rear Interface, 1X, 5X: 50 Ω ±10% at dc.
Dynamic Range—1X: 2.0 V p-p signal within a ±2 V dc window. 5X: 10 V peak, ±10 V dc.
Trigger Level Range—±2.0 V×attenuation minimum.
Maximum Input Voltage—Front Panel: 1X is 200 V peak; 400 V p-p from dc to 50 kHz, derate to 15 V p-p from 1.33 to 100 MHz. 5X is 200 V peak; 400 V p-p from dc to 5 MHz, derate to 20 V p-p at 100 MHz. Rear Interface: ≤4 V peak.

FREQUENCY TO 100 MHz

Gate Time (Resolution)—10 ms to 10 s (1 kHz to 1 Hz), selectable in decade steps; or autoranging (10 ms to 1 s only).
Accuracy—$\pm\frac{100\text{ ns}}{N}$ ±Time Base Error
Prescale Factor—÷10.

PERIOD AVERAGE

Range—DC Coupled: 0 Hz to 2.5 MHz. AC Coupled: 10 Hz to 2.5 MHz.
Resolution—100 to 0.1 ns, in decade steps; or autoranging (100 to 1 ns only).
Events Averaged (N)—10^0 to 10^3, in decade steps; or autoranging (10^0 to 10^2 only).
Accuracy—

$$\frac{\pm 100\text{ ns}}{N} \pm\text{Time Base Error}\times\text{Period} \pm 1.4\times\left(\frac{\text{Trigger Jitter Error}}{N}\right)$$

WIDTH AVERAGE

Range—DC Coupled: 200 ns to <10 sec. AC Coupled: 200 ns to 100 ms.

Resolution—$\frac{100\text{ ns}}{\sqrt{N}}$

Events Averaged (N)—10^0 to 10^3, selectable in decade steps; or autoranging (10^0 to 10^2 only).
Accuracy—

$$\frac{100\text{ ns}}{\sqrt{N}} \pm\text{Time Base Error}\times\text{Width}. \pm\frac{\text{Start Trigger Jitter Error}}{\sqrt{N}} \pm\frac{\text{Stop Trigger Jitter Error}}{\sqrt{N}}$$

+(Stop Slew Rate Error−Start Slew Rate Error) ±10 ns.

TOTALIZE

Frequency Range—DC Coupled: >0 Hz to 10 MHz. AC Coupled: 10 Hz to 10 MHz. Overflows above 999,999. Display update Run/Hold will hold display while counter continues to advance. Releasing Run/Hold will update display to new value.

TIME BASE

Frequency (At Calibration)—10 MHz $\pm 1\times10^{-7}$.
Temperature Stability—$\pm 5\times10^{-6}$ (±5 ppm), 0 to +50 °C.
Adjustment Resolution—$\pm 5\times10^{-8}$.
Aging Rate—$\leq 1\times10^{-6}$/year (≤1 ppm/year).

EXTERNAL TIME BASE INPUT

10 MHz. Must drive 1 LSTTL load. V_{IH}=2.0 V/20 μA V_{IL}=0.8 V/−400 μA.

RESOLUTION AND ACCURACY DEFINITIONS

Same as DC 503A except DC 504A has 100 MHz bandwidth and input hysteresis=30 mV p-p typical.

ORDERING INFORMATION

DC 5004 GPIB Compatible Counter/Timer. **$995**
Includes: Instruction manual (070-6918-00), IIG and reference guide.
DC 504A Counter/Timer. **$595**
Includes: Instruction manual (070-4291-00).

DC 503A

- **125 MHz Both A and B Channels**
- **10-ps Resolution in Time-Interval Average with 10^8 Averages**
- **Measurement Functions Include: Frequency; Period and Period Average; Width and Width Average; Time A→B; Time A→B Average; Events A During B and Events A During B Average; Totalize; Time Manual; Ratio A/B Average**
- **40-MHz Rep Rate in Time-Interval Average**
- **Trigger-Level Outputs for Accurate Trigger Setting**
- **Simplified Width Measurements**
- **Trigger-Level Outputs for Accurate Trigger Setting**
- **Shaped Outputs for Ease of Triggering**
- **Designed for True Probe Compatibility**
- **High Stability Oven Time Base**

The DC 503A offers a broad range of measurement features at an affordable price. The instrument has two input channels, A and B, each with 125-MHz capability. Each channel has separate triggering level, triggering slope, attenuator, and coupling mode controls. Eight measurement functions are available with the DC 503A, and an averaging feature allows averaging of 1 to 10 occurrences of the signal of interest. Signals to be counted or timed can be applied to channels A and B via front-panel BNC connectors or through rear-interface connections. The DC 503A features an easy-access front panel and an LSI-based design for increased instrument reliability.

The DC 503A is equipped with a temperature-controlled 10 MHz crystal oscillator to obtain a highly stable and precise internal time base.

CHARACTERISTICS

Display—Eight digit LED; indicators for units, gate open, and overflow.
Display Time—≈0.2 s to 5 s and hold.

CHANNEL A AND B INPUT

Frequency Range—0 to ≥MHz, dc coupled. 10 Hz to ≥125 MHz, ac coupled.
Sensitivity—20 mV RMS sinewave to 100 MHz. 60 mV p-p at minimum pulse width (of 5 ns to 100 MHz). 35 mV RMS sinewave to 125 MHz. 100 mV p-p (minimum pulse width of 4 ns to 125 MHz).
Attenuation—Selectable 1X, 5X.
Impedance—1 MΩ paralleled by ≈27 pF.
Dynamic Range—V p-p ≤3 V×attenuation.
Trigger Level Range—Adjustable ±3.5 V×attenuation.
Trigger Level Output Accuracy—±0.5% of reading for a dc input V, ±20 mV.
Independent Controls—Slope±, Attenuation 1X/5X, Coupled ac/dc, Source Internal/External.
Maximum Input Voltage—
1X: ≤200 V peak; ≤400 V p-p from dc to 50 kHz, derate to ≤15 V p-p from 1.33 to 125 MHz.
5X: ≤200 V peak; ≤400 V p-p from dc to 5 MHz, derate to ≤20 V p-p from 100 to 125 MHz.
Shaped Out—Shaped replica of signal being measured, aids proper triggering on complex waveforms. ≥200 mV p-p from 50 Ω.

FREQUENCY A

Range—0 to 125 MHz.
Resolution—0.1 Hz to 10 MHz in decade steps.
Accuracy—±1 count ±Time Base Error.

PERIOD B (SINGLE SHOT)

Range—100 ns to 10^9 s.
Resolution—100 ns to 10 s in decade steps.
Accuracy—±count±Time Base Error ×Period B ±1.4×Channel B Trigger Jitter Error.
Frequency Range—0 to ≥125 MHz.

PERIOD B (AVERAGE)

Range—8 ns to 10 s.
Resolution—1 fs (10^{-15}) to 100 in decade steps.
Events Averaged (N)—1 to 10^8.
Accuracy—$\pm\frac{100\text{ ns}}{N}$ ±Time Base Error
+Period B$\pm\frac{1.4\times\text{Channel B Trigger Jitter Error}}{N}$
Frequency Range—0 to ≥125 MHz.

RATIO A/B

Averaged over 1 to 10^8 cycles of Channel B signal.
Frequency Range—0 to ≥125 MHz (both Channel A and Channel B).
Accuracy—$\pm\frac{\text{Frequency B}}{\text{Frequency A}\times N}$
$\pm\frac{1.4\times\text{Channel B Trig Jitter Error}\times\text{Freq A}}{N}$
$\pm\frac{\text{Frequency A}}{0.3\times10^8}$

TIME A→B (SINGLE SHOT)

Range—100 ns to 10^9 s.
Resolution—100 ns to 10 s in decade steps.
Accuracy—
±1 count±Time BaseError×Time A→B
±Channel A Trigger Jitter Error
±Channel B Trigger Jitter Error
±(Channel B stop Trigger Slew Error
−Channel A start Trigger Slew Error) ±4 ns.

TIME A→B (AVERAGE)

Range—12.5 ns to 10 s.
Minimum Dead Time—12.5 ns (stop-to-start).
Resolution—$\frac{100\text{ ns}}{\sqrt{N}}$
Events Averaged (N)—1 to 10^8 in decade steps.
Accuracy—
$\pm\frac{100\text{ ns}}{\sqrt{N}}$ ±Time Base Error×Time A→B
$\pm\frac{\text{Channel A Trigger Jitter Error}}{\sqrt{N}}$
$\pm\frac{\text{Channel B Trigger Jitter Error}}{\sqrt{N}}$
+(Channel B stop Trigger Slew Error
−Channel A start Trigger Slew Error)±4 ns.

EVENT'S A DURING B (AVERAGE)

Maximum A Frequency—≥125 MHz.
Minimum B Pulse Width—5 ns.
Events Averaged (N)—1 to 10^8 in decade steps.
Accuracy—
$\pm\frac{\text{Period A}}{\text{Width B}\times\sqrt{N}}$ ×Events A during B
$\pm\frac{\text{Channel B start Trigger Jitter Error}}{\sqrt{N}}$
×Frequency A (in MHz)
$\pm\frac{\text{Channel B stop Trigger Jitter Error}}{\sqrt{N}}$
×Frequency A (in MHz)
+(Channel B stop Trigger Slew Error
−Channel B start Trigger Slew Error)
×Frequency A (in MHz)

WIDTH B (SINGLE SHOT)

Range—100 ns to 10^9 s.
Resolution—100 ns to 10 s in decade steps.
Accuracy—
±1 count±Time Base Error×Width B± Channel B start Trigger Jitter Error±Channel B stop Trigger Jitter Error+(Channel B stop Slew Rate Error−Channel B start Slew Rate Error).

WIDTH B (AVERAGE)

Range—5 ns to 10 s.
Resolution—$\frac{100\text{ ns}}{\sqrt{N}}$
Events Averaged (N)—1 to 10^8 in decade steps.
Accuracy—
$\pm\frac{100\text{ ns}}{\sqrt{N}}$ ±Time Base Error×width B
$\pm\frac{\text{Channel B start Trigger Jitter Error}}{\sqrt{N}}$
$\pm\frac{\text{Channel B stop Trigger Jitter Error}}{\sqrt{N}}$
+(channel B stop Slew Rate Error
−Channel B start Slew Rate Error)

Frequency Range—0 to 100 MHz.

TIME MANUAL

Electronic stopwatch, accumulates and displays time between activation of front panel start/stop button or rear interface signal line. Clock rates selectable from 100 ns to 10 s in decade steps. Range 100 ns to 10^9 s.

TOTALIZE A

1 count to 99,999,999 counts at maximum rate of 125 MHz. Start, stop and reset controlled by front panel pushbuttons or rear interface signal lines.

RESOLUTION AND ACCURACY DEFINITIONS

Time Base Error is the sum of all errors specified for the time base used.

N is the number of periods averaged in Period B (AVGS) mode, the number of intervals averaged in the Time A→B (AVGS) mode, the number of widths of B averaged in Width B (AVGS) and Events A During B modes, and the number of periods of B in the Ratio A/B mode.

Trigger Jitter Error (in μs) =
$$\frac{\sqrt{(en_1)^2+(en_2)^2}\ (V)}{\text{Input Slew Rate at Trigger Point (V/}\mu\text{s)}}$$
Where: en_1 = 100 μV RMS typical internal noise
en_2 = RMS noise of signal input at trigger point for a 125 MHz bandwidth

Trigger Slew Rate Error (in μs) =
$$\frac{\text{Input hysterisis (V)}/2}{\text{Input Slew Rate at set Trigger Point (V/}\mu\text{s)}}$$
Where: Input hysterisis = 20 mV p-p typical.

OTHER CHARACTERISTICS

HIGH STABILITY STANDARD TIME BASE

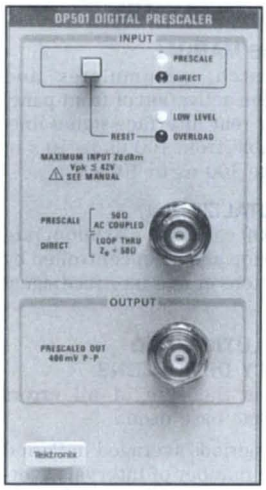
Crystal Frequency—10 MHz.
Temperature Stability—$<\pm2\times10^{-7}$ after warm-up, 0 to +50°C.
Warmup Time—Within 2×10^{-7} of final frequency in <10 minutes when cold started at 25°C.
Aging Rate—1×10^{-8}/day at time of shipment 4×10^{-8}/week after 30 days of continuous operation, 1×10^{-6}/year after 60 days of continuous operation.
Setability—Adjustable to within 2×10^{-8}.

REAR INTERFACE

Inputs—Direct count input to 50 MHz, (50 Ω) impedance, resistor may be removed for 1 MΩ impedance, remote start/stop, reset; external time base.
Outputs—BCD serial-by-digit, decimal point overflow, scan clock; trigger level; time base reference.

ORDERING INFORMATION

DC 503A Universal Counter/Timer. **$1,440**
Includes: Instruction manual (070-2971-00).



DP 501

- **Extends Frequency-Measurement Capability to 1.3 GHz**
- **Compatible with Most TM 500 and TM 5000 Counters**
- **AGC**
- **Low-Level Indicator**
- **GPIB Programmability w/DC 5009 and DC 5010**

The DP 501 Digital Prescaler adds 1.3-GHz frequency-counting capability to most counters, through it was designed specifically for use with the DC 503A, DC 509/DC 5009, and the DC 5010/DC 510 Universal Counter/Timers.

The DP 501 is placed in the signal line between the source and the counter's signal input and can be operated in either the Direct or the Prescale mode. The ÷16 prescaling function can be activated manually, with a front panel pushbutton, or via the GPIB when used with the DC 5009 or DC 5010.

Input sensitivity in the Prescale mode is 20-mV RMS to 1 GHz and 30-mV RMS to 1.3 GHz. A Low-Level indicator alerts the user if the input signal amplitude is too low for error-free counting. An automatic gain-control circuit provides optimum immunity to signal noise in the Prescale mode.

The DP 501 and DC 509/DC 5009 or DC 510/DC 5010 can be used with the Tektronix 7L14 Spectrum Analyzer and TR 502 Tracking Generator to provide counter-accuracy measurements of swept-frequency signals from 100 kHz to 1.3 GHz.

CHARACTERISTICS

Prescale Mode Input—Frequency range is ≤100 MHz to ≥1.3 GHz.
Sensitivity—100 MHz to 1 GHz is ≤20 mV RMS (−21 dBm). 1 to 1.3 GHz is ≤30-mV RMS (−17 dBm).
Impedance—50 Ω, ac coupled; vswr ≤2.2:1.
Output—Amplitude into 50 Ω is ≥200 mV, p-p. Unterminated is 2X terminated value.
Direct Mode Input—Connected directly to output.
Frequency Range—0 to >350 MHz.
Impedance—Loop through characteristic impedance is 50 Ω; nonterminated capacitance ≈20 pF (no connection to output).
Output—Connected directly to input. <1-dB insertion loss up to 350 MHz. Powers up in direct mode.
Overload Protection—Prescale: Input disconnects when input signal exceeds +20 dBm +5 dBm for a period of ≈0.5 s or more.
Damage Level—Prescale: Input may be damaged if signal level exceeds +25 dBm. Direct: 42 V peak maximum. Maximum current is 250 mA.
Input Attenuation—Automatic: Up to 40 dB range.
Low Level Indicator—Lights when input signal is below that required for error-free counting.
Tracking-Generator Compatibility—Outputs will drive two standard TTL loads. Inputs represent two standard TTL loads. Requires arming input to associated counter.

ORDERING INFORMATION

DP 501 Digital Prescaler **$585**
Includes: Instruction manual (070-4332-00).

UTILITY SOFTWARE

See Test & Measurement Software section for description.

CONVERSION KITS

IEEE Standard 488 Capability—
(DC 510) Order 040-1023-05 **$320**
(DC 509) Order 040-0957-04 **$325**
(DC 504A) Order 040-1255-00.*1

*1 *Contact your local sales office.*

OPTIONAL COUNTER ACCESSORIES

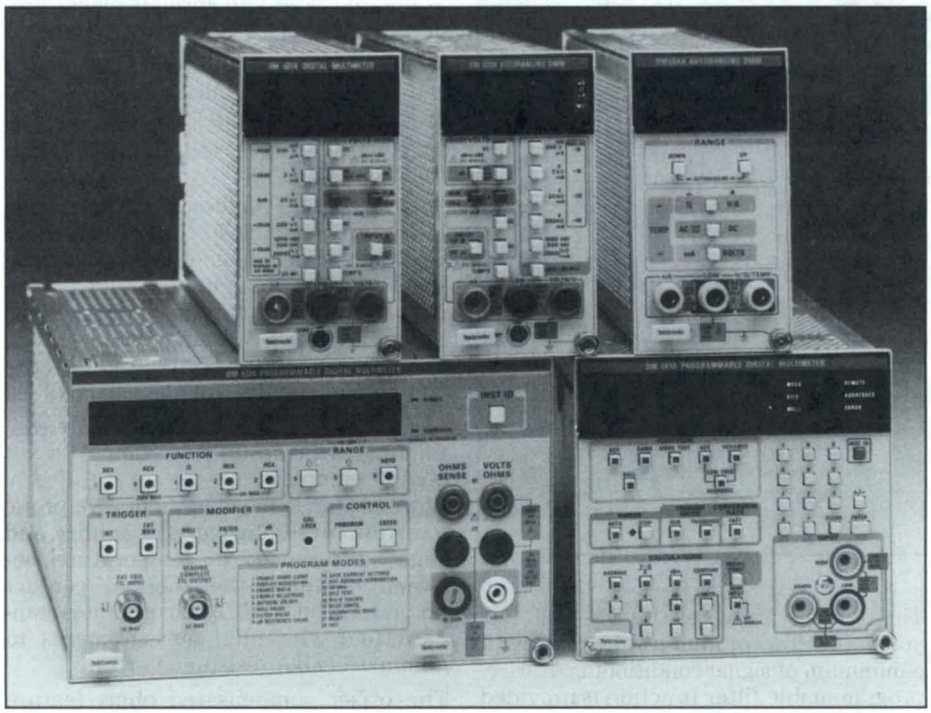
Power Divider — GR, 50 Ω.
Order 017-0082-00 **$800**
Adapters —
(GR to BNC female) Order 017-0067-00 **$75**
(GR to BNC male) Order 017-0064-00 **$100**
Cable Adapters —
(BNC to tip jack) DC 503, DC 509, DC 5009. Order 175-3765-01 **$39**
(BNC to RF) DC 510, DC 5010. Order 012-0532-00 **$42**

RECOMMENDED PROBES

P6125—5X Passive **$80**
P6101A—1X, dc to 34 MHz **$53**
P6106A—10X, dc to 300 MHz **$140**
P6201—FET, dc to 900 MHz **$1,280**
P6230—Bias/Offset, dc to 1.5 GHz **$420**
P6056—50 Ω, X10, dc to 3.5 GHz **$200**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

DIGITAL MULTIMETERS



The Tektronix TM 5000/TM 500 Modular Digital Multimeter selection now includes the new high-performance, programmable DM 5120, plus the new DM 504A, in addition to the DM 5010, the DM 501A, and the DM 502A.

The DM 5120 offers higher performance and more features than the already full range of capability offered in the DM 5010. Both offer full programmability in conformance with Tek Standard Codes and Formats.

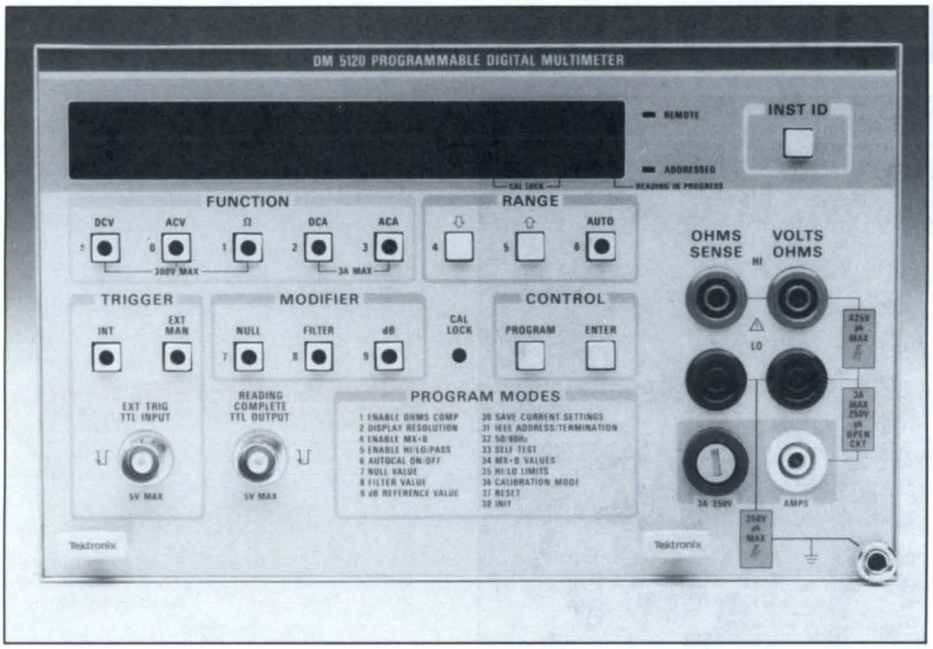
The DM 504A extends the capabilities of the manual digital multimeters by adding new features not previously available: a "beeper mode" for continuity testing, diode testing, and other functions. The DM 501A and DM 502A provide exceptional versatility in function and range at relatively low cost.

The TM 5000/TM 500 Digital Multimeters offer a compact solution to your measurement needs, without compromising performance. These instruments provide accuracy and flexibility on the laboratory bench, in field service, in maintenance applications, or in automatic system applications.

DIGITAL MULTIMETER SELECTION GUIDE

Application Feature	DM 501A	DM 502A	DM 504A	DM 5010	DM 5120
Number of Digits	4½	3½	4½	4½*1	6½
DC Volts Ranges	200 mV to 1000 V	200 mV to 1000 V	200 mV to 1000 V	200 mV to 1000 V	300 mV to 300 V
DC Volts Accuracy	±0.05%	±0.1%	±0.05%	±0.015%	±0.008%
DC Volts Best Resolution	10 μV	100 μV	10 μV	10 μV	0.1 μV
AC Volts Ranges	200 mV to 500 V	200 mV to 500 V	200 mV to 500 V	200 mV to 700 V	300 mV to 300 V
AC Volts Accuracy	±0.6%	±0.6%	±0.6%	±0.2%	±2%
AC Volts Best Resolution	10 μV	100 μV	10 μV	10 μV	1 μV
AC or DC Current Ranges	200 μA to 2 A	200 μA to 2 A	200 μA to 2 A	N/A	300 μA to 3 A
dB Ranges	+54 dB to −60 dB	+50 dB to −60 dB	N/A	Calculated	+49 dB to −54 dB
Resistance (HI-LO) Ranges	200 Ω to 20 MΩ	200 Ω to 20 MΩ	200 Ω to 20 MΩ	200 Ω*1 to 20 MΩ	300 Ω to 300 MΩ
Temperature Measurement Range	−62 to +240°C	−55 to +200°C	−62 to 230°C	N/A	N/A
True RMS	✓	✓	✓	✓	✓
Autorange		✓	✓	✓	✓
IEEE Standard 488				✓	✓
Mainframe Compatibility	TM 500 TM 5000	TM 500 TM 5000	TM 500 or TM 5000	TM 5000	TM 5000 *2
Prices Begin At	$925	$995	$595	$2,450	$1,795

*1 *Low Ω plus diode test.*
*2 *Also available as a monolithic,, DM 5520.*



NEW DM 5120/ NEW DM 5520

Programmable Digital Multimeters

GPIB IEEE-488

The DM 5120 and DM 5520 comply with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats*.

FEATURES

- **6½ Digit, Fully Autoranging (100 nV, 100 μΩ, 1 nA Resolution)**
- **1000 Readings per Second**
- **DC Volts, True RMS AC Volts, Ohms, DC Amps, True RMS AC Amps**
- **dB Calculations**
- **4-Wire Resistance Measurements**
- **Hi/Lo/Pass Limit Testing**
- **Offset Compensated Ohms**
- **Math Functions**
- **Standalone Digital Multimeter (DM 5520)**

The DM 5120 Programmable Digital Multimeter provides autoranging voltage, current and resistance measurements at up to 6½-digit resolution. DC voltage measurements with 100 nanovolt resolution can be performed to the full range of the multimeter. True RMS AC voltage and current, and a crest factor of 3:1 provide the reliability required for all AC measurements, regardless of the waveshape. Standard four-wire ohms measurement eliminates the errors caused by cable resistance, and the offset compensated ohms automatically subtracts thermal contact potentials.

The dynamic range of the DM 5120 lets you detect low- or high-level signals with a minimum of signal conditioning. A user-programmable filter function is provided to eliminate the effects of external noise. And a user-programmable "null" eliminates offsets.

The DM 5120 incorporates an easy-to-read, 3,000,000 count, LED display. Each count represents ⅓ ppm at full scale. Measurement units are displayed as part of the reading, providing unambiguous test results.

A fast autoranging feature permits the shortest possible test setup time, as well as dramatically increased throughput on your production line. Just connect the DM 5120 to the DUT, select the measurement function you want, and the DM 5120 will automatically find the proper range.

Built-in math functions such as PASS/FAIL limit testing, dB measurements, NULL, MX+B and others add measurement power, while hands-off calibration makes on-line instrument maintenance easy.

And if speed is critical, the DM 5120 will provide 1000 count voltage and current reading rates at 3½ digit resolution. High-speed data acquisition and analysis is possible with the DM 5120 connected to a GPIB controller/processor.

GPIB Programming

Programming the DM 5120 over the GPIB is straight-forward. Utilization of Tek's Standard Codes and Formats makes programming easy.

An INST ID key causes instant display of the GPIB address and EOI/LF termination. And front panel controls may be used in conjunction with GPIB commands for easy test setup.

A selection of eighteen programming modes are available at the instruments's front panel, including: Initialize, Self-Test, Display Resolution, Enable Ohms Compensation, dB Reference Value, Hi/Lo Limits, and MX+B Values, among others. Program modes are printed right on the front panel, eliminating the need to keep an operating manual at hand.

Eliminates Errors In Resistance Measurements

Low resistance measurements are prone to errors caused by cable resistance and slight differences in temperature between contacts—the thermal contact potential. The DM 5120 incorporates standard four-wire ohm measurements to eliminate cable resistance errors.

The offset compensated ohms feature eliminates errors caused by thermal contact potentials. In a two step process the contact potential is determined by measuring the voltage with no current applied. The resistance value obtained is then automatically subtracted from the resistance value determined when current is applied. This feature is especially useful in measurement systems with multiple switches, which have the effect of adding unwanted resistance to the DUT.

TM 5000 Compatibility

As a member of the Tektronix family of TM 5000 modular test instruments, the DM 5120 occupies three slots in any TM 5000 Mainframe, and will integrate easily into any TM 5000 programmable stimulus and measurement system. And it utilizes many of the same commands as the popular DM 5010 Programmable Digital Multimeter.

STANDALONE CONFIGURATION

The DM 5520 is a standalone version of the DM 5120. It includes a custom mainframe and GPIB. Note: The DM 5520 may be removed from the power housing and plugged into any TM 5000 mainframe.

CHARACTERISTICS

DC Volts

Range	Resistance	Accuracy (6-½ digits)*1 ±(% of reading + counts) 24 Hours 23 ±1°C	90 Days 18 to 28°C	1 Year 18 to 28°C	Temperature Coefficient +/(% rdg+cnt)/C 0–18°C to 28–50°C
300 mV	>1 GΩ	0.0020+20*2	0.005+20*2	0.008+20	0.0006+10
3 V	>1 GΩ	0.0013+10	0.003+20	0.0038+20	0.0004+1
30 V	11 MΩ	0.0015+10	0.006+20	0.008+30	0.0013+3
300 V	10.0 MΩ	0.0030+10	0.009+20	0.009+30	0.0013+1

*1 *For 5½-digit accuracy, divide 6-½ digit count error by 10. For 4-½ digit accuracy, count error is 5 (except 15 on 300 mV range). For 3-½ digit accuracy, count error is 5.*

*2 *When properly zeroed.*

Analog Settling Time—<1 ms (<2 ms on 300 mV range), to 0.01% of step change.
CMRR—>120 dB at dc, 50 or 60 Hz±(0.05%) with a 1 kΩ unbalance in either lead.
NMRR—>60 dB at 50 or 60 Hz±(0.05%).

Linearity—Linearity is defined as the maximum deviation from a straight line between the readings at zero and full range.
10 ppm of range for 3, 30, and 300 V ranges; 15 ppm of range for 300 mV range; at 23±1°C.
Maximum Input Voltage—Hi to Lo: 300 Vdc, 425 V peak, whichever is less. Lo to GND 350 V (dc + Peak ac).
Maximum Resolution—0.1 μV.

Ohms

Range	Accuracy (6½ digits)*1 ±(% reading + counts) 24 Hours*2 23±1°C	90 Days 18 to 28°C	1 Year 18 to 28°C	Temperature Coefficient ±(%rdg+cnts)/C 0–18°C & 28–50°C
300 Ω*3	0.0025+20 counts	0.008+20 counts	0.01+20 counts	0.001+7 counts
3 kΩ	0.0025+20 counts	0.005+20 counts	0.007+20 counts	0.001+1 count
30 kΩ	0.0025+20 counts	0.005+20 counts	0.007+20 counts	0.001+1 count
300 kΩ	0.006+20 counts	0.02+20 counts	0.021+20 counts	0.004+1 count
3 MΩ	0.007+20 counts	0.02+20 counts	0.021+20 counts	0.03+1 count
30 MΩ	0.06+50 counts	0.1+50 counts	0.1+50 counts	0.3+1 count
300 M*4Ω	2.0+ counts	2.0+5 counts	2.0+5 counts	

*1 *For 5½ digit accuracy divide count error by 10. For 4½ digit accuracy, count error is 5 (except 15 on 300 Ω range). For 3½ digit accuracy, count error is 5.*

*2 *Relative to calibration standards.*

*3 *When properly zeroed.*

*4 *Resolution on 300 MΩ range is limited to 5½ digits.*

Note: Four-wire measurement mode accuracy for 300 Ω to 3 MΩ ranges.

Offset Compensation (Requires Proper Zeroing)—300 Ω to 30 kΩrange ±10 mV on 300 Ω range ±100 mV on 3 kΩ and 30 kΩ range.
Open Circuit Voltage—≤5.5 volts.
Maximum Resolution—100 μΩ.
Linearity—Linearity is defined as the maximum deviation from a straight line between the readings at zero and full scale. 20 ppm of range for 300 Ω to 30 kΩ ranges at 23±1°C.
Maximum Input Voltage—300 V RMS or 425 V peak, whichever is less.

TRUE RMS AC VOLTAGE

Ranges—300 mV, 3 V, 30 V, 300 V.
Accuracy*1—5½ digits.
For sinewave inputs greater than 2000 counts—
20 to 50 Hz±(2% or reading+100 counts).
50 to 200 Hz±(0.3% of reading+100 counts).
200 Hz to 10 kHz±0.15% of reading +100 counts).
10 to 20 kHz±(0.4% of reading+200 counts).
For sinewave inputs greater than 20,000 counts
−3 dB bandwidth typically 300 kHz
20 to 100 kHz*2 ±(1.5% of reading+300 counts).

Temperature Coefficient 0–18°C, 28–50°C—<±(0.1 times applicable accuracy specification)/°C below 20 kHz.
<±(0.2 times) for 20 to 100 kHz.

*1 *For 4½ digit accuracy, divide count error by 10. For 3½ digit accuracy, count error is 5. In 3½ and 4½ digit modes, specifications apply for inputs >200 Hz.*

*2 *Specification for 300 mV range is ±(2% of reading+300 counts).*

Crest Factor—≤3:1.
Nonsinusoidal Measurement Accuracy—for fundamental frequencies <1 kHz, crest factor <3. 300 mV, 3 V ±(0.25% of reading) 30 V, 300 V ±(0.6% of reading).
Maximum Resolution—1 μV.
Input Impedance—Hi to Lo: 1 MΩ shunted by <120 pF.
Lo to GND: >1000 MΩ paralleled by <400 pF.
CMRR—>60 dB at 50 or 60 Hz (±0.05%) with 1 kΩ unbalance.
Settling Time—1 second to within 1% of change in reading.

Maximum Input Voltage—Hi to Lo 300 V RMS (425 V peak), 10 MΩ V-Hz product, whichever is less.
Lo to GND: 350 V (dc + peak ac) or 500 kΩV-Hz product, whichever is less.

dB (AC VOLTAGE)

Accuracy—1 year, 18–28°C—−34 to +49 dB (20 mV to 300 V): 20 Hz to 20 kHz±0.2 dB; 20 kHz to 100 kHz±0.4 dB; −54 to +34 dB (2 mV to 20 mV); 20 Hz to 20 kHz±1.1 dB; 20 kHz to 100 kHz±3 dB typical.
Maximum Resolution—0.01 dB.
Reference Level (default)—1 V rms=0 dB.

DC AMPS

Accuracy— (5½ digits) 1 Year, 18 to 28°C		Maximum Voltage Burden
300 μA	±(0.09% of reading+20 counts)	0.4 V
3 mA	±(0.05% of reading+10 counts)	0.4 V
30 mA	±(0.05% of reading+10 counts)	0.4 V
300 mA	±(0.05% of reading+10 counts)	0.5 V
3 A	±(0.09% of reading+10 counts)	2.0 V

Temperature Coefficient—0–18, 28–50°C <±(0.1 times applicable accuracy specification)/°C.
Maximum Resolution—1 nA.
Maximum Input—3 A (250 V) [fuse protected].

AC CURRENT (TRUE RMS)

Accuracy—5½ digits*1.
For 3 mA, 300 mA, 3 A Ranges—1 year, 18 to 28°C; 20 to 45 Hz ±(2% of reading+100 counts)*2.; 45 Hz to 10 kHz ±(0.6% of reading+100 counts)*2.
For 300 μA Range—20 to 45 Hz±(2% of reading+100 counts); 45 Hz to 1 kHz±(0.9% of reading+100 counts); 1 to 10 kHz ±(4.0% of reading+100 counts).

*1 *For sinewave inputs >2000 counts. For 4½ digit accuracy, divide count error by 10. For 3½ digit accuracy, count error is 5. In 3½ and 4½ digit modes, specifications apply for sinewave inputs >200 Hz.*

*2 *Accuracies correct for non-sinusoidal measurements on fundamental frequencies <1 kHz and crest factor <3.*

Temperature Coefficient—0–18, 28–50°C <±(0.1 times applicable accuracy specification)/°C.
Crest Factor—(Up to 2/3 full scale) ≤3:1.
Maximum Resolution—1 nA.

Maximum Voltage Burden—

300 mA	0.4 V
3 mA	0.4 V
30 mA	0.4 V
300 mA	0.5 V
3 A	2.0 V

Settling Time—1 second within 0.1% of change in reading.
Maximum Input—3 A (250 V) [fuse protected].
dB (Current) Accuracy—1 year, 18 to 28°C; 20 Hz to 10 kHz; 320 μA to 3 A, −9.9 to 69 dB ±0.2 dB; 2μA to 320 μA, −54 to −9.9 dB±0.9 dB.
Maximum Resolution—0.01 dB.
Reference Level (Default)—1 mA=0 dB.

Maximum Reading Rates*[1]

DCV, DCA, ACV, ACA Readings/Second

Resolution	Continuous into Internal Buffer MUX: Off	Continuous into Internal Buffer MUX: On	External Trigger into Internal Buffer MUX: Off	External Trigger into Internal Buffer MUX: On	Triggered via IEEE-488 Bus MUX: Off	Triggered via IEEE-488 Bus MUX: On
3½ digit	1000	1000	196	73	72	45
4½ digit	333	333	138	63	63	41
5½ digit	35(29)	8.2(7.5)	40(33)	9(7.5)	29(26)	8.2(7.5)
6½ digit*[2]		8.2(7.5)		0.25(0.2)		0.25(0.2)

Ohms Readings/Second

Resolution	Continuous into InternalBuffer MUX: Off	Continuous into InternalBuffer MUX: On	External Trigger into Internal Buffer MUX: Off	External Trigger into Internal Buffer MUX: On	Triggered via IEEE-488 Bus MUX: Off	Triggered via IEEE-488 Bus MUX: On
3½ digit	40	24	47	23	32	19
4½ digit	38	18	39	18	29	16
5½ digit	16(13)	9.5(7.5)	15(14)	9.5(7.5)	13(12.5)	9(7.5)
6½ digit		9(7.5)		0.3(0.25)		0.3(0.25)

Offset Compensated Ohms: *Rates are 0.5× normal MUX on ohms rates.*

*[1] *Reading rates are for on-range on-scale readings with internal filter off for 3V, 3 kΩ, and 3 mA ranges. 6½ and 5½ digit rates are for 60 Hz operation. Values in parenthesis are for 50 Hz operation.*

*[2] *Internal filter on.*

MISCELLANEOUS ELECTRICAL CHARACTERISTICS

Maximum Reading—3,029,999 counts in 6½ digit mode.
Warm-Up Time—2 hours to rated accuracy.
Power Consumption—11 W.
GPIB Programming—
Interface: IEEE-488.1 1987 Compatible
Subsets: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0.

PHYSICAL CHARACTERISTICS

Temperature—Operating: 0 to +50°C. Nonoperating: −20 to +65°C.
Humidity—75% RH, to 35°C. 35% RH, to 50°C.
Vibration—Vibrate in each x, y, z axis, from 0 to 200 Hz, with checks for resonance.
Bench Handling—12 drops from 45 degrees, 4 inch or equilibrium, whichever occurs first.
Transportation—Qualified under National Safe Transit Association Preshipment Test Procedures 1A-B-1 and 1A-B-2.
Electrical Discharge—6 kV maximum discharge applied to operating instrument from an ESD source per IEC 801-2 (150 Ω/150 pF).

PHYSICAL CHARACTERISTICS

Dimensions	DM 5120 cm	DM 5120 in.	DM 5520 cm	DM 5520 in.
Width	20.32	8.0	23.4	9.2
Height	12.7	5.0	14.0	5.5
Depth	27.94	11.0	43.2	17.0
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	2.1	5.7	5.7	15.4

ORDERING INFORMATION

DM 5120 Programmable
Digital Multimeter. **$1,795**
Includes: Instruction manual, one set test leads.

DM 5520 Programmable
Digital Multimeter **$2,395**
Includes: DM 5120 with power module, Instruction manual, one set test leads.

DM 5010

GPIB IEEE-488 The DM5010 complies with IEEE Standard 488.1-1987, and with Tektronix *Standard Codes and Formats.*

- **4½ Digit, Autoranging**
- **DC Volts, Ohms, True RMS (ac or ac + dc)**
- **Diode Test**
- **Comprehensive Math Functions: dB Calculations; Averaging; Offset; Scaling; Hi/Lo/Pass**

The fully programmable DM 5010 measures dc voltage, resistance, true RMS ac or ac + dc voltage, and even ac or dc current through the use of an external shunt resistor and a scaling factor. An OHMS function allows in-circuit resistance measurements without turning on parallel diode and transistor junctions. A Diode Test function is provided for forward and reverse testing diode and transistor junctions.

In most cases, the built-in math capability of the DM 5010 reduces raw measurements to meaningful information without controller assistance. Averaging, offset and scaling, conversion to dBm or reference dB, and HI/LO/PASS comparisons are among its many capabilities. User selectable constants for these functions can be supplied through the front panel or the GPIB.

Other major features include a Low-Frequency Response function, which permits stable readouts of low frequency ac voltages; a Null function, which provides rapid nulling in any mode; and easy calibration through the use of internal microprocessor-computed nonvolatile calibration constants.

CHARACTERISTICS

DC VOLTS

Ranges—200 mV, 2 V, 20 V, 200 V, 1000 V.

Accuracy*[1]

18 to 28°C

Voltage Ranges	Normal Conversion Rate	Fast Conversion Rate
200 mV	±[0.015% of reading +0.01% of full scale (2 counts)]	±[0.05% of reading +0.05% of full scale (1 count)]
2 V through 200 V	±[0.015% of reading +0.005% of full scale (1 count)]	±[0.05% of reading +0.05% of full scale (1 count)]
1000 V	±[0.020% of reading +0.010% of full scale (2 counts)]	±[0.05% of reading +0.1% of full scale (2 counts)]

0 to 18°C, 28 to 50°C

200 mV	±[0.06% of reading +0.035% of full scale (7 counts)]	±[0.1% of reading +0.1% of full scale (2 counts)]
2 V through 200 V	±[0.06% of reading +0.03% of full scale (6 counts)]	±[0.1% of reading +0.1% of full scale (2 counts)]
1000 V	±[0.065% of reading +0.035% of full scale (7 counts)]	±[0.1% of reading +0.15% of full scale (3 counts)]

*[1] *Valid for six months or 1000 operating hours, whichever occurs first.*

Common-Mode Rejection Ratio (With 1 kΩ Imbalance)—Unguarded: ≥130 dB at dc. ≥80 dB at 50 to 60 Hz. Guarded: ≥140 dB at dc. ≥100 dB at 50 to 60 Hz.
Normal-Mode Rejection Ratio—≥40 dB at 50 or 60 Hz ± 0.2 Hz.
Maximum Resolution—10 μV.
Step Response Time (To Rated Accuracy)
Run Mode—Normal conversion rate is ≤0.53 s. Fast conversion rate is ≤0.08 s.
Triggered Mode—Normal conversion rate is ≤0.33 s. Fast conversion rate is ≤0.06 s.

Input Resistance—200 mV to 20 V Range: $>10^9$ Ω. 200 to 1000 V Range: 10 MΩ±0.25%.
Maximum Input Voltage—1000 V peak.

TRUE RMS AC VOLTS (ACV AND AC+DC)

Input Signal—Must be between 5% and 100% of full scale.
Ranges—200 mV, 2 V, 20 V, 200 V, 700 V.
Accuracy[*1]

AC VOLTS AND AC VOLTS + DC VOLTS

18 to 28°C	Normal and Fast Conversion		
Voltage Ranges	**20 to 100 Hz**	**100 Hz to 20 kHz**	**20 to 100 kHz**
200 mV through 200 V	±(0.8% of rdg+0.2% of full scale)	±(0.2% of rdg+0.2% of full scale)	±(1.0% of rdg+0.5% of full scale)
700 V (15 kHz maximum)	±(0.8% of rdg+0.6% of full scale)	±(0.2% of rdg+0.6% of full scale)	
0 to 18°C, 28 to 50°C			
200 mV through 200 V	±(1.25% of rdg+0.35% of full scale)	±(0.65% of rdg+0.3% of full scale)	±(1.45% of rdg+0.65% of full scale)
700 V (15 kHz maximum)	±(1.25% of rdg+0.95% of full scale)	±(0.65% of rdg0.95% of full scale	

AC VOLTS +DC VOLTS ONLY

18 to 28°C	
Voltage Ranges	**Normal and Fast Conversion Rates 10 to 20 Hz**
200 mV through 200 V	±(0.8% of rdg+0.3% of full scale)
700 V	±(0.8% of rdg+0.9% of full scale)
0 to 18°C, 28 to 50°C	
200 mV through 200 V	±(1.25% of rdg+0.45% of full scale)
700 V	±(1.25% of rdg+1.25% of full scale)

[*1] *Valid for six months or 1000 operating hours, whichever occurs first.*

Common-Mode Rejection Ratio—Unguarded: Typically ≥80 dB from dc to 60 Hz. Guarded: Typically ≥100 dB from dc to 60 Hz.
Maximum Resolution—10 μV.
Response Time—<1.2 s (except for Low Frequency Response mode).
Input Impedance—2 MΩ±0.1% paralleled by <150 pF.
Maximum Input Voltage—1000 V peak ac, 500 V dc.
Crest Factor—Four (subject to maximum peak input voltage).

DIODE TEST

Operation—A 1 mA current is generated and the resultant voltage is measured on the 2 V dc range. This produces a voltage sufficient to turn on diode and transistor junctions.

RESISTANCE

Ranges—200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, 20 MΩ.
Accuracy[*1]

18 to 28°C		
Resistance Range	**Normal Conversion Rate**	**Fast Conversion Rate**
200 Ω	±[0.015% of reading +0.015% of full scale (3 counts)] (using null)[*2]	±[0.05% of reading +0.05% of full scale (1 count)] (using null)[*2]
2 kΩ to 200 kΩ	±[0.015% of reading +0.01% of full scale (2 counts)] (using null on 2 kΩ only)[*2]	±[0.05% of reading +0.05% of full scale (1 count)]
2 MΩ	±[0.10% of reading +0.01% of full scale (2 counts)]	±[0.10% of reading +0.5% of full scale (1 count)]
20 MΩ	±(0.15% of reading +0.005% of full scale (1 count)]	±(1.0% of reading +0.05% of full scale (1 count)]

Accuracy[*1]

0 to 18°C, 28 to 50°C		
Resistance Range	**Normal Conversion Rate**	**Fast Conversion Rate**
200 Ω	±[0.06% of reading +0.06% of full scale (12 counts)] (using null)[*2]	±[0.1% of reading +0.1% of full scale (2 counts)] (using null)[*2]
2 to 200 kΩ	±[0.06% of reading +0.035% of full scale (7 counts)] (using null on 2 kΩ only)[*2]	±[0.1% of reading +0.1% of full scale (2 counts)]
2 MΩ	±[0.54% of reading +0.035% of full scale (7 counts)]	±[0.55% of reading +0.1% of full scale (2 counts)]
20 MΩ	±[0.9% of reading +0.01% of full scale (2 counts)]	±[1.6% of reading +0.05% of full scale (1 count)]

[*1] *Valid for six months or 1000 operating hours, whichever occurs first.*
[*2] *When the null function is not used add ±0.2 Ω to all readings.*

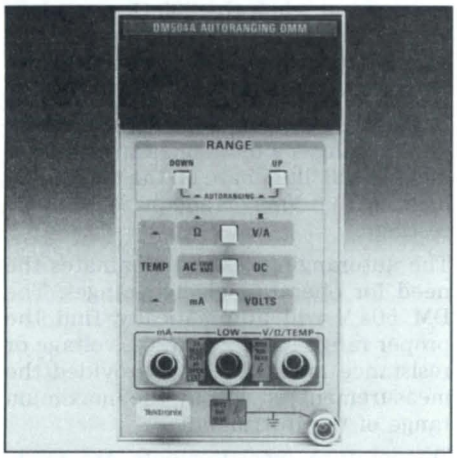
Maximum Resolution—10 mΩ.
Step Response Time (To Rate Accuracy) Run Mode—Normal conversion rate is ≤1.24 s. Fast conversion rate is ≤0.33 s.
Triggered Mode—Normal conversion rate is ≤0.73 s. Fast conversion rate is ≤0.19 s.
Maximum Input Volts—400 V peak.
Maximum Open Circuit Voltage Developed—<5 V.

OTHER CHARACTERISTICS

Overrange Indication—For Ohms and Diode Test, "OC" is displayed; for ACV, DCV, ACV+DCV, the display blinks.
Measurement Rate—ACV, DCV, ACV+DCV, Diode Test: 3/s at 4.5 digits; 26/s at 3.5 digits. Ohms: 1.6/s at 4.5 digits; 7.1/s at 3.5 digits.
Power consumption—≈20 VA.
IEEE Standard 488.1-1987 Interface Function Subsets Implemented—SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0.

ORDERING INFORMATION

DM 5010 Programmable Digital Multimeter. **$2,450**
Includes: One set test leads (003-0120-00); Instruction manual (070-2994-01); Instrument interfacing guide (070-4603-00); Reference guide (070-3542-00).



NEW DM 504A

Autoranging Digital Multimeter

- **4½ Digit Autoranging**
- **True RMS AC Functions**
- **Five Manually Selectable Voltage, Current and Resistance Ranges**
- **DC Volts, AC Volts, DC mAmps, AC mAmps, Ohms and Temperature Functions**
- **0.07% DC Voltage Accuracy**
- **Diode Test and Audible Continuity (Beeper) Modes**

The DM 504A Autoranging Digital Multimeter extends the functionality of the Tektronix TM 500 line of modular, digital multimeters with true RMS measurements, a "beeper" mode for indication of short circuits, and diode testing capability. The DM 504A also provides standard AC/DC voltage and current, and resistance measurements, and will operate in any compartment of a TM 500 or TM 5000 power module.

A straightforward, easy-to-use front panel makes this multipurpose digital multimeter the ideal companion for the engineer's work station, the educational training lab, and the service technician's workbench.

All ac voltage and current measurements are true RMS. And all measurement ranges, except temperature, diode measurements, and audible continuity (beeper), can be automatically or manually selected.

An audible "beeper" mode is provided for testing continuity. A beeper symbol is displayed when the 200 Ohm mode is selected, indicating that a beeper will sound a continuous tone for measurements less than 10 Ohms.

In the two megohm, 200 kilohm and two kilohm ranges a diode measurement indicator will illuminate on the display, indicating that Vmax is adequate for diode testing.

The autoranging feature eliminates the need for operator-selected ranges. The DM 504A will automatically find the proper range for the current, voltage or resistance measurements, provided the measurement is within the maximum range of the instrument.

Temperature measurements are made using an optional Tektronix P6602 Temperature Probe, or an equivalent platinum resistance probe. The DM 504A will measure temperatures from −62 to 230 °C.

The readout is a 4½-digit display in all ranges except temperature and beeper. The DM 504A will automatically adjust the decimal point according to the operating range of the instrument, and will automatically indicate the correct polarity of the measurement.

CHARACTERISTICS

ELECTRICAL

DC Volts

Ranges—200 mV, 2 V, 20 V, 200 V, 1000 V
Accuracy*—for automatic or manual ranging
18 to 28 °C: All ranges ±(0.05% of reading +0.02% of full scale)
0 to 18 °C, 28 to 50 °C:
200 mV range ±(0.15% of reading +0.06% of full scale);
2 V range ±(0.15% of reading +0.02% of full scale);
20 V range ±(0.15% of reading +0.04% of full scale);
200 V range ±(0.15% of reading +0.02% of full scale);
1000 V range ±(0.15% of reading +0.02% of full scale)

* *Valid for a period of six months or 1000 hours, whichever occurs first.*

Common Mode Rejection Ratio—(with 1 kΩ unbalance) 100dB at DC, 80 dB at 50/60 Hz.
Normal Mode Rejection Ratio—60 dB at 50/60 Hz(±0.2 Hz).
Maximum Resolution—10 μV.
Step Response Time—<1 second.
Input Resistance—10 MΩ ±0.5%.
Maximum Input Voltage—1000 V peak.

TRUE RMS AC VOLTS

Ranges—200 mV, 2 V, 20 V, 200 V, 500 V.
Accuracy*[1] for automatic or manual ranging—18 to 28 °C:
200 mV to 200 V range, 30 Hz to 20 kHz. For input signals >10% to 100% of full range, accuracy is ±(0.6% of reading +0.06% of full scale). For signals >25%, and 10 kHz to 20 kHz add 4.1% additional error.
500 V range, 60 Hz to 20 kHz. For input signals >100V to 500V RMS, accuracy is ±(0.6% of reading +0.1% of full scale)
40 Hz to 60 Hz ±(1% of reading +0.1% of full scale)
O to 18 °C, 28 to 50 °C:
200 mV to 200 V range, 30 Hz to 20 kHz. For input signals >10% to 100% of range, accuracy is ±(0.8% of reading +0.11% of full scale).

For signals 25%, and 10 kHz to 20 kHz add 4.1% additional error.
500 V range, 60 Hz to 20 kHz. For input signals >100V to 500V RMS, accuracy is ±(0.9% of reading +0.1% of full scale).
40 Hz to 60 Hz ±(1.3% of reading +0.1% of full scale).

* *Valid for a period of six months or 1000 hours, whichever occurs first.*

Resistance—Ranges: 200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, 20 MΩ.
Accuracy*[1]—For automatic and manual ranging.
Common Mode Rejection Ratio—(with 1 kΩ unbalance) −60 dB at 50 or 60 Hz.
Maximum Resolution—10 μV.
Response Time—<2 s.
Input Impedance—10 MΩ ±0.5% paralleled by <100 pF.
Maximum Input Voltage—Volts/Ohms/TEMP to LOW: 500 V RMS or 600 V DC, VOLTS/Ohms/TEMP to GND: 1000 V peak
LOW to GND: 1000 V peak.
Crest Factor—5 at full scale on all ranges except 500 V (500 V=2).

18 to 28°C

Range		Source	Vmax full scale
200 Ω (beeper)	±(0.05% of reading ±0.05% of full scale)	1.0 mA	0.2 V
200 Ω	±(0.05% of reading ±0.02% of full scale)	1.0 mA	0.2 V
2 kΩ	±(0.05% of reading ±0.01% of full scale)	1.0 mA	2.0 V
20 kΩ	±(0.05% of reading ±0.02% of full scale)	10 μA	0.2 V
200 kΩ	±(0.05% of reading ±0.01% of full scale)	10 μA	2.0 V
2 MΩ	±(0.1% of reading ±0.02% of full scale)	0.1 μA	0.2 V
20 MΩ	±(0.1% of reading ±0.01% of full scale)	0.1 μA	2.0 V

0 to 18°C, 28 to 50°C.

Range		Source	Vmax full scale
200 Ω (beeper)	±(0.25% of reading ±0.1% of full scale)	1.0 mA	0.2 V
200 Ω	±(0.25% of reading ±0.04% of full scale)	1.0 mA	0.2 V
2 kΩ	±(0.25% of reading ±0.03% of full scale)	1.0 mA	2.0 V
20 kΩ	±(0.25% of reading ±0.04% of full scale)	10 μA	0.2 V
200 kΩ	±(0.25% of reading ±0.03% of full scale)	10 μA	0.2 V
2 MΩ	±(1% of reading ±0.04% of full scale)	0.1 μA	2.0 V
20 MΩ	±(1% of reading ±0.03% of full scale)	0.1 μA	2.0 V

*[1] *Valid for six months or 1000 hours, whichever occurs first.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

Response Time—<2 seconds on 200 Ω to 2 MΩ range
<15 seconds on 20 MΩ range
<0.15 seconds on 200 Ω "beeper."
Maximum Input Volts—300 V peak.
Maximum Resolution—10 mΩ.
Maximum Open Circuit Voltage—<11 V.

DC CURRENT

Ranges—200 μA, 2 mA, 20 mA, 200 mA, 2000 mA.
Accuracy[*1]—For automatic or manual ranging 18 to 28°C.
±(0.1% of reading +0.01% of full scale)
0 to 18°C, 28 to 50°C.
±(0.3% of reading +0.025% of full scale)

[*1] *Valid for six months or 1000 hours, whichever comes first*

Response Time—<1 s.
Input Resistance:

Range	Resistance
200 μA	1.0 kΩ
2 mA	100.0 Ω
20 mA	10.2 Ω
200 mA	1.2 Ω
2000 mA	0.26 Ω

Maximum Open Circuit Input Voltage (mA to LOW)—250 V peak.
Maximum Input Current—2 A any range.
Maximum Floating Voltage—mA to GND, 1000 V peak
LOW to GND, 1000 V peak.
Maximum resolution—10 nA.

AC CURRENT

Ranges—200 μA, 2 mA, 20 mA, 200 mA, 2000 mA.
Accuracy[*1]—for automatic or manual ranging.
Sinewave—30 Hz to 10 kHz
Input current must be between 10% and 100% of full scale.
18 to 28° C ±(0.6% of reading +0.06% of full scale).
0 to 18°C, 28 to 50°C ±(0.9% of reading +0.11% of full scale).

[*1] *Valid for six months or 1000 hours, whichever comes first.*

Response Time—<2 s.
Input Resistance—

Range	Resistance
200 μA	1.0 kΩ
2 mA	100.0 Ω
20 mA	10.2 Ω
200 mA	1.2 Ω
2000 mA	0.4 Ω

Maximum Open Circuit Input Voltage (mA to LOW)—250 V peak.
Maximum Input Current—2 A any range.
Maximum Floating Voltage—mA to GND, 1000 V peak, LOW to GND, 1000 V peak.
Maximum Resolution—10 nA.

TEMPERATURE

Range—−62 to +230°C.
Accuracy—Using Tektronix P6602 Temperature Probe: 18 to 28°C ambient. Probe calibrated to instrument (probe/DMM calibration performed at 0°C). ±0.6°C from −62 to +150°C. ±1.6° from 150 to 230°C.
Any probe: ±3.5°C from −62 to +150°C. ±6°C from 150 to 230°C. 0 to 18°C, 28 to 50°C ambient.
Probe calibrated to instrument (probe/DMM calibration performed at 0°C): ±1.5°C from −62 to +150°C. ±2.5°C from 150 to 230°C.
Any probe: ±4.5°C from −62 to +150°C. ±7°C from 150 to 230°C.

OTHER CHARACTERISTICS

Power Consumption—Less than 8 W.
Reading Rate—>2.0 times per second.
Over-range Indication—Flashing Display.
Warm-up Time—30 minutes (50 minutes after storage in high humidity environment).

ENVIRONMENTAL SPECIFICATIONS

Temperature—Operating: 0 to 50°C. Non-operating: −55 to +75°C.
Humidity—95 to 100% for 5 days (derated above 25°C).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	66.8	2.63
Height	125.9	4.96
Depth	285.3	11.24
Weight ≈	**kg**	**lb**
Net	0.93	2.04

ORDERING INFORMATION

DM 504A Digital Multimeter. **$595**
Includes: Instruction manual, one set of test leads.

OPTION

Option 01—Adds P6602 Temperature Probe calibrated for use with DM 504A.[*1]

[*1] *Contact your local sales office.*

DM 502A

- **True RMS**
- **Autoranging**
- **Seven Functions, Including Temperature and dB**
- **0.1% DC Volts Accuracy**
- **3½-Digit Display**

The DM 502A Digital Multimeter measures seven different functions with pushbutton convenience. Autoranging, in all modes except current, eliminates any need for operator-selected ranges. The DM 502A measures dc and ac voltage, dc and ac current, dB, resistance, and temperature. True RMS provides more accuracy in ac measurements on distorted, noisy, random, or other nonsinusoidal ac waveforms. The resistance mode features HI-LO voltage (2 to 0.2 V). The low voltage is user-selectable for making in-circuit ohms measurements without turning on diode and transistor junctions. A higher voltage is available for testing junctions for forward and reverse resistance. The LED indicators provide a bright, readable 3½-digit display. Power consumption is approximately 8 V A.

CHARACTERISTICS

Ranges—2000 mV, 2 V, 20 V, 200 V, 1000 V. Automatic or manual ranging.

Accuracy[*1]

−18 to +18°C

Voltage Ranges	Normal and Fast Conversion Rate
20 mV to 200 V	±[0.1% of reading +0.05% of full scale (1 count)]
1000 V	±[0.1% of reading +0.1% of full scale (1 count)]

0 to 28°C, 28 to 50°C

Voltage Ranges	Normal and Fast Conversion Rate
200 mV to 200 V	±[0.2% of reading +0.1% of full scale (2 counts)]
1000 V	±[0.2% of reading +0.2% of full scale (2 counts)]

[*1] *Valid for six months or 1000 hours, whichever occurs first.*

Common-Mode Rejection Ratio—≥100 dB at dc. ≤80 dB at 50 to 60 Hz with 1 kΩ imbalance.
Normal-Mode Rejection Ratio—≥50 dB at 50 or 60 Hz ±0.2 Hz.
Step Response Time—1 s within a range, +1.5 s for each range change in autoranging mode.

Input Resistance—10 MΩ.
Maximum Input Voltage—1000 V peak.

TRUE RMS AC VOLTS

Ranges—200 mV, 2 V, 20 V, 200 V, and 500 V. Automatic or manual ranging (ac coupled).

Accuracy*1

0 to 18°C	Normal and Fast Conversion Rate	
Voltage Ranges	**20 to 40 Hz**	**40 Hz to 20 kHz**
200 mv to 200 V	±[1.5% of reading +0.3% of full scale (6 counts)]	±[0.6% of reading +0.3% of full scale (6 counts)]
500 V	±[1.5% of reading +1.2% of full scale (6 counts)]	±[0.6% of reading +1.2% of full scale (6 counts)]

0 to 18°C, 28 to 50°C	Normal and Fast Conversion Rate	
Voltage Ranges	**20 to 40 Hz**	**40 Hz to 20 kHz**
200 mV to 200 V	±[1.8% of reading +0.35% of full scale (7 counts)]	±[0.8% of reading +0.35% of full scale (7 counts)]
500 V	±[1.8% of reading +1.4% of full scale (7 counts)]	±[0.8% of reading +1.4% of full scale (7 counts)]

*1 *Valid for six months or 1000 hours whichever occurs first. Typically usable to 100 kHz.*

Common-Mode Rejection Ratio—≥60 dB at 50 to 60 Hz with 1 kΩ imbalance.
Maximum Resolution—100 μV.
Resolution Time—1 s within a range, +1.5 s for each range change in autoranging mode.
Input Impedance—10 MΩ, paralleled by <100 pF.
Maximum Input Voltage—500 V ac RMS, 600 V dc, not to exceed 1000 V peak.
Crest Factor—4 (at full scale all ranges), ≤2 on 500 V range.

dB (TRUE RMS)

Zero dB Reference—1 mW in 600 Ω (0.775 V) (dBm). Internal jumper change for 0 dB reference of 1,000 V (dBV).

Accuracy*1

18 to 28°C	20 Hz	2kHz	10 kHz	20 kHz
+50 to −50 Db	±0.5 dB			
−50 to −60 dB	±0.5 dB	±1.5 dB	Typically ±2.5 dB	

*1 *From 0 to 18°C, 28 to 50°C, add 0.6 dB to above accuracy specifications. For example, at 0°C the accuracy in the +50 dB to −50 dB range from 20 Hz to 20 kHz would be ±1.1 dB.*

Noise Level—Typically −75 dB.
Maximum Resolution—0.1 dB.
Response Time—≤1 s within a range, ≤1.5 s for each range change in autoranging mode.
Input Impedance—10 MΩ, paralleled by <100 pF.
Maximum Input Voltage—500 V RMS, not to exceed 1000 V peak.
Crest Factor—4 (at FS), ≤2 above 40 dB.

RESISTANCE

Ranges—200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, and 20 MΩ. Automatic or manual ranging.

Accuracy*1

Resistance Ranges	18 to 28°C
200 Ω to 2000 kΩ	±[0.5% of reading +0.05% of full scale (1 count) +0.2 Ω]
20 MΩ	±[1% of reading +0.05% of full scale (1 count)]

0 to 18°C, 28 to 50°C	
Resistance Ranges	
200 Ω to 2000 kΩ	±[0.8% of reading +0.1% of full scale (2 counts) +0.2 Ω]
20 MΩ	±[1.3% of reading +0.1% of full scale (2 counts)]

*1 *Valid for 6 mo. or 1000 hrs whichever occurs first.*

Response Time—≤1 s within a range. ≤1.5 s for each range change in autoranging mode.
Max Input Volts—130 V dc or ac RMS indefinitely. 230 V dc or ac RMS for 30 minutes max.
HI-LO Ohm Operation—A low voltage is user-selectable for making in-circuit ohms measurements without turning on silicon diode and transistor junctions. A high voltage is also available for testing junctions for forward and reverse resistance.
Maximum Resolution—0.1 Ω.
Maximum Open-Circuit Voltage Developed—≈14 V.

DC AND TRUE RMS AC CURRENT

Ranges—200 μA, 2 mA, 20 mA, 200 mA, and 2000 mA. Manual ranging only.
DC Current Accuracy—18 to 28°C: ±[0.2% of reading +0.05% of full scale (1 count)]. 0 to 18°C, 28 to 50°C: ±[0.3% of reading +0.1% of full scale (2 counts)].
AC Current Accuracy (From 40 Hz to 10 kHz)—Usable to 20 kHz. 18 to 28°C: ±[0.6% of reading +0.3% of full scale (6 counts)]. 0 to 18°C, 28 to 50°C: ±[0.7% of reading +0.5% of full scale (10 counts)].
Response Time—≤1 s.

Input Resistance

Ranges	Approximate Resistance
200 μA	1.0 kΩ
2 mA	100.0 Ω
20 mA	10.2 Ω
200 mA	1.2 Ω
2000 mA	0.4 Ω

Maximum Open Circuit Input Voltage (mA to LOW)—250 V peak, fused with 2 A fast blow.
Maximum Floating Voltage—1000 V peak.
Maximum Resolution—0.1 μA.

TEMPERATURE

Range—−55 to +200°C.
Resolution—0.1°C.

Accuracy*1

18 to 28°C			
Temperature to be Measured	**−55°C**	**+150°C**	**+200°C**
P6601 Probe and DM 502A calibrated as a pair	±2.5°C		±2.5°C
P6601 and instrument not calibrated as a pair	±4.5°C		±5.5°C

*1 *For 0 to 18°C, 28 to 50°C ambient temperatures, add ±1.5°C to accuracy specifications.*

OTHER CHARACTERISTICS

Overrange Indication—Blinking display (except 1000 V dc and 500 V ac).
Measurement Rate—Three per second.
Power Consumption—≈8 W.
Inputs—Maximum input voltage is 1000 V. The front panel V/Ω, or Low, or mA terminal can be floated 1000 V peak maximum above ground, the rear input 200 V peak. For the rear input, ac volts, ohms, and maximum input specs are derated.

ORDERING INFORMATION

DM 502A Digital Multimeter **$995**
Includes: One pair test leads (003-0120-00); P6601 Temperature Probe (010-6601-01); Instruction manual (070-2693-00.)

OPTION

Option 02—Deletes P6601 Temperature Probe and temperature-measurement capability. **−$80**

DM 501A

- **0.05% DC Voltage Accuracy**
- **Seven Functions Including Temperature and dB**
- **4½ Digit Display**
- **True RMS Capability**

The DM 501A Digital Multimeter measures dc and ac voltage, dc and ac current, resistance, dB, and temperature. The DM 501A gives 4 digits of readout resolution, all with 0.05% accuracy and true RMS capability. True RMS allows accurate measurement of distorted waveforms. Readout in dB is useful when making critical audio and communication measurements. Fast accurate temperature measurements to 240°C come from the Tektronix P6601 platinum-film temperature sensing probe. The P6601 reaches 90% of final reading in 1.5 seconds. Power consumption is approximately 9 V A.

CHARACTERISTICS

DC VOLTS

Ranges—200 mV, 2 V, 20 V, 200 V, and 1000 V.

Accuracy*1

18°C to 28°C	
Voltage Ranges	**Normal and Fast Conversion Rate**
200 mV	±[0.05% of reading +0.015% of full scale (3 counts)]
2 V to 200 V	±[0.05% of reading +0.01% of full scale (2 counts)]
1000 V	±[0.05% of reading +0.02% of full scale (2 counts)]
0 to 18°C, 28 to 50°C	
200 mV to 200 V	±[0.1% of reading +0.025 of full scale (5 counts)]
1000 V	±[0.1% of reading ±0.05% of full scale (5 counts)]

*1 *Valid for six months or 1000 hours, whichever occurs first.*

Common-Mode Rejection Ratio—≥100 dB at dc ≥80 dB at 50 Hz and 80 Hz with 1 kΩ imbalance.
Normal-Mode Rejection Ratio—≥60 dB at 50 Hz or 60 Hz±0.2 Hz.
Maximum Resolution—10 μV.
Step Response Time—<1 s.
Input Resistance—10 MΩ.
Maximum Input Voltage—1000 V peak.

TRUE RMS AC VOLTS

Input Signal—Must be between 5 and 100% of full scale.
Ranges—200 mV, 2 V, 20 V, 200 V, and 500 V (ac coupled).

Accuracy*1

18 to 28°C

Voltage Ranges	20 Hz to 40 Hz	40 Hz to 10 kHz	10 kHz to 20 kHz
200 mV to 200 V	±[1% of reading +0.05% of full scale (10 counts)]	±[0.6% of reading +0.05% of full scale (10 counts)]	±[1% of reading +0.05% of full scale (10 counts)]
500 V	±[1% of reading +0.2% of full scale (10 counts)]	±[0.6% of reading +0.2% of full scale (10 counts)]	±[1% of reading +0.2% of full scale (10 counts)]

18 to 28°C

Voltage Ranges	20 Hz to 40 Hz	40 Hz to 10 kHz	10 kHz to 20 kHz
200 mV to 200 V	±[1.3% of reading +0.075% of full scale (15 counts)]	±[0.8% of reading +0.075% of full scale (15 counts)]	±[1.3% of reading +0.075% of full scale (15 counts)]
500 V	±[1.3% of reading +0.3% of full scale (15 counts)]	±[0.8% of reading +0.3% of full scale (15 counts)]	±[1.3% of reading +0.3% of full scale (15 counts)]

*1 *Valid for six months or 1000 hours, whichever comes first.*

Common-Mode Rejection Ratio—≥60 dB at 50 to 60 Hz with 1 kΩ imbalance.
Maximum Resolution—10 μV.
Response Time—<2 s.
Input Impedance—10 MΩ paralleled by 160 pF.
Maximum Input Voltage—500 V ac rms, 600 V dc, not to exceed 1000 V peak.
Crest Factor—4 (at full scale).

dB (TRUE RMS)

Zero dB Reference—1 mW in 600Ω (0.775 V) (dBm) Internal jumper change for 0 dB reference of 1.0000 V (dBV).

Accuracy*1

18 to 28°C

	20 Hz	2 kHz	10 kHz	20 kHz
+50 to −50 dB	0			±0.5 cB
−50 to −60 dB	±0.5 dB	±1.5 dB	Typically ±2.5 dB	

*1 *From 0 to 18°C, 28 to 50°C, add 0.6 dB to above accuracy specifications.*

Maximum Resolution—0.1 dB.
Response Time—<2 s.
Input Impedance—10 MΩ paralleled by <160 pF.
Maximum Input Voltage—500 V RMS, not to exceed 1000 V peak. Equivalent to +54 dBV or +56.2 dBm.
Crest Factor—4 (at full scale)

RESISTANCE

Response Time—<2 s in 200 Ω to 200 kΩ ranges; <10 s in 20 MΩ range.
Maximum Input Volts—250 V peak.
Maximum Resolution—10 mΩ.
HI-LO Ohm Operation—A low voltage is user-selectable for making in-circuit ohms measurements without turning on silicon diode and transistor junctions. A high voltage is also available for testing junctions for forward and reverse resistance.
Maximum Open-Circuit Voltage Developed—<6 V.
Ranges—200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2000 kΩ, and 20 MΩ.

Accuracy*1

18 to 28°C

Resistance Ranges	Normal and Fast Conversion Rate	
200 Ω	LO Ω	±[0.15% of reading +0.015% of full scale (3 counts)]
2 kΩ to 2000 kΩ	HI Ω	±[0.15% of reading +0.015% of full scale (3 counts)]
2 kΩ to 200 kΩ	LO Ω	±[0.15% of reading +0.015% of full scale (3 counts)]
2000 kΩ	LO Ω	±[0.3% of reading +0.015% of full scale (3 counts)]
20 MΩ	HI Ω only	±[0.15% of reading +0.05% of full scale (3 counts)]
0 to 18°C, 28 to 50°C		
200 Ω	LO Ω	±[0.3% of reading +0.025% of full scale (5 counts)]
2 kΩ to 2000 kΩ	HI Ω	±[0.3% of reading +0.025% of full scale (5 counts)]
2 kΩ to 200 kΩ	LO Ω	±[0.3% of reading +0.025% of full scale (5 counts)]
20 kΩ	HI Ω	±[1.2% of reading +0.025% of full scale (5 counts)]
2000 MΩ	LO Ω	±[1.2% of reading +0.025% of full scale (5 counts)]

*1 *Valid for six months or 1000 hours, whichever occurs first.*

DC AND TRUE RMS AC CURRENT

Input Signal—Must be between 5 and 100% of full scale (ac only).
Ranges—200 μ, 2 mA, 20 mA, 200 mA, and 2000 mA.
DC Current Accuracy—18 to 28°C: ±[0.2% of reading +0.015% of full scale (3 counts)]. 0 to 18°C and 28 to 50°C: ±[0.3% of reading +0.025% of full scale (5 counts)].
AC Current Accuracy From 20 Hz to 10 kHz—18 to 28°C: ±[0.6% of reading +0.05% of full scale (10 counts)]. 0 to 18°C, 28 to 50°C: ±[0.7% of reading +0.075% of full scale (15 counts)]. Usable to 20 kHz.
Response Time—<1 s dc current, <2 s ac current.

Input Resistance

Ranges	Approximate Resistance
200 μA	1.0 kΩ
2 mA	100.0 Ω
20 mA	10.2 Ω
200 mA	1.2 Ω
2000 mA	0.4 Ω

Maximum Open-Circuit Input Voltage (mA to LOW)—250 V peak, fused with 2 A fast blow.
Maximum Floating Voltage—1000 V peak.
Maximum Resolution—10 nA.

TEMPERATURE

Range—−62 to +240°C.
Resolution—0.1°C.

Accuracy*1

Temperature to be Measured	−62 to +150°C	+150 to +240°C
P6601 and DM 501A calibrated as a pair	±2°C	0 to −6°C
P6601 and instrument not calibrated as a pair	±4°C	+2 to −8°C

*1 *18 to 28°C ambient temperature. For 0 to 18°C, 28 to 50°C ambient temperatures, add 1.5°C to above limit in each direction.*

OTHER CHARACTERISTICS

Overrange Indication—Blinking display (except on 1000 V dc and 500 V ac ranges).
Measurement Rate—3⅓/s.
Power Consumption—≈9 VA.
Inputs—Maximum input voltage is 1000 V. The front panel Volts/Ω, or Low, or mA terminals can be floated to 1000 V peak maximum above ground, the rear input only 200 V peak. For the rear input, ac volts, ohms, and maximum input specifications are derated.

ORDERING INFORMATION

DM 501A Digital Multimeter **$925**
Includes: One pair of test leads (003-0120-00); P6601 Temperature Probe (010-6601-01); Instruction manual (070-2749-00).

OPTION

Option 02—Deletes P6601 Temperature Probe and temperature-measurement capability. **−$80**

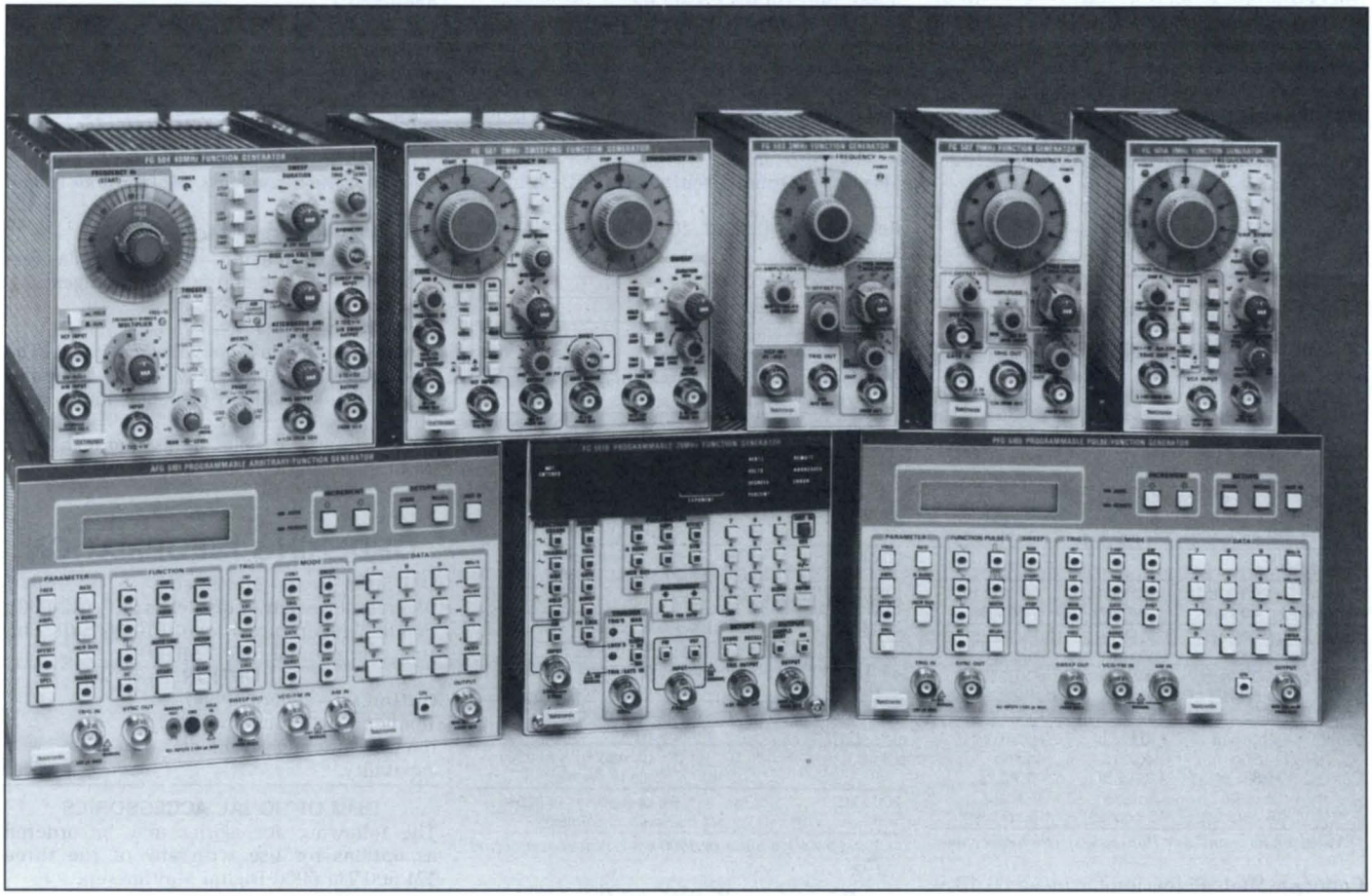
DMM OPTIONAL ACCESSORIES

The following accessories may be ordered as options for use with any of the three TM 500/TM 5000 Digital Multimeters.

Test Leads—
(Black) 4 ft. Order 012-0425-00 **$13.25**
(Red) 4 ft. Order 012-0426-00 **$24**
(Black) 4 ft. Order 012-0426-01 **$24**
Test Lead Set—Includes 012-0425-00, 012-0426-00, and 013-0107-05. Order 012-0427-00 **$30**
(DM 5120/5520 only)
Order 012-0941-02.*1
Temperature Probes—P6601 (DM 501A and DM 502A only). **$250**
P6602 (DM 504A only). **$260**
Adapter—Female-BNC-to-Dual-Banana. Order 103-0090-00. **$10**
High-Voltage Probe—(DM 501A, DM 502A, DM 504A only)
Order 010-0277-00. **$185**
Cables—No specification changes.
(1 meter) Order 175-1661-00. **$29**
(3 meter) Order 175-1661-02. **$33**
Kelvin Clip Lead Set—
Order 012-1296-00.*1

*1 *Contact your local sales office.*

FUNCTION GENERATORS



For test and measurement problems requiring waveform generation, the high-performance TM 5000/TM 500 Function Generators offer both precision and multifunctionality for versatile solutions.

Two new Function Generators, the AFG 5101/5501 and the PFG 5105, join the FG 5010 with full programmability and GPIB compatibility.

The AFG 5101 provides accurate "real-world" simulation by combining analog and arbitrary waveform generation with the ability to generate user defined sweep shapes. Its really three generators in one.

The PFG 5105 combines full-featured function generation with pulse generation in one convenient package. Both the AFG and the PFG can store up to 99 complete front panel settings. This feature speeds up the programming process for computer controlled applications and enhances benchtop capabilities.

Tektronix realizes the need for monolithic products in specific applications. The AFG 5501 and the PFG 5505 have been developed to meet these needs.

The FG 5010 provides full GPIB programmability, accuracy within 0.1% of reading to 20 MHz, variable symmetry, complementary output, and a host of other features.

Both the FG 501A and the FG 507 provide low distortion waveforms from 0.02 Hz to 2 MHz, while the FG 507 adds linear and logarithmic sweeps. Both are well suited to audio applications.

The FG 504 generates three basic waveforms from 0.001 Hz to 40 MHz. Its unique phase lock mode enables conversion of digital signals to high or low frequency sine waves, pulses, or triangles.

The FG 501A, FG 502, and the FG 503 are lower frequency generators that provide a low cost alternative for straight forward applications in biological, geophysical, and mechanical simulations.

EXTENDED FUNCTIONALITY

The DD 501 Digital Delay is an events-counting device that can be used with pulse, function and clock generators in such applications as precise digital delay between two related events, divide-by-N frequency divider, precision gate generator, counted burst output from a gated pulse or frequency generator, etc.

FUNCTION GENERATOR SELECTION GUIDE

Application/Feature	FG 501A	FG 502	FG 503	FG 504	FG 507	FG 5010	AFG 5101/PFG 5105
Waveforms Sine, Square, Triangle	✓	✓	✓	✓	✓	✓	Sine, square, triangle, DC
Pulse, Ramp	✓	✓		✓	✓	✓	✓*8
Symmetry (%)	≤5 to ≥95 Variable	5, 50, 95 Fixed	50 Fixed	7 to 93 Variable	≤5 to >95 Variable	10 to 90 1% steps	50% Fixed; AFG
Frequency Range (Hz) with var. symmetry	0.002 to 2 M 200 k±10%	0.1 to 11 M (1.1 M Pulse, Ramp)	1 to 3 M (0.01 to 5 M usable)	0.001 to 40 M 4 M	0.002 to 2 M 200 k±10%	0.002 to 20 M	0.012 to 12 M
Dial Accuracy % of full scale	≤3	≤3 to 1 MHz ≤5 to 10 MHz	≤5	≤3 to 4 MHz*1 ≤6 to 40 MHz*1	≤3 ≤5 in sweep mode *2	≤0.1 of selected frequency Digital LED Display	≤0.2 121 Hz to 5 MHz ≤0.005 with synthesizer
Custom Freq. Range	No	No	With user installed cap.	Includes cap. for 20 Hz to 20 kHz	No	No	No
Frequency Stability % of full scale			≤0.05 for 10 min, ≤0.1 for 1 hr, ≤0.5 for 24 hrs, constant temp.			≤0.05 for 1 hr. ≤0.05 for 24 hrs.	0.2 for 24 hrs in cont mode
Amplitude (Vpp) open circuit	30	10	20	30	30	20	19.98
into 50 Ω	15	5	10	15	15	10	9.99
Attenuator (dB) in 20-dB steps	0 to −60			0 to −50	NA		Digital control of fixed & variable
with AMPL control	>20 additional				NA		
with VAR control			Variable control only <10 mV p-p		NA		
Offset (V dc) open circuit	±13	±5	±7.5	±7.5	NA	±7.5	±9.98
into 50 Ω	±6.5	±2.5	±3.75	±3.75	NA	±3.75	±4.99
Peak Signal + Offset (V dc) open circuit	±15	±10	±15	±20	±15	±15	±9.98
into 50 Ω	±7.5	±5	±6	±11.25	±7.5	±7.5	±4.99
Output Impedance (Ω)	50	50	50	50	50	50	50
Amplitude Flatness (Hz) (10-kHz ref, 50-Ω load) Sine	±0.1 dB, 20 to 20 k; ±0.5 dB, 20 k to 1 M; ±1 dB, 1 M to 2 M	±0.5 dB, 20 to 20 k; ±1.5 dB, 0.1 to 11 M	±0.5 dB, 20 to 20 k; ±2 dB, 0.1 to 3 M	±0.5 dB, 0.001 to 40 k	±0.1 dB, 20 to 20 k; ±0.5 dB, 20 k to 1 M; ±1 dB, 1 to 2 M	±3%, 0.002 to 1 k; ±3.5%, 1 k to 1 M; ±5%, 1 to 5 M; +5%, −10%, 5 to 20 M	0.5 dB, 0.012–120 k 2.0 dB to 1.2 M 3 dB to 12 M 1 kHz ref
Triangle	±0.5 dB, 20 to 200 k; ±2 dB, 200 k to 2 M	±3 dB ref to Sine Wave	±1 dB ref to Sine Wave	±2 dB, 40 k to 40 M	±0.5 dB, 20 to 200 k; ±2 dB, 200 k to 2 M	±2%, 0.002 to 1 k; ±3.5%, 1 to 100 k; +4%, −5%, 1 to 5 M; +4%, −20%, 5 to 20 M	Same as Sine
Square	±0.5 dB, 20 to 2 M	±3 dB ref to Sine Wave	±1 dB ref to Sine Wave	±0.5 dB to 20 M; ±2 dB to 40 M	±0.5 dB, 20 to 2 M	±2%, 0.002 to 1 k; ±3.5%, 1 k to 1 M; ±5%, 1 to 10 M; ±10%, 10 to 20 M	Same as Sine
Sine-Wave Distortion (Hz, Maximum Output, 50-Ω load)	≤0.25%, 20 to 20 k*2; ≤0.5%, 20 to 100 k Harmonics: ≤−30 dB, 100 k to 2 M	≤0.5%, 10 to 50 k*2 Harmonics: ≤−30 dB at all other frequencies	≤0.5%, 1 to 30 k; ≤1 %, 30 to 300 k; ≤2.5%, 300 k to 3 M	≤0.5%, 20 to 40 k*1 Harmonics: ≤−30 dB, 40 k to 1 M; <−20 dB, 1 to 40 M	≤0.25%, 20 to 20 k*2; ≤0.5%, 20 to 100 k Harmonics: ≤−30 dB, 100 k to 2 M	±0.5%, 20 to 19.99 k ≤1%, 20 to 99.99 k Harmonics: >30-dB down, 100 k to 20 M	<0.6%, 121 Hz to 120 k Harmonics: <20 dB above 120 k
Square-Wave Response	≤25-ns rise/fall; <3% p-p aberrations	≤20-ns rise/fall; ≤3% p-p aberrations	≤60-ns rise/fall; ≤3% p-p aberrations	≤6-ns rise/fall fixed, 10 ns to 100 ms variable; ≤5% p-p +30 mV aberrations	≤25-ns rise/fall; <3% p-p aberrations	≤10-ns rise/fall; ≤5% p-p aberrations	<20 ns rise/fall <10% p-p aberrations

*1 *15 to 35°C ambient.*
*2 *20 to 30°C ambient.*
*3 *20 Hz to 20 kHz modulation frequency.*
*4 *FG 504 requires forced-air circulation above 40°C.*
*5 *Percent of indicated frequency.*
*6 *Absolute voltage accuracy.*
*7 *Separate FM function (1%/V).*
*8 *PFG 5105 does not have ramp.*

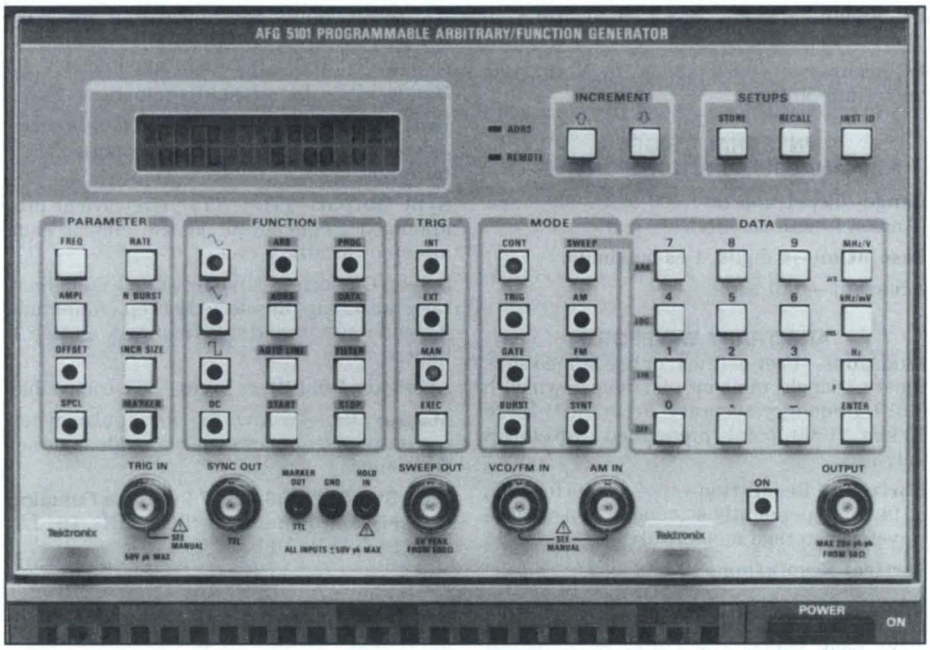
Selection Guide continued next page.

FUNCTION GENERATOR SELECTION GUIDE

Application/Feature	FG 501A	FG 502	FG 503	FG 504	FG 507	FG 5010	AFG 5101/PFG 5105
Triangle Linearity (Hz 10 to 90%)	≥99%, 20 to 200 k ≥97%, 200 k to 2 M	≥99%, 0.1 to 100 k ≥97%, 100 k to 1 M; ≥95%, 1 to 11 M	≥99%, 1 to 100 k; ≥95%, 100 k to 3 M	≥99%, 10 to 400 k; ≥95%, 400 k to 40 M; ≥98%, 0.001 to 10 (typ.)	≥99%, 20 to 200 k; ≥97%, 200 k to 2 M	>98% to 2M; >90% to 20 M	>98% to 100 k
Trigger Output (V_{peak})	≥+2 from 50 Ω	+2.5 to 50-Ω load	+2.5 to 600-Ω load	+2 from 50 Ω	≥+4 from 50 Ω	+ 2 from 50 Ω	TTL compatible
External Input	Impedance ≈2 kΩ; Trigger threshold level +1 V±20%	Impedance ≈1 kΩ; ≥+2 V gate signal required	No	Impedance ≥10 kΩ; Sensitivity ≤1 V p-p; Trigger level; −1 to +10 V	Impedance ≈2 kΩ; Trigger threshold +1 V ±20%	1 MΩ/50 Ω selectable; 0.0 V/0.5 V selectable	TTL compatible Impedance ×10 kΩ
Trigger	±90° variable start phase control	No	No	20 MHz maximum, ±80° start phase control to 10 MHz	±90° variable start phase control		Fixed phase
Gate	±90° variable start phase control	Fixed 0°	No	No			Fixed phase
Phase Lock (Hz)		No		100 to 40 M ±80° phase range	No	20 to 20 M (Auto Scan)	No
Counted Burst		with DD501		No	with DD501	1 to 9999	1–9999
Internal Sweep		No		Log or linear, separate start/stop dials		No	100 n to 999.9
Duration				0.1 m to 100	1 m to 100		
External Trigger		NA		+1 to 10 V trig level; 1 V sensitivity	±1 V ±20% trig level; ≈2 kΩ input	NA	TTL compatible
Ramp Output				0 to +10 V from 1 kΩ ±5% to 1 ms, ±10% ≤1 ms	≤0.3 to 10 V from 1 kΩ ±5%		(Sweep out) 0–5 V from 600 Ω
Gate Output				No	≥+4 V from 50 Ω		
Other Modes				Manual sweep trig	Manual sweep trig; manual sweep; sweep and hold		Manual sweep trig, Internal sweep trig.
Amplitude Modulation		No		100% with ≈5 V p-p, DC to 100 kHz; <5% distortion to 4 MHz at 70%*3, <10% to 40 MHz at 65%*3	No	100% with ≈5 V p-p, DC to 100 kHz, <2% distortion to 2 MHz at 70%, <4% to 20 MHz at 70%	DC to 20 kHz: 100% with 5.0 V p-p
Voltage-Controlled Frequency (FM)*7	Up to 1000:1 frequency change with 10 V external signal.						5.0 V for 500:1
Slew Rate	Slew rate ≥0.3 V/μs. 10 kΩ input impedance.					N/A	0.1 V/μs
Nominal Hz/V Sensitivity (X Frequency Multiplier except FG 5010)	2	1.1	3	4	2	10% of selected range	
Output Hold Mode (Hz)		No		0.001 to 400	No	0.002 to 200	TTL input; Arbit, Output Hold only*8
Arbitrary Sweep:*8							Yes
Horizontal Resolution*8							8192 pts, 1000 pt resolution
Vertical Resolution*8							12 bits, 4096 pts
Output Accuracy*8							2.5 %±20 mV p-p, peak data values ±2047
Point Duration (Rate)*8							100 ns to 999.9 s with 4 dig
Waveform Storage Memories*8							2 memory banks 8192 pts ea.4096)
Resolution							10 MHz lowest range, 1 kHz highest range
Accuracy							50 ppm averaged measurement
IEEE STD 488.1 1987						Yes	Yes
Price	$940	$1,110	$690	$3,275	$2,275	$3,995	$3,395/$2,995

*1 *15 to 35°C ambient.*
*2 *20 to 30°C ambient.*
*3 *20 Hz to 20 kHz modulation frequency.*
*4 *FG 504 requires forced-air circulation above 40°C.*
*5 *Percent of indicated frequency.*
*6 *Absolute voltage accuracy.*
*7 *Separate FM function (1%/V) for FG 5010.*
*8 *AFG 5101 only.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.



NEW AFG 5101/ NEW AFG 5501

Function Generators

GPIB IEEE-488 The AFG 5101/AFG 5501 comply with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats*.

FEATURES

- **Fully Programmable From Front Panel or GPIB**
- **Standard and Arbitrary Waveform Generation from 1 μHz to 12 MHz**
- **Two Non-volatile, Selectable 8K Memories for Waveform Storage**
- **Non-volatile Storage for Up to 99 Front Panel Settings**
- **10 mV to 9.99 V p-p into 50 Ohms**
- **0.2% Accuracy (0.005% With Synthesizer Option)**
- **Sine, Square, Triangle, Ramp Up, Ramp Down, Arbitrary Waveforms, and DC**
- **Linear, Logarithmic, and Arbitrary Sweep Capabilities**

The AFG 5101/AFG 5501 combine the capabilities of standard analog and arbitrary waveform generation with the ability to generate virtually any sweep shape to allow accurate simulation of real-world functions.

Standard analog functions include sine, square and triangle waveforms, and DC with frequencies from 0,012 Hz to 12 MHz and amplitudes from 10 mV to 9.99 V p-p into 50 ohms. Waveforms can be continuous, triggered, gated, or burst. Trigger can be internally, manually, or GPIB supplied.

Arbitrary waveforms can be defined point by point, generated mathematically, transferred from computer graphics, or captured from an analog source and stored into one of two independently selectable 12 bit by 8K waveform memories for later use.

A sweep generater, from which linear, logarithmic, or user defined sweep shapes can be selected, allows complete customization of waveforms. A high-speed execution buffer allows viewing and editing of the waveform as it is designed.

Build a Waveform Library

Once a waveform is generated, it can be stored in non-volatile internal memory. Or, through the GPIB, a complete library of calibration and stimulus waveforms and panel settings can be stored on disk. Up to 99 panel settings can also be stored in internal non-volatile memory.

TM 5000 Series Compatibility

The AFG 5101 is part of Tek's TM 5000 family of modular test instruments. It occupies 3 slots in any TM 5000 Manframe, and since it conforms to Tek *Standard Codes and Formats* it can be combined with any of the TM 5000 instruments to form a fully programmable stimulus and measurement system. (The AFG 5101 incorporates many of the commands used with the TEK FG 5010 Programmable Function Generator.)

Configurations

- The AFG 5101 is a 3-wide plug-in module that fits into the TM 5003 or TM 5006 Power Module Mainframe
- The AFG 5501 is the 5101 mounted in a three wide GPIB power module
- The AFG 5101 is at the heart of the EBS 5002 Programmable Arbitrary Stimulus/ Measurement Package.

Options

Option 02 adds a frequency lock synthesizer that provides a stable output waveform by locking the output to an internal quartz crystal. This option operates in continuous mode only, from 12.1 Hz to 12 MHz.

CHARACTERISTICS

Waveforms—Sine, square, triangle, arbitrary, and dc.

Operating Modes

Continuous—Output continuous at programmed frequency, amplitude, and offset.

Triggered—Output quiescent until triggered by an internal, external, GPIB, or manual trigger; then generates one cycle at programmed frequency, amplitude, and offset.

Gated—Same as triggered mode except waveform is executed for the duration of the gated signal. The last cycle started is completed.

NBurst—Same as triggered mode for programmed number of cycles from 1 to 9999, as set by the NBurst function.

Sweep—Internal, programmable start frequency, stop frequency, rate (time per step) and marker frequency. Linear, logarithmic, and arbitrary sweep shapes can be continuous, triggered, gated, or burst seleted.

Modulated—The analog generator can be frequency and amplitude modulated. Arbitrary waveforms can be amplitude modulated only.

Increment—Frequency, amplitude, offset, rate, sweep marker, and NBurst can be manually incremented/decremented by a settable Increment delta. Step rate is 2 steps/s for first 3 steps, then 10 steps/s for successive steps at one continuous keystroke.

FREQUENCY

Range—0.012 Hz to 12.0 MHz.
Resolution—3½ digits (1200 counts). Optional synthesizer mode: 4½ digits (12,000 counts).
Accuracy—±0.2% of reading from 121 Hz to 5 MHz in continuous mode..
±0.5% of reading from 5 Mhz to 12 MHz in continuous mode.
±5% of reading from 0.1 Hz to 120 Hz in continuous mode.
±0.005% in optional synthesizer mode, 12.1 Hz to 12 MHz.

Jitter—<0.1% to 5 MHz.

Stability—±0.2% in continuous mode for all time intervals.
±0.005% in optional synthesizer mode, 12.1 Hz to 12 MHz.
±0.5% for 24 hours in other modes.

Repeatability—±1% for 24 hours in other than continuous mode..
±0.005% in optional synthesizer mode, 12.1 Hz to 12 MHz.

OUTPUT

Amplitude Range—10 mV to 9.99 V p-p into 50 ohms (20 mV to 19.98 V p-p into open circuit). (Open circuit values are 2 times the displayed values.)

Amplitude Resolution—10 mV from 1 V to 9.99 V p-p into 50 Ω; 1 mV from 0.1 V to 0.999 V p-p into 50 Ω. 1 mV from 10 mV to 0.99 mV p-p into 50 Ω.

Amplitude Accuracy—±2% ±20 mV of programmed value for 1.0 V to 9.99 V output at 20 to 30 °C; ±3% ±5 mV for 10 mV to 999 mV output, specified for a sine, square, or triangle wave output at 1 kHz.

Repeatability—±1% for 24 hours.

Amplitude Flatness—0.5 dB from 0.012 Hz to 120 kHz, ±2 dB to 1.2 MHz, ±3 dB to 12 MHz referenced to 1 kHz sine, square, or triangle wave.

Offset Plus Peak Amplitude—Absolute peak amplitude plus offset is limited to a maximum tha is dependent on the signal amplitude range. 4.99 V maximum for 1 V to 9.99 V range; 0.499 V maximum for 0.1 V to 0.999 V range; 0.049 V maximum for 0.01 V to 0.099 V range.

Offset Resolution—3 digits; 1 mV when p-p amplitude is <999 mV; 10 mV when p-p amplitude is >1 V (into 50 ohms).

Offset Accuracy—±0.6% ±20 mV (into 50 Ω).

Repeatability—±1% ±20 mV for 24 hours.

Output Impedance—50 Ω.

Output Protection—The instrument is nondestructively protected against short circuits or accidental voltage of up to ±100 V (dc plus peak ac) applied to the main output connector.

WAVEFORM

Sine Distortion—<0.6% THD (RMS), 121 Hz to 120 kHz at 5 V p-p amplitude at 20 to 30 °C. <1% THD (RMS), 12 Hz to 120 kHz at full temperature and amplitude range. (All harmonics less than −20 dB below fundamental from 121 kHz and above.)

Square Wave Time Symmetry—<0.5% 121 Hz to 120 kHz; ±1% 0.012 kHz to 1.200 MHz; ±5% 1.21 MHz to 12.0 MHz.

Square Wave Transition Time—<15 ns 10 to 90% at full output amplitude; elsewhere, <20 ns, 10 to 90%.

Square Wave Aberrations—<8% of p-p amplitude ±20 mV from 3.4 to 9.99 V p-p output amplitude. <10% of p-p amplitude below 3.34 V p-p output amplitude.

Triangle Linearity—98% to 100 kHz measured from 10 to 90% on waveform.

DC Range—±10 mV to ±4.99 Vdc from 50 ohms (into 50 Ω).

DC Accuracy—±0.6% ±20 mV in DC function only, (into 50 Ω).

INTERNAL TRIGGER ANALOG FUNCTIONS ONLY

Range—Repetition rate 100 ns to 999.9 sec. (Analog functions only).

Resolution—4 digits, 1 ns maximum.

Accuracy—0.01%.

ARBITRARY WAVEFORM

Functions—User defined, or predefined sine, square, triangle, ramp up, and ramp down with 0.01% frequency accuracy. From 0.001 Hz to 10 kHz (1000 point predefined waveforms only).

Horizontal Resolution—8192 points for each of two independently selectable non-volatile waveform storage memories.

Vertical Resolution—12 bits.

Output Accuracy—±2.5% ±20 mV of programmed p-p amplitude when arbitrary data point peak values are ±2047 to −2047 at waveform frequencies of 1 kHz with predefined waveform functions.

Point Duration—100 ns to 999.9 sec with 4 digits resolution. Accuracy typically better than 0.01%.

Risetime—<150 ns 10 to 90% (with no filtering).

Setting Time—<300 ns to within 1% of final value with a full scale step (with no filtering).

Waveform Execution—
Buffer: 8192 points, volatile.
Filters: 4 selectable, single pole filters (3 dB cutoff frequency).
0 —Filter off.
1 —Typically 1 MHz ±20%.
2 —Typically 100 kkHz ±20%
3 —Typically 11 kHz ±20%.
4 —Typically 1.3 kHz ±20%.

FREQUENCY SWEEP

Sweep Types—Linear, logarithmic, arbitrary.
Sweep time—100 ns to 999.9 sec per point; 1 ns maximum resolution.

Sweep Width—1200—1 maximum; start and stop frequencies must be in the same range.

Sweep Ranges—10 kHz to 12 MHz; 1 kHz to 1.2 MHz; 100 Hz to 120 kHz; and so on until 0.1 Hz to 120 Hz plus 0.012 Hz to 12 Hz.

Start/Stop Frequency Accuracy—±5% of upper frequency.

Marker accuracy—±5% of upper frequency.

INPUTS and OUTPUTS

VCO/FM Input—5 V p-p for a 500:1 frequency change.

Trigger In—TTL compatible.

Nominal impedance—10 kOhms.

Maximum rate—6 MHz.

Minimum width—20 ns.

AM Input—Input resistance: 10 Ω nominal. 5 V p-p (0 V to +5 VDC) for 100% modulation. (AM limited to 30% at certain amplitude levels.)

Bandwidth—DC to 20 kHz minimum.

Input Protection—All inputs protected against up to ±50 V (dc plus peak ac) accidental input.

Sync Output—TTL level squarewave at programmed frequency or at the end of each sweep or arbitrary cycle.

Sweep Output—Source resistance 600 ohms; same waveshape as selected sweep. (Amplitude depends on start and stop frequency and a 5 V limit.)

Arbitrary Hold/Reset Input—TTL compatible.

Marker Out—Positive TTL level pulse, when the output frequency equals provided marker frequency.

IEEE Standard 488.1-1987 Interface Function Subsets Implemented—SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, E2.

GENERAL

Environmental—Operating: 0 to 50 °C. Nonoperating: −55 to +75 °C.

Power Consumption—50 VA maximum, limited by internal fuse.

Power Dissipation—AFG 5101: 30 W AFG 5501: 90 W

Memory—Non-volatile, stores up to 99 complete front panel settings. Two selectable 8192 arbitrary waveform memories.

	AFG 5101		AFG 5501	
Dimensions	**mm**	**in**	**mm**	**in**
Width	233	8.0	234	9.2
Height	127	5.0	141	5.5
Depth	279	11.0	432	17.0

Display—2 line alphanumeric, 16 character LCD. Provides for descriptive error messages. Variable back lighting and contrast.

ORDERING INFORMATION

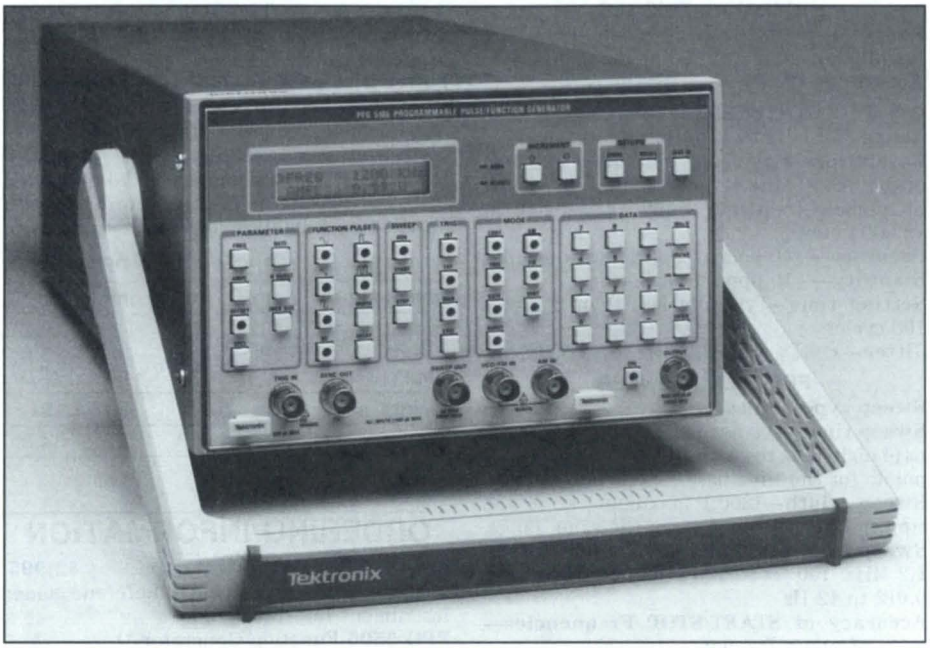
AFG 5101—Programmable Arbitrary/ Function Generator (plug-in). **$3,395**
Includes: Instrument manual; Reference guide; Instrument interfacing guide.

AFG 5501—Programmable Arbitrary/ Function Generator (monolithic). **$3,995**
Includes: Instrument manual; Reference guide; Instrument interfacing guide.

OPTION

Option 02—Adds a frequency lock synthesizer. **+$350**

Service Manual—Contact your local Sales Representative.



NEW PFG 5105/ NEW PFG 5505

Pulse/Function Generators

GPIB IEEE-488 The PFG 5105/PFG 5505 complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats*.

FEATURES

- **0.012 Hz to 12 MHz; Accuracies to 0.005% with Synthesizer Option**
- **Programmable Width and Delay**
- **10 mV to 9.99 V p-p Into 50 Ohms**
- **Continuous, Triggered, Gated and Burst, AM, VCF and Linear Sweep Modes**
- **Non-volatile Storage for 99 Front Panel Settings**

The PFG 5105/PFG 5505 Programmable Pulse/Function Generators combine the advantages of pulse generation with the versatility of full-featured function generation and complete programmability. Its waveform generation capabilities include pulse, double pulse, sine, triangle, square, and dc outputs from 0.012 Hz to 12 MHz in continuous, triggered, gated, burst, swept, and AM/VCF modes. A synthesizer option is available that locks the output to an internal quartz crystal for accuracies of 0.005% (continuous mode only).

In addition to complete programmability, the PFG 5105 has the ability to store up to 99 front panel settings which can be called up either from the front panel or through the GPIB. This feature reduces programming time and enhances standalone bench applications.

Flexible Front Panel

A SPCL function key extends the functions of the front panel, letting you change the GPIB address and/or terminators, or alter the contrast and backlighting of the front panel. Use the INCREMENT keys to scroll through the SPCL codes for the desired operation.

Convenient LCD Display

The PFG 5105 features a two-row LCD display with 16 characters in each row. Character mnemonics describe the function or parameter being displayed, with its current value and its units of measure. Errors are displayed as 3-digit code numbers (same as GPIB code) with an accompanying description. Pressing the INST ID key causes instant display of the generator's GPIB address and EOI/LF termination.

Paired Pulse Generation

Double pulse generation is very convenient when evaluating a circuit's ability to differentiate between two closely spaced pulses. Paired pulses can be generated at selected repetition rates with the delay control determining the time between the two pulses.

TM 5000 Series Compatibility

As a member of the Tektronix TM 5000 family of programmable modular test instruments, the PFG 5105 is fully GPIB compatible and adheres to Tek's Standard Codes and Formats, insuring ease of configurability and communication for integrated systems use configurations.

The **PFG 5105** occupies three slots in any TM 5000 Mainframe and can be combined with any of the TM 5000 instruments to form completely programmable stimulus and measurement systems.

The **PFG 5505** is a standalone version of the PFG 5105.

Options

Option 02 adds a frequency lock synthesizer that provides a stable output waveform by locking the output to an internal quartz crystal. This option operates in continuous mode only, from 12.1 Hz to 12 MHz.

CHARACTERISTICS

Waveforms—Sine, square, triangle, pulse, double pulse, and dc.

OPERATING MODES

Continuous—Output continuous at programmed frequency, amplitude, and offset.
Triggered—Output quiescent until triggered by an internal external, GPIB, or manual trigger; then generates one pulse event or one function cycle at programmed frequency, amplitude and offset.
Gated—Same as triggered mode except waveform is executed for the duration of the gated signal. The last cycle started is completed.
Burst—Same as triggered mode for programmed number of cycles from 1 to 9999, as set by the NBURST function.
Sweep—Linear, programmable start frequency, stop frequency, and rate (time per sweep). Sweeps can be continuous, triggered, gated, or burst.
Modulation—Generator can be frequency and amplitude modulated.
Increment—Frequency, amplitude, offset, rate, width, delay, and NBurst can be manually incremented/decremented by a settable INCREMENT delta. Step rate is 2 steps/sec for first 3 steps, then 10 steps/sec for successive steps at one continuous keystroke.

FREQUENCY

Range—0.012 Hz to 12.0 MHz
Resolution—3½ digits (1200 counts); Optional synthesizer mode: 4½ digits (12000 counts)
Accuracy—±0.01% for pulse modes with internal triggering. ±0.2% of reading from 121 Hz to 5 MHz in continuous mode. ±0.5% of reading from 5 to 12 MHz in continuous mode; ±5% of reading from 0.1 to 120 Hz in continuous mode; ±0.005% in optional synthesizer mode, 12.1 Hz to 12 MHz.
Jitter—<0.1% to 5 MHz.
Stability—±0.2% in continuous mode for all time intervals. ±0.005% in optional synthesizer mode, 12.1 Hz to 12 MHz. ±0.5% for 24 hours in other modes.
Repeatability—±1% for 24 hours in other than continuous mode. ±0.005% in optional synthesizer mode, 12.1 Hz to 12 MHz.

OUTPUT CHARACTERISTICS

Amplitude Range—10 mV to 9.99 V p-p into 50 Ω (20 mV to 19.98 V p-p into open circuit)
Amplitude Resolution—10 mV from 1 to 9.99 V p-p into 50 Ω; 1 mV from 0.1 to 0.999 V p-p into 50 Ω; 1 mV from 10 to 99 mV p-p into 50 Ω.
Amplitude Accuracy—±2.0% ±20 mV of programmed value for 1.0 to 9.99 V output at 20 to 30 °C; ±2.5% ±20 mV of programmed value for 1.0 to 9.99; 3% ±5 mV for 10 to 999 mV output, specified for a sine, square, or triangle wave output at 1 kHz.
Repeatability—±1% for 24 hours.
Amplitude Flatness—0.5 dB from 0.012 Hz to 120 kHz, ±2 dB to 1.2 MHz, ±3 dB to 12 MHz referenced to 1 kHz sine, square or triangle wave.
Offset Range—4.99 V from 1 to 9.99 V into 50 Ω; 0.499 V from 0.1 to 0.999 V into 50 Ω; 0.049 V from 0.01 to 0.099 V into 50 Ω.
Offset Resolution—3 digits; 1 mV when p-p amplitude is <999 mV; 10 mV when p-p amplitude is >1 V, into 50 Ω.
Repeatability—±1% ±20 mV for 24 hours.
Output Impedance—50 Ω.
Output Protection—The instrument is nondestructively protected against short circuits or accidental voltage of up to ±100 V (dc + peak ac) applied to the main output connector.

WAVEFORM CHARACTERISTICS

Sine Distortion—<0.6% THD (RMS), 121 Hz to 120 kHz at 5V p-p amplitude at 20 to 30 °C. <1% THD (RMS), 12 Hz to 120 kHz at full temperature and amplitude range.
Square Wave Time Symmetry—<0.5%, 121 Hz to 120 kHz; ±1%, 121 kHz to 1.2 MHz; ±5%, 1.21 MHz to 12.0 MHz.
Pulse and Square Wave Transition Time—<15 ns 10 to 90% at full output amplitude; elsewhere <20 ns, 10 to 90%.
Pulse and Square Wave Aberrations—<8% of p-p amplitude ±20 mV from 3.4 to 9.99 V p-p output amplitude. <10% of p-p amplitude below 3.34 V p-p output amplitude.
Triangle Linearity—98% to 100 kHz measured from 10 to 90% on waveform.
Pulse Width and Delay—40 ns to 99.9 ms.
Resolution—3 digits, 10 ns maximum.
Accuracy—±3% of programmed value, ±10 ns.
Repeatability—±1%, ±5 ns.
Pulse Duty Cycle—Up to 50% when delay plus width <500 ns, 80% when delay plus width >500 ns.
Double (Paired) Pulse—2 pulses of selected width up to 6 MHz separated by selected delay period.
DC Range—±10 mV to ±4.99 V dc from 50 Ω into 50 Ω load.
DC Accuracy—±0.5% ±20 mV in DC function only, into 50 Ω.

INTERNAL TRIGGER

Range—Repetition rate 100 ns to 999.9 s.
Resolution—4 digits, 100 ns maximum.
Accuracy—0.01%.

SYNTHESIZER OPTION

Range—12.1 Hz to 12 MHz.
Resolution—Frequency resolution (LSD of display) is 10 MHz on lowest range and 1 kHz on highest frequency range (4.5 digits, or 12,000 counts).
Accuracy—±50 ppm averaged measurements.
Stability—±10 ppm/°C or better.
Setting time—Typically less than 2 s plus 100 cycles.
Jitter—<0.1% from 12.1 Hz to 12 MHz.

FREQUENCY SWEEP

Sweep type—Linear only.
Sweep time—100 ns to 999.9 s per point. 100 ns (4 digit) max resolution. 1 sweep equals 256 points for the time base.
Sweep width—1200:1 maximum; start and stop frequencies must be in the same range.
Sweep ranges—10 kHz to 12 MHz; 1 kHz to 1.2 MHz; 100 Hz to 120 kHz; and so on until 0.012 to 12 Hz.
Accuracy of START/STOP Frequencies—±5% of upper frequency, typical.

INPUTS AND OUTPUTS

VCF Input—5V p-p for a 500:1 minimum frequency change.
Trigger IN—TTL compatible. Nominal impedance: 10 kΩ. Maximum rate: 6 MHz. Minimum width: 20 ns.
AM Input—Input resistance: 10 kΩ nominal. 5 V p-p (0 to +5 V dc) for 100% modulation. Bandwidth: dc to 20 kHz minimum.
Input Protection—All inputs protected against up to ±50 V (dc + peak ac) accidental input.
Sync Output—TTL level squarewave at programmed frequency.
Sweep Output—Source resistance 600 Ω; same waveshape as selected sweep. Amplitude depends on start and stop frequency and a 5 V limit.

GPIB PROGRAMMING

Interface—IEEE 488.1 1987 compatible
Subsets—SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E2

ENVIRONMENTAL CHARACTERISTICS

Temperature—Operating: 0 to 50 °C. Nonoperating: −20 to +60 °C.
Electrical Discharge—Operating Max Test Voltage: 15 kV, 150 pF through 150 Ω. Nonoperating Max Test Voltage: 20 kV, 150 pF through 150 Ω.

GENERAL

Power Consumption—50 VA maximum limited by internal fuse.
Power Dissipation—30 W (PFG 5105); 90 W (PFG 5505).
Memory—Non-volatile, stores up to 99 complete front panel settings.
Display—2 line alphanumeric, 16 character LCD. Provides for descriptive error messages. Variable back lighting and contrast.

	PFG 5105		PFG 5505	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	135	5.3	234	9.2
Height	127	5.0	140	5.5
Depth	310	12.2	432	17.0
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	1.7	4.6	5.3	14.3

ORDERING INFORMATION

PFG 5105 Function Generator. **$2,995**
Includes: Instrument manual; Referene guide; Instrument Interface guide.
PFG 5505 Function Generator.*[1]
Includes: Instrument manual; Reference guide; Instrument interface guide.

*[1] *Contact your local sales office.*

FG 5010

GPIB IEEE-488

The FG 5010 complies with IEEE Standard 488.1-1987, and with Tektronix *Standard Codes and Formats.*

- **0.002 Hz to 20 MHz**
- **Up to 20 V p-p From 50 Ω**
- **Sine, Square, Triangle, Pulse, and Ramp Waveforms**
- **10 ns Rise/Fall**
- **10 to 90% Variable Symmetry in 1% Steps**
- **Trigger, Gate, Counted Burst**
- **Phase Lock, With Autoscan**
- **AM, FM, VCF**
- **Waveform Complement**

The FG 5010 Programmable Function Generator provides waveform generation from 0.002 Hz to 20 MHz. It provides not only the conventional sine, square, triangle, pulse and ramp waveforms, but also incorporates variable symmetry which is usable throughout the frequency range and extends pulse and ramp capabilities beyond those of conventional generators. The FG 5010 also provides trigger, gate counted burst, phase lock, AM, FM, and VCF modes. Variable phase enhances the trigger, gate, burst, and phase-lock modes.

All functions are fully programmable either from the front panel or over the GPIB. The ability to store up to 10 complete front panel settings reduces programming requirements and enhances stand alone capability.

The FG 5010 maintains frequency accuracy within 0.1% over its full 0.002-Hz to 20-MHz frequency range. Automatic phase lock to an external signal is possible from 20 Hz to 20 MHz. Waveform complement and ± trigger slope allow interfacing to circuits with the proper waveform phase, especially important in pulse and digital applications. Waveform hold can freeze the output voltage of any 200-Hz or less waveform at its instantaneous value. With the output amplitude set to zero volts, the dc offset can be programmed to provide a dc voltage source of 0 to ±7.5 V in 10-mV steps.

CHARACTERISTICS

Symmetry—10 to 90%, 1% steps, ±2% accuracy. Range above 4 MHz is limited by 25-ns minimum triangle transition time (decreases to 50% at 20 MHz).

Frequency—Range: 0.002 Hz to 20 MHz. Accuracy: Continuous mode, ±0.1%. Trigger, Gate, Burst Modes: Frequency ≤200 Hz, ±0.1%; frequency >200 Hz, ±5.0%. Resolution: Continuous mode, 4 digits, Trigger, Gate, Burst modes. Frequency ≤200 Hz, 4 digits. Frequency >200 Hz, 3 digits.

Amplitude—Range: 20 mV to 20 V p-p from 50 Ω (into open circuit).

GENERAL

Power Consumption—60 W.

IEEE Standard 488.1 1987 Interface Function Subsets Implemented—SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0.

ORDERING INFORMATION

FG 5010 20 MHz Function Generator. **$3,995**

Includes: Instruction manual (070-3467-01); Instrument Interfacing Guide (070-4613-00); Reference Guide (070-3561-00).

FG 507

- **0.02 Hz to 2 MHz**
- **Includes All FG 501A Features**
- **Logarithmic or Linear Sweep**
- **Separate Start/Stop Frequency Dials**
- **Sweep Up or Down**
- **Sweep and Hold**
- **Manual Sweep**

The FG 507 features the same basic performance as the FG 501A and adds flexible, easy-to-use log- and linear-sweep capability.

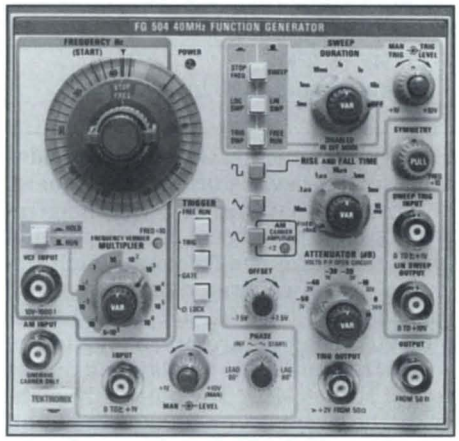
The log sweep of the FG 507 is mathematically correct and allows accurate frequency plots when using log scales, log paper, or a storage oscilloscope like the SC 503. Separate start and stop frequency dials make frequency settings easy to adjust and interpret. The instrument can be internally or externally swept up or down. A third frequency control allows you to manually sweep between the preset start and stop frequencies without disturbing their settings. This is especially convenient for examining frequency and amplitude anomalies of a circuit under test or in setting start and stop points. The sweep generator can be swept and the sweep-gate output can be used to gate (burst) the generator on for swept bursts. The sweep-hold mode allows the generator to sweep to the stop frequency and remain there until released.

The accurate log/linear-sweep capability of the FG 507 plus the low distortion (0.25% over the audio range) make it ideally suited to audio testing.

ORDERING INFORMATION

FG 507 2 MHz Function Generator. **$2,275**

Includes: Instruction manual (070-2986-00).



FG 504

- **0.001 Hz to 40 MHz**
- **Three Basic Waveforms, Plus a Wide Range of Shaping With Variable Rise/Fall Times and Symmetry Controls**
- **Logarithmic or Linear Sweep**
- **Up to 30-V P-P Output**
- **Built-In Attenuator**
- **AM and FM**
- **Phase-Lock Mode**
- **External and Manual Trigger or Gate**
- **Counted Burst With DD 501**

The output of the FG 504 can be phase locked, gated, or triggered by a reference signal. This lets you convert from one waveform to another, such as pulses to sine waves, as well as adjusting phase relationships. Post-attenuator offset enables use of the full ±7.5 V offset range with small signals. The FG 504 output can be swept, or amplitude or frequency modulated by external signals. In addition, the FG 504 can supply internally generated linear- or logarithmic-swept frequencies of up to a 1000:1 range with convenient control of start and stop frequencies.

The FG 504 also provides trigger output, external voltage-control input, and sweep output.

For more Function Generator characteristics, see selection guide, pages 395 and 396.

ORDERING INFORMATION

FG 504—40-MHz Function Generator **$3,275**

Includes: Instruction manual (070-2655-00),

FG 504 T—40-MHz Function Generator **$3,695**

Includes: FG 504, TM 503A Mainframe, and 016, 0195-03 Blank Panel.

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 multiple 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 can 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 peak-to peak can be developed across a 50-Ω load (20 V peak-to-peak open circuit). Selectable offset up to 3.75 V dc across 50 Ω (7.5 V dc open circuit) is also featured.

ORDERING INFORMATION

FG 503—3-MHz Function Generator **$690**
Includes: Instruction manual (070-1727-01).

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. VCF input permits the FG 502 to be used as a sweep generator or as an FM generator.

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. The FG 502 is used in wireless or radio remote-control equipment and in certain phases of the telephone industry.

ORDERING INFORMATION

FG 502—11-MHz Function Generator **$1,110**
Includes: Instruction manual (070-1706-01).

FG 501A

- **0.002 Hz to 2 MHz**
- **30 V Peak-to-Peak, ±13-V Offset**
- **5 to 95% Variable Symmetry**
- **Trigger or Gate, ± Slope**
- **60-dB Step Attenuator**
- **≤0.25% Sine-Wave Distortion**
- **≤25 ns Rise/Fall**

The FG 501A provides low-distortion outputs from 0.002 Hz to 2 MHz. It is capable of generating five basic waveforms—sine, square, triangle, ramp, and pulse—at output levels up to 30 V peak-to-peak with up to ±13 V of offset from a 50-Ω source. Waveform triggering and gating are provided with a variable phase control to permit up to ±90° of phase shift for generating haver-sines, sin pulses, and haver triangles. A step attenuator provides 60 dB of output signal attenuation in 20-dB steps with an additional 20 dB of variable attenuation. Variable symmetry from 5% to 95% provides ramps and pulses. Pulse rise time is ≤25 ns. Audio sine-wave distortion is ≤0.25% and audio amplitude flatness is within 0.1 dB.

ORDERING INFORMATION

FG 501A 2 MHz Function Generator. **$940**
Includes: Instruction manual.

DD 501

- **Digital Events Delay**
- **Delay to 99,999 Events**
- **Divide by N Up to 20 MHz**
- **Pulse Counting to 65 MHz**
- **Time Delay With External Clock**
- **Compatible with Most Attenuator Probes**

The DD 501 Digital Delay is an events-counting device that can be used with pulse, function, and clock generators in such applications as precise digital delay between two related events, divide-by-N frequency divider, precision gate generator, counted burst output from a gated pulse or frequency generator, etc.

Basically, the DD 501 has two modes of operation. In the gating mode, the DD 501 generates a gate that starts with the application of a start pulse and continues until a selected number of event pulses have occurred. It can be used for generating a counted burst of N pulses when used with a pulse generator capable of being gated. Tektronix generators capable of being gated by the DD 501 are the FG 501A, FG 502, FG 504, FG 507, FG 5010, PG 507, and PG 508.

In the delayed-trigger mode, the DD 501 generates a trigger pulse after the selected number of event pulses have occurred. Besides being used strictly for generating precision delays, the delayed-trigger mode can also be used as a frequency count-down divider. In both modes, the desired number of events (from 0 to 99,999) is selected by front-panel thumbwheel switches.

Trigger slope and level controls for both the Start and Events inputs permit use with a wide variety of applied signals. Both inputs are compatible with Tektronix attenuator probes. In special applications, the trigger levels can be remotely set by application of analog voltages through the front-panel Level In/Out jacks.

CHARACTERISTICS

EVENTS DELAY

Count—10 to 99,999 events.
Maximum 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 at 30 MHz.
Frequency Response—Up to 65 MHz at 120-mV sensitivity.
Minimum Detectable Pulse Width—5 ns.
Threshold Level Range—From −1.0 to +1.0 V (−10 to +10 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

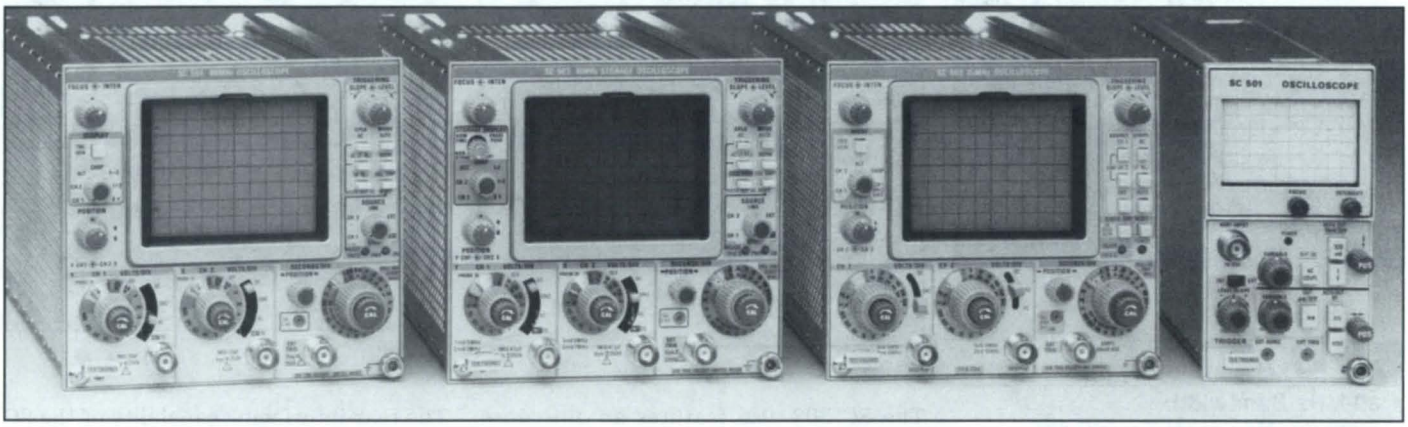
Pulse Width—Width of events pulse plus 6 ns or less.
Voltage Swing—+0.8 V or less to at least +2.0 V with 3 TTL loads (≈5 mA).
Light—Indicates output trigger.

ORDERING INFORMATION

DD 501 Digital Delay **$1,930**
Includes: Instruction manual (070-6759-00).

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

MODULAR OSCILLOSCOPES



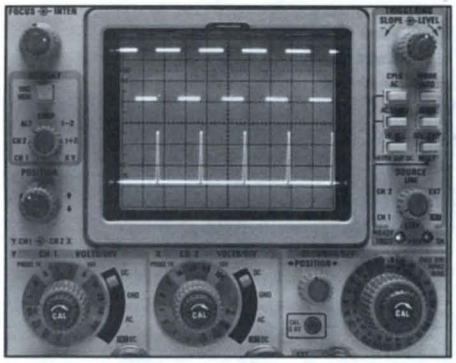
OSCILLOSCOPE SELECTION GUIDE

Application/Feature	SC 504	SC 503	SC 502	SC 501
Vertical Deflection*1				
HF Bandwidth (MHz) (Upper −3 dB point)	80	10	15	5
Rise Time (ns)	4.4	35	23	—
Step Response Aberrations	±4%	±2%, ≤3% p-p		—
AC-Coupled Low-Frequency Response (Hz)		≤10, 1, with 10X probe*1		≤2
Deflection Factors (V/div)	5 m to 10, 1-2-5 sequence; continuously variable between 11 calibrated steps	1 m to 20, 1-2-5 sequence; continuously variable between 4 calibrated steps		10 m, 100 m, 1 continuously variable
Accuracy	±2%	±3%	±2%	±3%
Input R&C (MΩ paralleled by pF)	1±1% | ≈20		1±1% | ≈47	
Max Input Voltage: (V dc+peak ac)	250	350	350	350
(V p-p @ ≤1 kHz)	500	700	700	
CMRR (CH1 minus CH2)	At least 50:1 at 1 MHz with same attenuator setting			NA
Channel Isolation	NA	2% or less to 10 MHz	2% or less to 15 MHz	NA
Displayed Noise	NA	≤0.2 mV p-p at 1 mV/div		NA
Calibrator (V)	0.6±1%, ≈1 kHz		0.6±1%, ≈twice power-line freq.	
Horizontal Deflection Sweep Rates (s/div)	0.2 to 50 n (21 steps, 1-2-5 seq.), X10 Mag to 5 n	2 to 0.5 μ (21 steps, 1-2-5 seq.), X10 Mag to 50 n	0.5 to 0.2 μ (20 steps, 1-2-5 sequence), X10 Mag to 20 n	1 μ to 100 m (decade steps)
Continuously Variable To	0.5 s/div	5 s/div	1.25 s/div	1 s/div
Sweep Rate Accuracy*2	±3%, 0.2 s to .50 ms/div; ±2%, 20 ms to 0.2 μs/div; ±3%, 0.1 μs to 50 ns/div	±4%, 2 s to 0.5 s/div; ±3%, 0.2 s to 5 μs/div; ±4%, 2 μs to 0.5 μs/div	±3%, all rates	±5%, all rates
X-Y Mode: Bandwidth (Hz)	DC to 2 M	DC to 500 k	DC to 2 M	DC to 100 k
Phase Diff.	3° at 50 kHz			—
Trigger Sensitivity (min. p-p signal)				
Coupling / Source (MHz)	DC to 30 / 30 to 80	DC to 5 / 5 to 10	DC to 5 / 5 to 15	DC to 5
DC / CH1, CH2 (div)	0.4, 60 mV / 1, 150 mV	0.4 / 1	0.4 / 1	0.4
Ext, Rear Interface	typ. 50 mV / 100 mV to 50 MHz	35 to 60 mV / 80 to 150 mV	60 mV / 150 mV	5 V
AC	Requirements increase below 50 Hz			NA
AC LF Rej.	Requirements increase below 10 kHz		Requirements increase below 5 kHz	NA
AC HF Rej.	Requirements increase above 50 kHz		NA	NA
Triggering Level Range	Ext ≥1.4 V	Ext ≥1.2 V, Int ≥6 div	Ext ≥1.2 V, Int ≥8 div	
CRT: Phosphor	GH (P31)	GX (P44)	GH (P31)	GH (P31)
Accelerating Potential	12 kV		12 kV	
Graticule	8×10 div (0.25 in./div) internal graticule lines)			6×10 div (0.2 in./div)
Recommended Probes	1X, P6101A; 10X, P6102A; 1X/10X, P6062B			
Prices	$3,960	$4,160	$2,840	$1,820

**1 Optimum bandwidth, rise time, aberrations, and deflection-factor accuracy. Expect lower performance for other temperature ratings and attenuator settings.*

**2 Accuracy at 15 to 35°C, X1 magnifier. Derate additional 1% for X10 magnifier on, and an additional 1% for operation at 0 to 15°C and 35 to 50°C.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.



SC 504

SC 504

- **80-MHz Bandwidth**
- **5-mV/div Maximum Sensitivity**
- **5-ns/Div Maximum Calibrated Sweep Rate**
- **Enhanced Automatic Triggering**
- **True X-Y Capability**
- **Switchable Rear-Interface Capability**

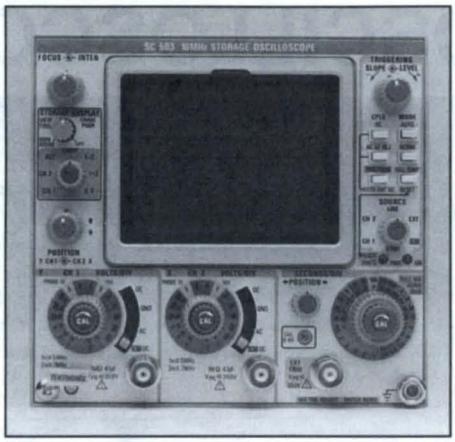
The SC 504 is a general-purpose, dual-trace, nondelayed-sweep oscilloscope. It has a high writing speed with a maximum sensitivity of 5 mV/div and a maximum sweep rate of 5 ns/div (with magnifier). This oscilloscope features Add (CH1 plus CH2), differential (CH1 minus CH2), and "true" X-Y modes, and also includes rear-interfacing capability (switchable CH1, CH2, and ext trig inputs). Enhanced auto-triggering, trigger view, and variable trigger holdoff make this oscilloscope very versatile and easy to use.

SC 503

- **10-MHz Bandwidth, Dual Trace**
- **50-ns/Div Maximum Calibrated Sweep Rate**
- **1-mV/Div Maximum Sensitivity**
- **Bistable Storage Autoerase**
- **Trigger View, Variable Trigger Holdoff**
- **Switchable Front/Rear X and Y Inputs**
- **Rear Z-Axis Input**
- **True X-Y Capability**

The SC 503 is a nondelayed-sweep, general-purpose storage oscilloscope that can be used to store and display waveforms after the input signal is removed.

Important storage applications of the SC 503 include measurement of signals in computer peripherals, communication terminals, and industrial control systems.



SC503

The SC 503 also features an autoerase mode that erases the stored signal and automatically retriggers the oscilloscope, and X-Y capability. The X-Y capability allows creation of Lissajous patterns in many cause-and-effect testing relationships including: acoustic-speech testing, nerve-potential testing, and optical-stimulus-response testing.

STORAGE SYSTEM

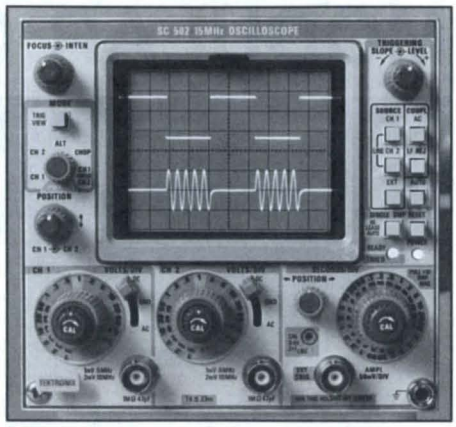
Stored Writing Speed (Center 6 × 8 Divisions)—At least 80 div/ms (50 cm/ms).
Erase Time—400 to 600 ms.
Autoerase Viewing Time—Continuously variable from ≤0.5 to ≥5s.
Maximum Recommended Storage Time—≈4 hrs.

SC 502

- **15-MHz Bandwidth, Dual Trace**
- **20-ns/Div Maximum Calibrated Sweep Rate**
- **1-mV/Div Maximum Sensitivity**
- **Delay Line**
- **Trigger View, Variable Trigger Holdoff**
- **Enhanced Automatic Triggering**

The SC 502 is a compact general-purpose, 15-MHz dual-trace oscilloscope with 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 is intended to be a powerful tool in the field servicing of digital equipment. The CRT of the SC 502 offers 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 a unique combination of performance, compactness, and systems capability.



SC 502

The rear-interfacing capability of the SC 502 and all TM 500/TM 5000 instrumentation suggests exceptional applicability to systems of built-in test equipment or rackmounted installations. The TM 515 Traveler mainframe with the SC 502, forms a nucleus for sophisticated, compact field-service "packages."

SC 501

- **5-MHz Bandwidth**
- **Single Compartment Size**
- **6.4-cm (2.5 in.) CRT**

The SC 501 is a single-channel, 5-MHz plug-in-unit oscilloscope with a 2.5-inch CRT display that occupies a single TM 500/TM 5000 series plug-in compartment.

Since the SC 501 fits any TM 500 or TM 5000 mainframe, it can be used on the bench, in a rack, or on the road.

Calibrated sweep rates are selected by pushbutton logic in decade steps from 1 μs/div to 100 ms/div. 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.

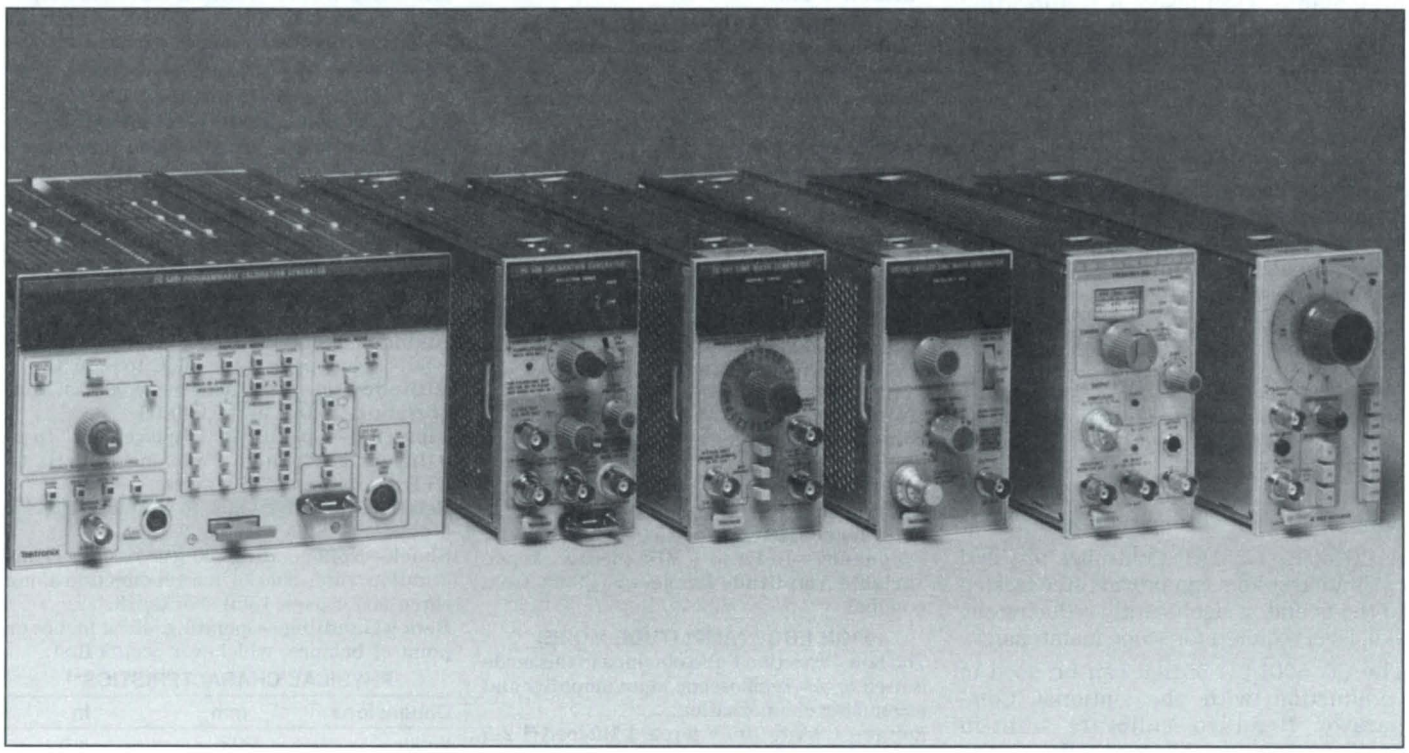
A 0- to 10-V ramp for all sweep rates (excluding the X5 magnification) is provided at a rear-interface connector.

ORDERING INFORMATION

SC 504 80-MHz Oscilloscope **$3,960**
Includes: Instruction manual (070-2296-00).
For Floating Measurements, order A6902B Isolator. See page 543 for complete description.
SC 503—10-MHz Storage Oscilloscope **$4,160**
Includes: Instruction manual (070-3438-00).
SC 502 15-MHz Oscilloscope **$2,840**
Includes: Instruction manual (070-1878-01).
SC 501 5-MHz Oscilloscope **$1,820**
Includes: Instruction manual (070-1700-01).

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

OSCILLOSCOPE CALIBRATION INSTRUMENTS



PRODUCT SUMMARY

The TM 5000/TM 500 line of modular Scope Calibration Instruments provides the solution to all of your scope calibration needs.

The CG 5001/CG 551AP fully programmable generators can be used in a computerized system for calibration and verification of all major oscilloscope parameters. Both are ideally suited for environments where multiple scopes are maintained, and both are complemented by a complete set of calibration instruments.

The TG 501 Time-Mark Generator provides time marks from 5 s to 1 ns, plus a variable timing output which allows you to read the scope's percentage timing error directly on a digital display.

The PG 506A Calibration Generator provides clean, fast-rise square waves and calibrated-amplitude square waves for checking oscilloscope transient response and for setting the vertical-amplifier gain of the oscilloscope respectively. Percentage calibration error can be read directly from the digital display.

The SG 503 and SG 504 generators provide leveled sine waves for bandwidth checks and triggering performance checks. The range of the SG 503 is 250 kHz to 250 MHz, while the range for the SG 504 is from 245 to 1050 MHz.

The SG 502 Oscillator is perfect for calibration applications where verification of low-frequency rolloff in ac modes and performance measurement of low-frequency-reject triggering modes is required.

OSCILLOSCOPE CALIBRATION INSTRUMENT SELECTION GUIDE

Instrument	Primary Functions	Secondary Functions
CG 5001/CG 551AP Programmable Calibration Generator	Amplitude Calibration 40 μV to 200 V Time Base Calibration 0.4 ns to 5 s	Testing risetime and transient response, attenuator compensation, oscilloscope nonlinearity
PG 506A Calibration Generator	Amplitude Calibration 200 μV to 100 V	Testing risetime and transient response, attenuator compensation
TG 501 Time Mark Generator	Time Base Calibration 1 ns to 5 s	Testing oscilloscope nonlinearity
SG 502 Signal Generator	LF Response & Triggering 5 Hz to 500 kHz	Low distortion leveled signal source
SG 503 Signal Generator	Bandwidth Calibration 250 kHz to 250 MHz	General leveled RF signal source
SG 504 Signal Generator	Bandwidth Calibration 245 MHz to 1050 MHz	General leveled RF signal source with frequency modulaton capability

CG 5001/CG 551AP

GPIB IEEE-488

The CG5001/CG551AP comply with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

The Tektronix CG 5001/CG 551AP Programmable Oscilloscope Calibration Generators can be used as a part of a computerized system for the calibration and verification of major oscilloscope parameters, including:

- Vertical Gain
- Horizontal Timing and Gain
- Vertical Bandwidth/Pulse Response Characteristics
- Probe Accuracy and Compensation
- Current-Probe Accuracy
- Calibrator-Output Accuracy

The CG 5001/CG 551AP feature a wide range of functions, all programmable by controller via the GPIB. A "Learn" mode allows any manually set function or range to be acquired by a controller. Subsequent use of the resulting program requires a minimum of operator skill and makes data logging an automatic operation.

A CG 5001/CG551AP Controller test and calibration system can provide step by step to the operator, significantly reducing the skill level required for scope maintenance.

The CG 5001/CG 551AP can be used in conjunction with the optional Comparator Head to calibrate built-in oscilloscope calibrators. Both the oscilloscope calibrator and the CG 5001 signals are applied to the Comparator Head and simultaneously displayed on the scope's CRT. The CG 5001 signals are then varied to obtain congruent displays. Errors are automatically displayed on the readout.

The Remote Variable option, the Units/Div, Variable-Fixed button, the Continue push-button, and the VAR allow remote operation of the system.

The CG 5001/CG 551AP is designed to greatly reduce your maintenance costs. Built in self test routines and hardware check the operation of all major circuits each time power is turned on.

Modular construction means that all circuit boards unplug (except the Main Interconnect) for easy exchange if service is required. A signature analysis mode is included to facilitate troubleshooting of the digital portion of the instrument.

CHARACTERISTICS

VOLTAGE (AMPLITUDE MODE)

The standard voltage is used to calibrate vertical display accuracy.
Range—40 μV to 200 V (1-2-5 steps with multiplier).
Multipliers—1, 2, 3, 4, 5, 6, 8, 10 divisions
Polarity—Positive from ground.
Aberrations—Duration 55% of period & >15% ±10 mV of amplitude
Accuracy—+0.25% ± 1 μV.
Frequency—40 mV to 80 mV: 10 Hz to 100 kHz. 100 mV to 10 V: dc or 10 Hz to 100 kHz. 12 V to 200 V: dc or 10 Hz to 10 kHz.
Variable Range—±9.9%.

CURRENT (AMPLITUDE MODE)

The standard current is used to calibrate current probes.
Range—1 mA to 100 mA (1-2-5 sequence).
Multipliers—1, 2, 3, 4, 5, 6, 8 10.
Accuracy—±0.25% ± μA.
Frequency—Dc or 10 Hz to 1 MHz (decade steps).
Droop—≥1%.
Variable Range—±9.9%

LOW EDGE (AMPLITUDE)

The Low Distortion Pulse obtained in this mode is used to test oscilloscope input amplifier and attenuator compensation.
Range—20 mV to 1 V p-p (50Ω load only) (1-2-5 steps with multipliers).
Multipliers—1, 2, 3, 4, 5, 6, 8 10.
Polarity—Positive or negative transitions to ground.
Risetime (Falltime)—≤1.3 ns.
Aberrations—±2%.
Long Term Flatness—±0.5% after first 10 ns.
Frequency—10 Hz to 1 MHz (decade steps).
Variable Amplitude Range—> ±9.9% from nominal.

HIGH EDGE (AMPLITUDE MODE)

The Low Distortion Pulse obtained in this mode is used to test oscilloscope input amplifier and attenuator compensation.
Range—1.2 V to 100 V p-p ≥ 1 MΩ load (1-2-5 steps with multipliers).
Polarity—Positive transition only (negative voltage to ground).
Risetime—<100 ns.
Aberrations—±2% of squarewave amplitude.
Long Term Flatness—±0.5% after first 500 ns.
Frequency—10 Hz to 100 kHz (decade steps).
Variable Amplitude Range—> ±9.9% from nominal.

MARKERS (TIMING MODE)

The markers obtained in this mode are used to calibrate oscilloscope time bases.
Range—10 ns to 5 s (1-2-5 steps).
X10 Magnifier—Increase marker rate by a factor of ten (0.1 μs to 5 s range).
Accuracy—±0.01% (optional TXCO ±0.0003%).
Amplitude—1 V minimum into 50 Ω.
Variable Range—±9.9%.

SLEWED EDGE (TIMING MODE)

Slewed Edges are used to calibrate the very fastest ranges found on oscilloscope time bases.
Ranges—0.4 ns to 100 ns (1-2-5 steps plus 0.4 ns).
X10 Magnifier—Increases Slewed Edge rate by a factor of ten (5 ns to 100 ns range).
Accuracy—±0.01% (Optional TCXO ±0.0003%).
Edge Position Uncertainty—±40 ps.
Amplitude—>1 V into 50 Ω.
Variable Range—±9.9%.

TRIGGER OUTPUT

The oscilloscope under test is normally triggered externally from this source.
Output Amplitude—1 V minimum into 50 Ω.
Trigger Rate (Marker Mode)—Normal: Slaved to marker rate from 100 ns to 5 s; remains at 100 ns for faster markers. Divided by 10: Reduces normal trigger rate by a factor of ten. Divided by 100: Reduces normal trigger rate by a factor of one hundred.
Slewed Edge Mode—One trigger per slewed edge.
All Other Modes—Normal: Slaved to output frequency. Divided by 10: One-tenth output frequency. Divided by 100: One-hundredth output frequency.

TIMING REFERENCE OUTPUT EXTERNAL TIMING REFERENCE

Input Frequency—Any integral multiple of 1 MHz up to 5 MHz.
Required Accuracy—±0.001%.
Input Amplitude—1 V to 10 V RMS.
Input Resistance—10 kΩ (nominal).

ENVIRONMENTAL

Meets or exceeds MIL-T-28800C, Class 5 requirements.
Ambient Temperature—Operating: 0°C to +50°C. Nonoperating: −55°C to +75°C.
Altitude—Operating: 4500 m (15,000 ft). Nonoperating: 15,000 m (50,000 ft).
Vibration—Operating: Displacement (p-p) 0.015 inch. Vibration Frequency: 10 Hz to 55 Hz. Total time: 75 minutes.
Relative Humidity—90% to 95% at +50°C for 5 days.
Shock—Nonoperating: 30 g's. ½ sine, 11 ms duration, three shocks in each direction along three major axes; total shocks, 18.
Bench Handling—Operating: 45° 4 inches or point of balance, whichever occurs first.

PHYSICAL CHARACTERISTICS*1

Dimensions	mm	in
Width	203	8.0
Height	124	4.9
Depth	305	12.0
Weights	**kg**	**lb**
Standard	3.9	8.5
Option 01	4.4	9.6
Option 02	4.0	8.7

*1 *Maximum Overall Dimensions (triple compartment plug-in)*

PULSE HEAD (STANDARD ACCESSORY) FAST EDGE (AMPLITUDE MODE)

The Pulse Head is used to generate fast rise, low-distortion pulses for testing higher bandwidth vertical amplifiers.
Polarity—Positive or negative transitions from ground.
Risetime—≤200 ps.
Aberrations—±3% of pulse amplitude; not to exceed 4% p-p for adjacent peaks.
Frequency—100 Hz to 100 kHz (decade steps).
Amplitude—1.1 V peak ±5% into 50 Ω.
Variable Range—±10%.

ORDERING INFORMATION

CG 5001 Programmable Calibration Generator **$14,995**
Includes: Output cable assembly (012-0884-00); Pulse head (015-0311-01); Instrument interface guide (070-4616-00); Instruction manual (070-4767-00).
CG 551AP Programmable Calibration Generator **$14,995**

Ordering information continued on next page.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

OPTIONS

Option 01—Adds High Accuracy Time Base (TCXO) CG 5001/CG 551AP **+$650**

Option 02—Deletes Pulse Head CG 5001/CG 551AP **−$1,100**

CONVERSION KIT

CG 551AP—Field Modification Kit to convert to CG 5001. Order 040-1041-02 **$180**

MAINFRAME COMPATIBILITY

CG 5001 requires either a TM 5003 or TM 5006. The CG 551AP is a TM 500 version of the CG 5001 and requires a TM 506 Mod JB, TM 515 Mod UB or RTM 506 Mod JB. The CG 5001 is not compatible with TM 500 power module mainframes.

OPTIONAL ACCESSORIES

Comparator Head—Used to calibrate built-in oscilloscope calibrators against the signals available from the CG 5001. Both the oscilloscope calibrator and CG 5001 standard amplitude signals are applied to the Comparator Head and simulataneously displayed on the oscilloscope CRT. The CG 5001 signals are then varied to obtain congruent displays. Errors are then displayed on the CG 5001 readout. Order 015-0310-01 **$690**

Remove Variable—Permits remote operation of the following front panel controls: Units/Div, Variable-Fixed Button, Continue Pushbutton and the VAR. Order 015-0309-01 **$475**

Pulse Head—(When purchased separately). Order 015-0311-01 **$1,495**

Rigid Circuit Board Extender—Order 067-0975-00 **$125**

Flexible Circuit Board Extender—Troubleshooting Aid Order 067-0974-00 **$380**

SG 502 Oscillator

- **5-Hz to 500-kHz Sine Waves and Square Waves**
- **Low-Distortion Sine Wave**
- **5-V RMS Open Circuit—600-Ω Source**
- **0- to 40-dB Output Variable Plus 0 to 70 dB in 10-dB Steps**

The SG 502 Oscillator features a wide frequency range of 5 Hz to 500 kHz with low distortion (0.035% between 20 Hz and 50 kHz) and is desirable for general test purposes. Other SG 502 features include 70-dB amplitude control plus a simultaneous fixed-amplitude square wave.

CHARACTERISTICS

SINE WAVE

Frequency Range—5 Hz to 500 kHz in 5-decade steps. Accurate within 5% of dial setting from 5 Hz to 50 kHz; within 10% of dial setting from 50 to 500 kHz.

Amplitude Response (1-kHz Reference)—Flatness: 0.3 dB over entire range. Attenuation: selectable from 0 to 70 dB in 10-dB steps with pushbuttons. Accurate within 0.2 dB for each step selected, additive. An uncalibrated control provides continuous variation from 0 to −40 dB.

Harmonic Distortion—<0.035% (−70 dB) from 20 Hz to 50 kHz. <0.15% from 50 to 500 kHz ($R_L \geq 600\ \Omega$).

Maximum Output Voltage—5 V RMS open circuit; 2.5 V RMS into 600 Ω.

Output Impedance—600 Ω, grounded.

SQUARE WAVE

Frequency Range and Accuracy—Same as sine wave. The square wave switches on the 0° phase of sine out.

Rise Time and Fall Time—50 ns or less.

Amplitude—+5 V, fixed, open circuit.

Output Impedance—600 Ω, grounded.

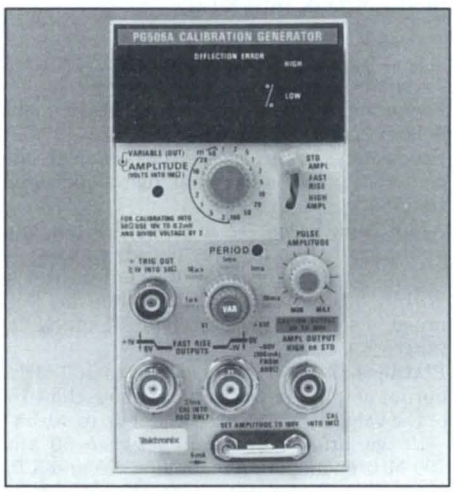
SYNC INPUT

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.

ORDERING INFORMATION

SG 502 Oscillator **$1,150**
Includes: Instruction manual.



NEW PG 506A Calibration Generator

- **Three Square-Wave Output Modes**
- **10 Hz to 1 MHz**
- **Direct Readout of Oscilloscope Deflection Error**

The PG 506A Calibration Generator provides three modes of square-wave output, selectable dc outputs, and a variable-amplitude output with front-panel digital indication of oscilloscope deflection error. Simultaneous, plus and minus low-level, fast-rise (1.0 ns) square waves or high-amplitude (60 V), extremely clean square waves are available at frequencies from 10 Hz through 1 MHz for checking oscilloscope transient response. A 5-mA calibration current loop is useful for current-probe calibration. A 1-kHz square wave can be generated in the amplitude-calibration mode. Its amplitude can be varied around the calibrated level until the square wave aligns with the oscilloscope graticule divisions. Scope deflection error can then be read directly off the PG 506 digital display in percentage high or low, permitting rapid verification of oscilloscope performance.

An optional Tunnel-Diode Pulser provides a clean, fast-rise pulse for adjusting the transient response of high frequency oscilloscopes and other instruments. It can be driven by the PG 506A at repetition rates exceeding 50 Hz. Output amplitude of the pulse is approximately 250 mV into 50 ohms, while rise time is less than or equal 125 ps; aberrations are less than 1% in a 1 GHz system.

The optional Precision Voltage Divider is designed for use with the PG 506A in the Standard Amplitude mode. This .4 divider allows your oscilloscope to display a constant four division when checking amplitude calibration from 20 uV/div through 1 V/div. It also allows more convenient use of the PG 506A with oscilloscopes that cannot display five divisions of amplitude. The input limit on the instrument is 5 V RMS. The output is 0.4 X the PG 506A amplitude with a voltage accuracy of 0.4%. The input capacitance requirement is 50 ohms with an output load greater than or equal to 100 kohms.

CHARACTERISTICS

AMPLITUDE-CALIBRATOR MODE

Period—Fixed at ≈1 ms or dc.

Amplitude—From 200 μV p-p to 100 V p-p in 1-2-5 sequence, accurate within 0.25% into 1 MΩ. 100 μV p-p to 5 V p-p into 50 Ω.

Error Readout—Range: ±7.5%. Resolution: 0.1%.

PULSE MODES

Period—1 μs to 10 ms (within 5%) in decade steps with the variable control in Cal position. Variable extends period to at least 100 ms.

Symmetry—≈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.

ORDERING INFORMATION

PG506A Calibration Generator **$3,050**
Includes: Instruction manual.
Precision Voltage Divider
Order 015-0265-00. **$195**
Tunnel-Diode Pulser
Order 067-0681-01. **$240**

TG 501 Time-Mark Generator

- **Marker Outputs, 1 ns to 5 s**
- **Direct Readout of Oscilloscope Timing Error**
- **External Trigger Output**

The TG 501 Time-Mark Generator provides marker outputs from one nanosecond to five seconds. A unique feature of the TG 501 is a variable timing output with a front-panel two-digit LED display. The display indicates percentage of timing error between the normal time interval and a variable interval that lines up the marker pulse with graticule or division marks 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.

CHARACTERISTICS

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

Crystal Frequency	5 MHz
Stability (0 to 50°C)	within 5 parts in 10^7 after ½ hour
Long-Term Drift	1 part or less in 10^7 per month
Setability	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).

ORDERING INFORMATION

TG 501 Time-Mark Generator **$2,670**
Includes: Instruction manual.
(070-1576-02).

SG 503 Signal Generator

- **250 kHz to 250 MHz**
- **Leveled, Variable Output**
- **Digital Readout of Frequency**

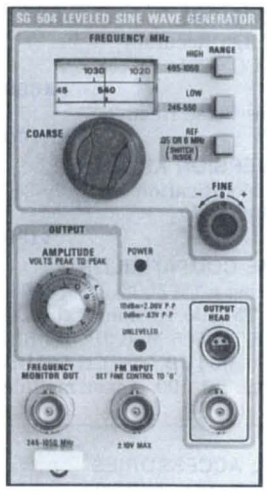
The SG 503 Signal Generator provides a leveled output that is variable in frequency from 250 kHz to 250 MHz. The selected frequency is indicated by a built-in autoranging frequency counter with a three-digit LED readout on the front panel. Accurately calibrated output voltage is variable from 5 mV to 5.5 V peak-to-peak into 50 Ω.

CHARACTERISTICS

Frequency Range—250 kHz to 250 MHz, plus 50-kHz reference frequency.
Frequency Accuracy—Within ±0.7 of one count of the 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 (X.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 and 100 MHz on amplitude multiplier X.1 and X.01 ranges only. From 100 to 250 MHz, amplitude variation is within 3% of the value at 50 kHz.
Harmonic Content—Second Harmonic: At least 35-dB down. Third Harmonic and All Higher Harmonics: At least 40-dB down.
Rear-Card-Edge Connection—Addresses the leveling circuit.

ORDERING INFORMATION

SG 503 Signal Generator **$2,450**
Includes: Three-foot precision 50 Ω cable (012-0482-00); Instruction manual.



SG 504 Signal Generator

- **245 to 1050 MHz**
- **Leveled, Variable Output**
- **Frequency-Modulation Capability**
- **Internal Peak Detection**

The SG 504 Signal Generator provides leveled output amplitude and is variable from 245 to 1050 MHz in two bands via its compact output leveling head. 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 p-p into 50 Ω.

CHARACTERISTICS

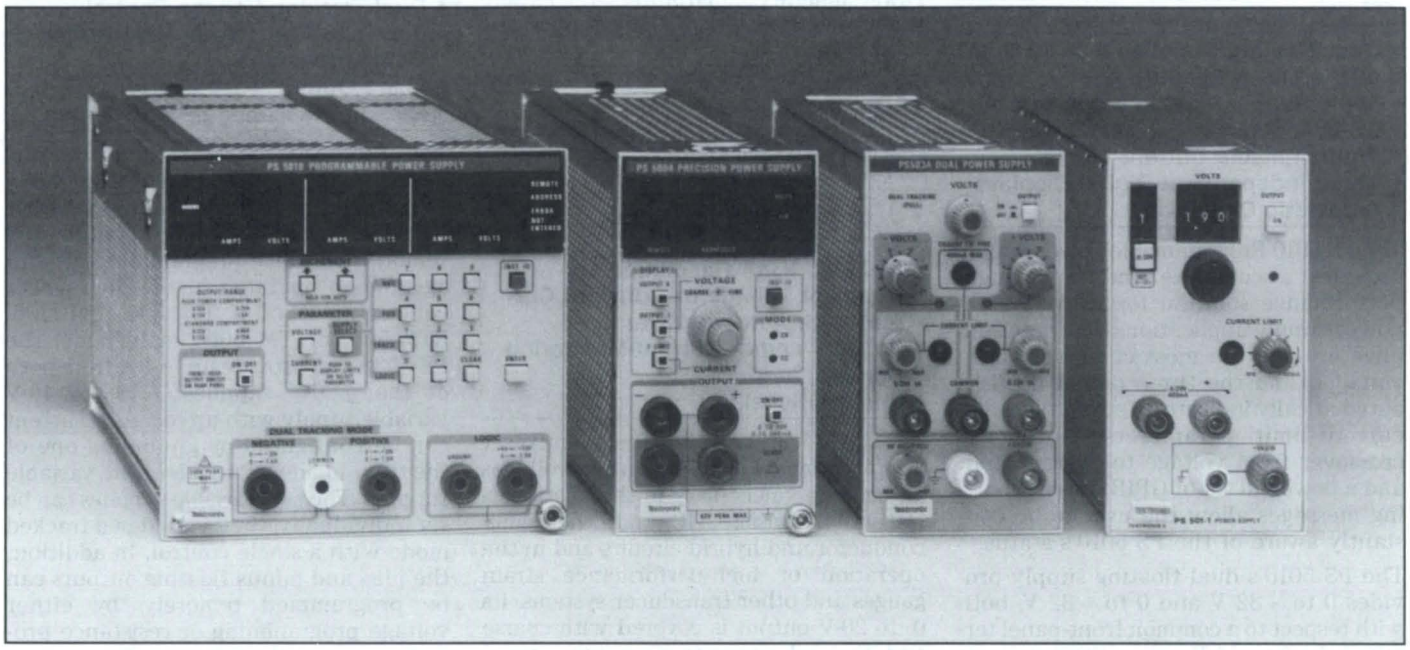
Frequency Range—Low Band: 245 to 550 MHz. High Band: 495 to 1050 MHz, plus 50-kHz or 6-MHz reference frequency (internally selected).
Frequency Accuracy—±2% of dial indication.
Amplitude Range—0.5 V to at least 4.0 V p-p.
Amplitude Accuracy (At Reference)—Within 3% of indicated amplitude.
Flatness—±4% of amplitude at reference frequency.
Harmonic Content—Second Harmonic: At least 25-dB down. Third Harmonic and All Higher Harmonics: At least 40-dB down.
FM Input—Frequency Range: DC to 100 kHz. Deviation Sensitivity: ±9 V produces from 0.05% to 0.5% deviation of carrier, depending on output frequency.
Frequency Monitor Output—≥0.3 V p-p into a 50-Ω load from 245 to 1050 MHz.
Rear-Card-Edge Connections—Address FM input, frequency-monitor output, and amplitude control.

ORDERING INFORMATION

SG 504 Signal Generator **$4,060**
Includes: Instruction manual.
(070-1632-01);Leveling head.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

POWER SUPPLIES



PRODUCT SUMMARY

Design engineers require power supplies that are flexible enough to meet their needs and compact enough to allow a complete, custom-designed test system to fit neatly on a crowded workbench. To ensure versatility and convenience in your test system, the TM 5000/TM 500 power supplies can be rear-interfaced with other instruments to reduce front-panel clutter while providing capabilities not otherwise available. For example, the output level can be monitored via the rear interface by a companion TM 5000/TM 500 digital multimeter without the need for extra cabling at the front of the instrument. Remote sensing terminals available at the rear interface allow sensing of the applied voltage at the load, thereby minimizing the effects of loading on the supply.

POWER SUPPLIES SELECTION GUIDE

Characteristic	PS 501-1		PS 503A		PS 5004	PS 5010	
Supply Voltage	0 to 20	+5	+ and −20	+5	0 to 20	+ and −32	Logic
Isolation (V dc +peak ac)	350	gnd ref	350	gnd ref	42	150 front panel, 42 rear inter.	gnd ref
Current Limit (A) High-Power Compartment Standard	<40 m−400 m	1	100 m−1 / 40 m−400 m	1	0−300 m	50 m to 0.760*1 / 50 m to 400 m*1	100 m−3
Voltage Mode Overall Accuracy (total effect)					±(0.01% +500 μV)	±(0.5% + 20 mA)	±50 mV
Source Effect (line regulation)	5 mV	50 mV	5 mV	250 mV	0.005%	±(0.1%+2 mV)	1 mV
Load Effect (load regulation) (V change for A change in load current)	1 m for 400 m	100 m for 1	3 m for 1	100 m for 1	500 μ for 300 m	10 m for 1; 1 m for 1 with remote sensing	
Temperature Coefficient (Typical)	<0.01%/°C	—	<0.025%/°C	—	≤(30 ppm +100 μV)/°C	<(0.01% +0.1 mV)/°C	<500 μV/°C
Resolution (step size) (V)	1.6 m	—	50 m		500 μ	10 m to 10; 100 m above 10.1	10 m
PARD (mV) (periodic and random deviations)	0.5 p-p; 0.1 RMS	5 p-p	3 p-p	5 p-p	≤3 p-p	10 p-p; 1 RMS	10 p-p; 2 RMS
Current Mode	Current limit		Current limit		See individual instrument descriptions.		
Display	See individual instrument descriptions.						
Prices	$750		$770		$1,850	$3,050	

Notes: 1. All supplies feature remote sensing at the rear interface. *Notes: 2. All units have Output On/Off controls.*

PS 5010

GPIB IEEE-488 The PS 5010 complies with IEEE Standard 488.1-1987, and with Tektronix *Standard Codes and Formats.*

- **Dual Floating Supplies 0 to 32 V, to 0.75 A (1.6 A to 15 V)**
- **Logic Supply +4.5 to 5.5 V, to 3 A**
- **0.5% Accuracy**
- **Programmable Current Limits**
- **Three Independent Digital Displays**
- **Automatic Crossover**

The PS 5010 Programmable Power Supply provides a complete and rapid high-performance solution for many system power-supply applications. Its three supplies provide the most commonly used voltages, and the three digital displays automatically indicate all six voltage- and current-limit parameters. Automatic crossover from voltage to current limit and a powerful set of GPIB status reporting messages allow the user to be constantly aware of the PS 5010's status.

The PS 5010's dual floating supply provides 0 to +32 V and 0 to −32 V, both with respect to a common front-panel terminal. Or 0 to 64 V across the terminals of both supplies together—with current up to 0.75 A throughout the total voltage range and 1.6 A below 15 V. The logic supply provides +4.5 to +5.5 V with respect to ground, with current to 3 A. The user can program the outputs on and off, and can lock out the front-panel controls with GPIB commands.

OTHER CHARACTERISTICS

POSITIVE AND NEGATIVE FLOATING SUPPLIES

Constant Current Mode

Range—50 mA to 0.75 A (1.60 A at 15 V and below) in high-power compartment; 50 mA to 400 mA (0.750 A at 15 V and below) in two standard-power compartments.

Overall Accuracy—±(5% +20 mA) Source Effect: ±1 mA line regulation. Load Effect: ±10 mA. Output impedance is typically 5 kΩ shunted by 20 μF.

PARD (Ripple and Noise)—10 mA p-p, 20 Hz to 20 MHz.

Resolution—50 mA ±15 mA.

Change Response Time—20 ms up or down.

LOGIC SUPPLY

Constant Current Mode

Range—100 mA to 3.0 A (Foldback characteristic below 4.5 V, maximum short circuit current is <1.5 A).

Overall Accuracy—±(5% +20 mA).

Resolution—100 mA ±30 mA.

Scaled Output—10 mA = 1 mV ±(2% +2 mV) available at rear interface (not ground referenced).

Overvoltage Protection—SCR crowbar typically trips at 6 to 7 V.

Power Consumption—250 V A maximum in high power compartment, 200 V A in standard compartment.

IEEE Standard 488.1-1987 Interface Function Subsets Implemented—Same as PS 5004.

Power Module Compatibility—The PS 5010 is not compatible with TM 500 mainframes.

PS 5004

GPIB IEEE-488 The PS 5004 complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

- **0- to 20-V Floating Output**
- **0.01% Accuracy**
- **500 μV/0.1 mA Resolution**
- **Constant Voltage or Constant Current With Autocrossover**
- **Voltage- and/or Current-Monitoring Display**
- **Remote Sensing**

The single-width PS 5004 Precision Power Supply provides high-resolution voltages and currents necessary in the characterization of transistor, IC, and other semiconductor and hybrid circuits and in the operation of high-performance strain gauges and other transducer systems. Its 0- to 20-V output is covered with coarse and fine adjustments to provide rapid setability and ±500-μV resolution without the necessity of changing ranges. Setability resolution over the GPIB is also ±500 μV. The supply output is at the rear interface as from the front-panel terminals. Overall accuracy is ±0.01% ±2 mV.

The PS 5004 operates in either a constant-voltage or constant-current mode with autocrossover between the two. Front-panel annunciators indicate the mode at all times. The operating mode is also reported over the bus, and the PS 5004 can be programmed to assert SRQ when operating conditions cause it to change modes. The 4½-digit display shows actual output voltage, selected current limit, or actual output current. The actual output voltage is shown even when the PS 5004 is operating in the current-limited or unregulated mode. Display resolution is 1 mV or 0.1 mA.

The buffered high-impedance sense terminals allow proper regulation of the supply with up to 3 Ω of resistance in either of the sense leads.

OTHER CHARACTERISTICS

CONSTANT CURRENT MODE

Range—10 mA to 305 mA in 2.5 mA steps.

Overall Accuracy—±2% +5 mA.

Power Consumption—35 A V

IEEE Standard 488.1-1987 Interface Functions Subsets Implemented—SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0.

Power Module Compatibility—The PS 5004 is not compatible with TM 500 mainframes.

PS 503A

- **Independent + and − Controls**
- **Dual Tracking Voltage Control**
- **0 to ±20 V at 1 A (in High-Power Compartment)**
- **Fixed Output +5 V at 1 A**
- **Remote Resistance Programming**

The PS 503A provides dual floating variable ±20-V supplies, plus a fixed 5-V, 1-A supply. The PS 503A features superior tracking, over-voltage protection, and remote resistance programming of voltage. When operated in the high-power compartment of a TM 504, TM 506, RTM 506, or TM 5006 mainframe, the PS 503A can provide up to 1 A from both of the ±20-V supplies. A 0- to 40-V variable supply with up to 1 A of current can be configured by grounding one of the two outside terminals of the variable supplies. The two variable supplies can be set individually, then varied in a tracked mode with a single control. In addition, the plus and minus floating outputs can be programmed remotely, by either voltage programming or resistance programming via the rear interface.

PS 501-1

- **Floating Output, 0 to 20 V**
- **0 to 400 mA**
- **Precise Regulation**
- **Low Ripple and Noise**
- **Fixed Output +5 V at 1 A**
- **3½-Digit Ten-Turn Dial**

The PS 501-1 supplies 0 to 20 V (floating) and adjustable current limiting to 400 mA, with constant-current operation above the limit setting. The PS 501-1 features precise regulation and better than 2-mV resolution over its voltage range. A multiturn dial with mechanical digital readout provides accurate setting of the output voltage. A fixed +5-V supply provides up to 1 A.

ORDERING INFORMATION

PS 5010 Power Supply **$3,050**
Includes: Instruction manual (070-3391-00); Instrument interfacing guide (070-4610-00); Reference guide (070-3402-00).

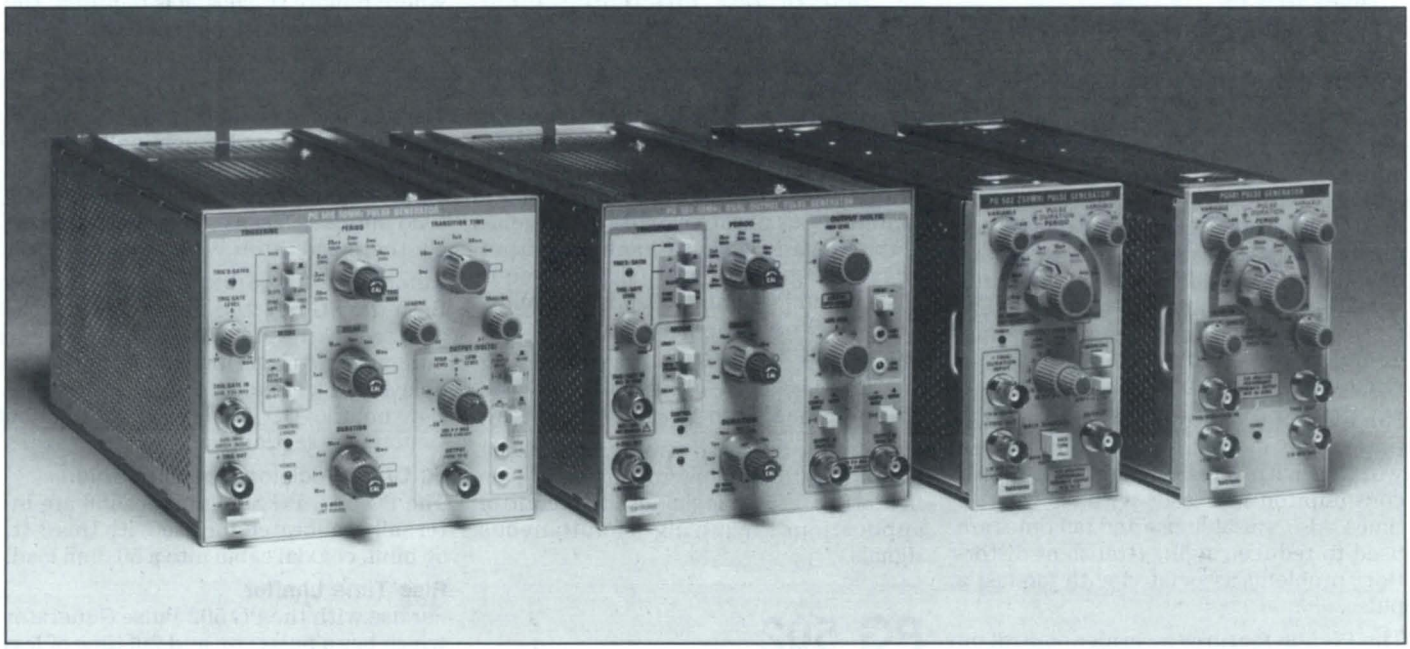
PS 5004 Precision Power Supply **$1,850**
Includes: Instruction manual (070-4442-00); Instrument interfacing guide (070-4789-00); Reference guide (070-4596-00).

PS 503A Power Supply **$770**
Includes: Instruction manual (070-1834-01).

PS 501-1 Power Supply **$750**
Includes: Instruction manual (070-1301-02).

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

PULSE GENERATORS



Whether testing wide-band systems, simulating data transmission signals, or driving a laser, the TM 500 series Pulse Generators have the required capabilities to meet your needs. The general purpose, yet versatile PG 508 features independently variable rise and fall times for close approximations of real world events. The 50 MHz PG 507 provides complementary dual outputs, making it ideally suited for digital applications. These multipurpose generators can also be used for stimulus of high-impedance MOS, HTL, and CMOS logic circuits.

In 50 ohm systems, the repetition rates, amplitudes, and transition times of the PG 501 and PG 502 are designed to be compatible with common TTL, DTL, and ECL circuits.

EXTENDED FUNCTIONALITY

The DD 501 Digital Delay is an events-counting device that can be used with pulse, function and clock generators in such applications as precise digital delay between two related events, divide-by-N frequency divider, precision gate generator, counted burst output from a gated pulse or frequency generator, etc.

PULSE GENERATOR SELECTION GUIDE

Characteristic	PG 507	PG 508	PG 501	PG 502
Pulse Period (s)	≤20 n to ≥200 m (50 MHz to 5 Hz)			≤4 n to ≥100 m (250 MHz to 10 Hz)
Pulse Duration (s)	≤10 n to ≥100 m			≤2 n to ≥50 m
Duty Factor (s)	≥70% to 0.2 μ period, ≥50% at 20 n period			≥50%
Square-Wave Mode	✓	✓		✓
Pulse Delay (s)	≤10 n to ≥100 m*[1]		Fixed, 20 n	Fixed, 17 n
Double Pulse	✓	✓		
Transition Times (s)	fixed, ≤3.5 n, ≤4 n @ >5 V	≤5.5 n to ≥50 m, variable	Fixed, ≤3.5 n	Fixed, ≤1 n
Aberrations (% p-p)	≤5 +25 mV into 50 Ω	≤5 +50 mV into 50 Ω	±3.5 into 50 Ω	±5 (duration ≥5 ns)
Amplitude (V p-p from 50-Ω source impedance)	≥7.5, ±7.5-V window	≥10, ±10-V window	≥5	5, ±5-V window
Simultaneous Outputs	Complementary	No	Positive & negative	No
Pulse Coincidence	≤1 ns at 50% ampl.	NA	≤1 ns at 50% ampl.	NA
External Input Input Impedance (Ω)	1 M or 50	1 M or 50	50	50
Trigger Level (V) Sensitivity (mV p-p)	−3 to +3 80 to 10 MHz, 250 to 50 MHz		+1	+1
Trigger Output (50% square wave or follows external signal)	≥+2 V from 50 Ω, ≈35 ns before pulse (23 ns in square wave or external duration modes)		≥+2 V from 50 Ω, ≈8 ns before pulse	≥+2 V from 50 Ω, ≈10 ns before pulse
Price	$2,975	$2,360	$870	$3,100

*[1] *Add 60 ns for delay from external trigger.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

PG 508

- **Independently Variable Rise and Fall Times to 5 ns**
- **20-V Output in a ±20-V Window to Impedance, 10 V into 50 Ω**
- **Normal or Complement Output**

The PG 508 is a versatile, general-purpose, 50-MHz pulse generator. The circuitry of the PG 508 is designed so that rise and fall waveforms closely simulate real-world waveforms. This capability is particularly useful in research-and-development applications demanding versatility in rise and fall times, such as testing of amplifiers, slew-rate testing, comparator simulation, and logic-circuitry performance tests.

For example, controllable rise and fall times are extremely desirable when working with CMOS where logic power consumption increases with slower rise times. Also, variable rise and fall times are used to reduce ringing (transient distortion) problems associated with too fast a pulse.

The PG 508 features a vernier control on the rise and fall times controllable from 100 to 1. This completely overlaps the next decade range and increases the PG 508's versatility in applications simulating different rise and fall times, especially the output of nonlinear devices. This overlap feature can also be used to generate a ramp signal or simulate unequal slew rates in an amplifier.

Also adding to the simplicity of using the PG 508 is the capability of changing output amplitude while variable rise and fall times remain constant.

PG 507

- **Dual Outputs With Tracking Level Controls**
- **Normal or Complement Pulse Output on Both Channels**
- **15-V Output in a ±15-V Window Into High Impedance, 7.5 V Into 50 Ω**
- **3.5-ns Rise/Fall Times**

The PG 507 is a high-performance, 50-MHz pulse generator designed specifically for logic-design applications.

The PG 507 features complementary dual outputs that greatly increase its applicability in logic-design areas, especially interfacing within systems or to peripherals. For instance, the complementary outputs allow simulation of line drivers or opposite-phase clocks.

The PG 507 also offers versatility to the design engineer in an analog environment. For example, the dual outputs can be used to test differential input amplifiers or multiplexers.

The PG 507 features four output modes: normal complement mode (Channel A output positive going, Channel B output negative going), opposite phase complement mode (Channel A output negative going, Channel B output positive going), simultaneous negative mode (Channel A output negative going, Channel B output negative going), and simultaneous positive mode (Channel A positive going, Channel B output positive going).

In addition, the Output High Level and Low Level voltage controls track between channels, making amplitude settings easy.

This unique output flexibility within the normal and complement modes is particularly useful in logic-design or control applications requiring simultaneous signals.

PG 502

- **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**
- **Optional Rise Time Limiter**

The PG 502 features fast rise and fall times, 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.

PG 501

- **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**
- **Optional Manual Trigger Generator**

The PG 501 is a 50-MHz Pulse Generator featuring simultaneous plus and minus outputs, a wide range of pulse-period durations and duty factors, trigger output, and external trigger/duration input. Its performance and ease of operation make it well-suited to basic digital and analog applications.

Manual (One-Shot) Trigger Assembly

For instruments that do not have a manual trigger (such as the PG 501), or where remote triggering is required, the Manual Trigger Assembly initiates a pulse or a full chain of events at the push of a button.

The Trigger Assembly produces a debounced output pulse nominally 2 ms in width and 3 V in amplitude (from 50 ohms) with rapid rise and fall times. It will send pulses as fast as the operator can cycle the pushbutton.

Automated Triggering with the DD 501

Both the PG 507 and the PG 508 can be adapted with the DD 501 to provide automated triggering in a gated or delayed trigger mode. For more information on the DD 501 see the Function Generators section.

50 Ohm Precision Coaxial Cable

The PG 502, PG 506, and SG 506 are internally calibrated for use with this 3-ft, 50 ohm, coaxial cable into a 50 ohm load.

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.

ORDERING INFORMATION

PG 508 50-MHz Pulse Generator **$2,360**
Includes: Instruction manual (070-2044-01).
PG 508T 50-MHz Pulse Generator **$2,780**
Includes: PG 508, TM 503A Mainframe, and 016-0195-03 Blank panel.
For counted burst order the DD 501 Digital Delay **$1,930**
Suggested 10-inch BNC 50-ohm cable (2 required) for interconnecting PG 508 and DD 501
Order 012-0208-00 **$28**
PG 507 50-MHz Pulse Generator **$2,975**
Includes: Instruction manual (070-2962-00).
PG 502 250-MHz Pulse Generator **$3,100**
Includes: Instruction manual (070-1598-01).
PG 501 50-MHz Pulse Generator **$870**
Includes: Instruction manual (070-1361-01).
DD 501 Digital Delay. **$1,930**
Includes: Instruction manual (070-1818-01).

RECOMMENDED PROBES

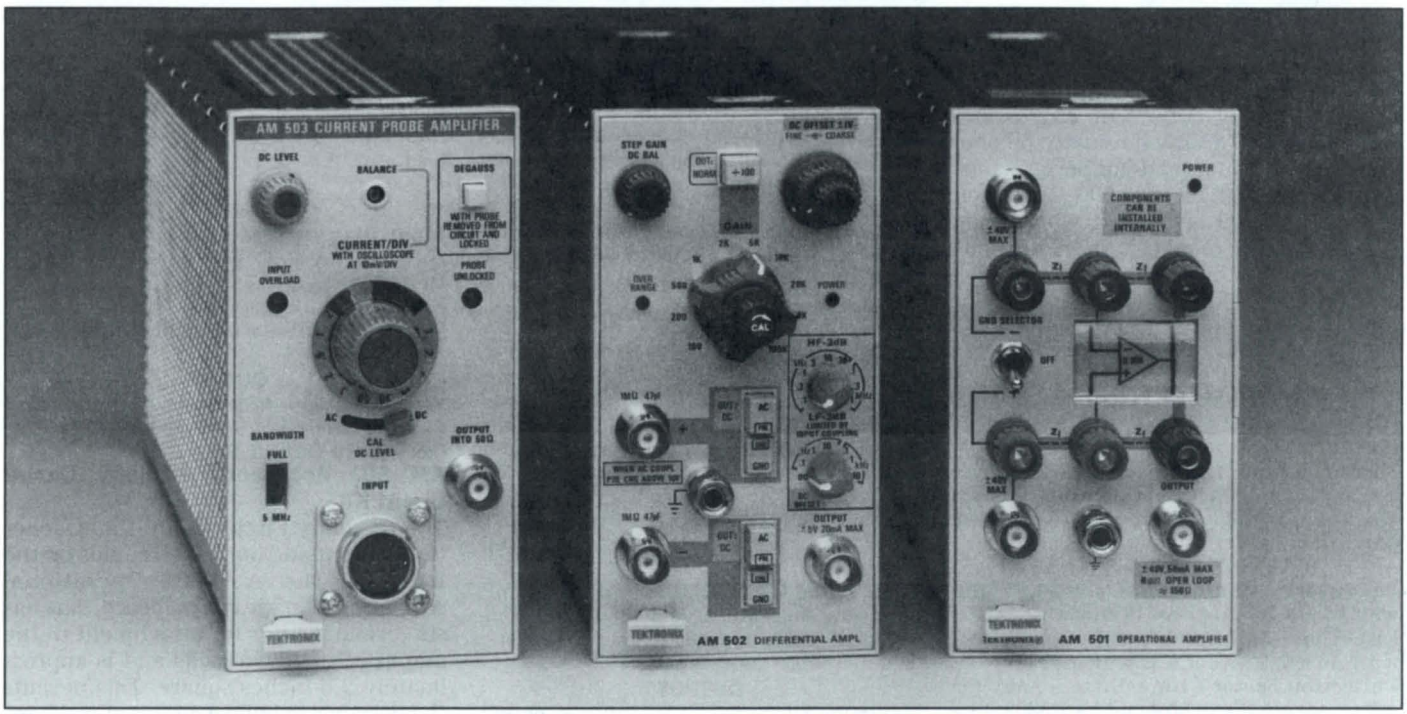
See Signal Acquisition section.
P6062B—1X/10X, dc to 100 MHz. **$175**
P6108A—10X, dc to 100 MHz. **$75**
P6122—10X, dc to 100 MHz. **$58**

OPTIONAL ACCESSORIES

50-Ω Cable—Order 012-0482-00 **$29**
Trigger Generator—
Order 016-0597-00 **$260**
Risetime Limiter—
Order 015-0249-00 **$200**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

SIGNAL CONDITIONERS



PRODUCT SUMMARY

The TM 500 Signal Conditioners offer unique capabilities for solving electrical measurement-and-analysis problems. Compact portability and plug-in flexibility allow complete lab instrumentation set-ups within stringent space and budget limitations.

These versatile signal alteration devices are applicable to a broad range of measurement needs including: preamplification of low-level signals, addition or removal of dc offset, integration, differentiation, or summing of multiple signals; impedance transformation; or amplification (to 80 V peak-to-peak).

CURRENT PROBE

The AM 503 is specifically designed to work with the A6302/A6303 Current Probes and incorporates a feature that limits the bandwidth to 5 MHz to eliminate transients or noise. An illuminated knob skirt indicates calibrated current per division.

The AM 503/A6302 and AM 503/A6303 Current Probe Systems have a wide variety of applications from SCR and power-supply measurements to medical applications. These probes use inductive coupling to minimize interference with the circuit under test.

A current probe package is available (AM503S) that includes the AM503, A6302 (and/or A6303), and the 016-0362-02 Tool Box Module for probe storage, all in a TM502A Power Module.

DIFFERENTIAL AMPLIFIERS

The versatile AM 502 Differential Amplifier lets you control gain, dc offset, and low-frequency and high-frequency response for maximum rejection of unwanted signals. Adjustable dc offset allows high amplification even when low-level signals have a dc component of up to 1 V. High-performance features of the AM 502 are a dc-to-1 MHz bandwidth and 100-dB common-mode-rejection ratio.

OPERATIONAL AMPLIFIER

The AM 501 Operational Amplifier's output power (±40 V and ±50 mA across 800-Ω loads) is more than adequate for most electronic and electro-mechanical applications. This high-output unit has front-panel connectors that let you change configurations by selecting feedback components. The AM 501 is easily set up for differentiation, integration, summing, and impedance-transformation problems.

By combining an oscilloscope, such as the SC 504, with the AM 503/A6303 Current Probe Amplifier in a TM 500/TM 5000 mainframe, you will have a convenient and compact high-current amplification/measurement system.

AM 503/AM 503S

- **Displays Current Signals on an Oscilloscope**
- **Current Range, Maximum Current, Bandwidth Determined by Probe**

The AM 503 Current-Probe Amplifier allows display of current on any oscilloscope having 10 mV/div sensitivity, 50-ohm or 1-megohm input, and (for performance to full bandwidth) at least 100 MHz when using the A6302 or 50 MHz when using the A6303. The amplifier attenuator has 12 calibrated steps in a 1-2-5 sequence, and the knob-skirt is illuminated to indicate current per division.

CHARACTERISTICS

(When used with the A6302 or A6303 Current Probes.)

Maximum Input Current—20 A (dc + peak ac) for A6302. 100A (dc + peak ac) for A6303.
Maximum Voltage for Current Under Test (Bare Conductor)—500 V (dc + peak ac) for A6302. 700 V (dc + peak ac) for A6303.
Bandwidth (−3 dB)—DC to at least 50 MHz with A6302. DC to at least 15 MHz with A6303.
Rise Time (Full Bandwidth)—7 ns or less with A6302. 23 ns or less with A6303.
Deflection Factor—1 mA/div to 5 A/div for A6302. 20 mA/div to 50 A/div for A6303. In a 1-2-5 sequence for both probes.
Attenuator Accuracy—Within 3% of indicated Current/Div for both probes.

AM 502

- **1 to 100,000 Gain**
- **100-dB CMRR**
- **Selectable Upper and Lower −3 dB Points**
- **DC to 1 MHz Maximum 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, displays, or processing devices. In the unity-gain mode, it can be used as a signal conditioner. Input dc offsetting to ±1 V is provided.

CHARACTERISTICS

AMPLIFIER

Gain—100 to 100,000; 1-2-5 sequence; accurate within 2%. 1X gain obtained by 100X attenuation.
HF −3 dB Point—Selectable in 9 steps (1-3 sequence) from 100 Hz to 1 MHz, Upper −3 dB point reduces to 500 kHz at 50 k gain; 250 kHz at 100 k gain.
LF −3 dB Point—Selectable in 6 steps from 0.1 Hz to 10 kHz; ac coupling limits −3 dB point to 2 Hz or less.
Variable DC Offset—At least ±1 V.
Common-Mode Rejection Ratio—Normal Mode: At least 100 dB, dc to 50 kHz. ÷100 Mode: at least 50 dB, dc to 50 kHz.

INPUT

Input Gate Current—±100 pA for T ≤30 °C.
Maximum Voltage Drift—100 μV/°C referred to input Normal mode.
Maximum Noise—≤25 μV (tangentially measured) referred to input Normal mode.
Maximum Input Voltage—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 ≈47 pF. Input impedance can be increased to a FET input via a simple internal jumper change.

OUTPUT

Maximum Output—±5 V, ±20 mA, output resistance is 5 Ω or less.
Minimum Load Impedance—250 Ω
Over Range—Front-panel lamp indicates most over-range conditions.

AM 501

- **±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 TM 500 modules.

CHARACTERISTICS

AMPLIFIER

Open Loop Gain—At least 10,000 at 60 Hz into 800-Ω load.
Unity Gain Bandwidth—At least 5 MHz into 800-Ω load.
Common-Mode Rejection Ratio—Typically >20,000 to 1 at 60 Hz for common-mode signals up to ±40 V.
Slew Rate—At least 50 V/μ s into an 800-Ω load.

INPUT

Input Bias Current—Typically <500 pA at 25 °C, <2 nA at 50 °C.
Drift—<100 μV/°C.
Noise—<10 μV rms.
Maximum Differential Input Voltage—80 V.

OUTPUT

Voltage Range—At least ±40 V into 2 kΩ.
Current Limit—At least ±50 mA.
Open Loop Output R—≈150 Ω.

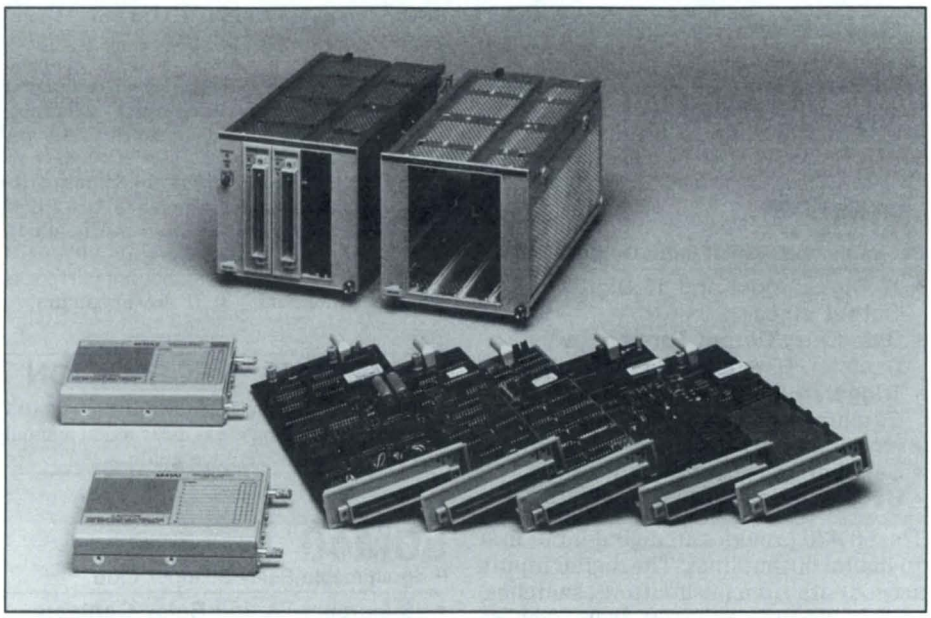
AM 501 Accessory Auxiliary Circuit Board Kit

The Auxiliary Circuit Board Kit attaches to the input and output terminals on the front of the AM 501 Operational Amplifier. The kit is a pc board that has six terminal studs for attachment to the amplifier's banana jacks and is approximately 2.5-inches square. 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.

ORDERING INFORMATION

AM 503 Current-Probe Amplifier **$1,240**
Includes: 50 ohm cable with BNC 50-Ω terminator; Instruction manual.
AM 503S Current Probe System **$2,120**
Includes: AM 503, A6302 (calibrated to AM 503). Tool Box, TM 502A
A6302 Current Probe. See page 540 **$625**
Includes: Five-inch ground lead (175-0124-01); Three-inch ground lead; Two alligator clips; Instruction manual.
A6303 Current Probe. See page 540 **$1,180**
Includes: Carrying case; Instruction manual (070-3906-01).
AM 502 Differential Amplifier **$1,425**
Includes: Instruction manual.
AM 501 Operational Amplifier **$840**
Includes: Instruction manual.
Auxiliary Circuit Board Kit
Order 013-0146-00 **$27**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.



MI 5010/MX 5010

GPIB IEEE-488

The MI 5010 and MX 5010 comply with IEEE Standard 488.1-1987, and with Tektronix *Standard Codes and Formats.*

- **Up to Six Functions at One Address**
- **D-to-A, A-to-D Conversion**
- **Low-Level Signal Scanning**
- **Digital I/O**
- **Digital Word Acquisition and Generation**
- **Built-In Time-of-Day and Pacing Clock**
- **Common Buffer for Controller-Free Operation**

The MI 5010/MX 5010 Multifunction Interface System consists of the MI 5010 Multifunction Interface, the MX 5010 Multifunction Interface Extender, and seven different types of function cards. These cards are capable of a variety of functions typically required in automated test-system interfacing, data acquisition and generation, and process control.

The MI 5010 and MX 5010 each house up to three function cards, in any combination. The MI 5010 provides the communication between the system controller and the function cards. The MX 5010 is always used with an MI 5010, extending its control to six function cards at one GPIB address.

The function cards available for the MI 5010/MX 5010 Multifunction Interface System are: 50M10 Analog-to-Digital Converter, 50M20 Digital-to-Analog Converter, 50M30 Digital I/O, 50M40 Relay Scanner, 50M41 Low-Level Scanner, 50M50 Memory, and 50M70 Development card. Each function card contains its own ROM with the specific firmware and its own unique set of commands required for its particular function. Each card can be operated in any slot of the MI 5010 and/or MX 5010 regardless of the other cards in the system.

In addition to providing the interface between the function cards and the system controller, the MI 5010 also has its own intelligence and a built-in command buffer. This buffer is capable of storing up to 300 system commands and executing them in sequence, paced by the on-board time-of-day and pacing clock or by signals from the system under test. It requires no interference from the system controller, thus freeing the controller to direct activity elsewhere in the system.

IEEE Standard 488-1978 Interface Function Subsets Implemented—SH1, AH1, T6, L4, SR1, RL0, PP0, DC1, DT1, C0.

ORDERING INFORMATION

MI 5010 Multifunction Interface **$1,760**
Includes: Instruction manual (070-3712-00); instrument interface guide (070-5187-00); reference guide (070-3882-00).

MX 5010 Interface Extender **$740**
Includes: Same as MI 5010.

50M10 Programmable A-D Converter

- **12-Bit Resolution**
- **32-μs Conversion Time**
- **Four Voltage Ranges ±100 mV to ±100 V**
- **Data Transfer via GPIB or Front-Panel Connector**

The 50M10 uses a 12-bit successive approximation conversion technique with a track-and-hold amplifier to achieve a total conversion time of 32 μs or less (approximately 30,000 conversions per second). Using the front panel connector, conversion values can be sent over the GPIB (via the MI 5010) or to external memory devices (such as the 50M50 Memory card). In either case, data is transferred in two 8-bit bytes.

Four voltage ranges are provided, manually selectable by on-board jumpers: +100 mV, +1 V, +10 V, and +100 V. The total span for each range is divided into 4096 parts (12-bits). The front-panel analog input connections (high and low) can be elevated to a potential of +340 volts, dc plus peak ac.

Two handshaking modes are provided, one for communication with devices faster than the 50M10, and the other for communication with devices slower than the 50M10 (the 50M10 must be clocked by the external receiving device). Front-panel control lines permit the 50M10 conversions to be triggered, gated, or triggered within a gate.

CHARACTERISTICS

Maximum Conversion Rate—32 μs.
Maximum Aperture Time—≤400 ns.
Accuracy (Full Scale)

Range	18 to 28°C	0 to +50°C
100 mV	±0.15%	±0.25%
1 and 10 V	+0.075%	±0.125%
100 V	±0.125%	±0.2%

Amplifier Settling Time—100-mV Range: ≤150 μs. 1-V Range: ≤25 μs. 10-V Range: ≤10 μs. 100-V Range: ≤30 μs.
Input Impedance—100-mV, 1-V and 10-V Ranges: $\geq 10^{10}$ Ω. 100-V Range: ≥1 MΩ.
Digital-Data Transfer Format—12-bit word transferred in two bytes, high byte first. Lower six bits of each byte contain data, seventh bit is high byte/low byte indicator, eighth bit is unused.

ORDERING INFORMATION

50M10 Analog-to-Digital Converter Card **$895**
Includes: Interfacing cable; Instruction manual; Reference guide.

50M20 Programmable D-A Converter

- **12-Bit Resolution**
- **Voltage or Current Mode**
- **20-μs (Maximum) Conversion Time**
- **250 V RMS Isolation**
- **Mnemonic Instructions**
- **Self-Test and Error Indicators**
- **UL 1244 Listed**

The 50M20 converts digital data to either analog voltage or current. The voltage or current mode is selectable manually via an on-board switch.

Data format is 12 bits, sent in two sequential 7-bit words. Data can be sent via the IEEE Standard 488 (GPIB) using the MI 5010 as the interface, or from an external (front connector) bus for high-speed data transfer (with appropriate handshake lines). On-board firmware will convert commands and data to the proper format to perform the required digital-to-analog conversion. Two lines at the front-panel connector are provided to handshake data into the 50M20 from the user's external system.

System commands sent to the MI 5010 microprocessor, along with specialized programming commands unique to the 50M20, control the source and the format of the digital data. The 50M20 can be programmed to respond to either external or internal system triggers.

CHARACTERISTICS

VOLTAGE MODE

Range—−10.240 to +10.235 V.
Accuracy—±10.0 mV (+20 to +30°C) ±15 mV (0 to +50°C).
Resolution (1 LSB)—5 mV.
Total Conversion Time (Maximum)—20 μs.
Output Ripple and Noise—<5 mV p-p at 5-MHz BW.
Output Current Range—0 to ±5 mA.

CURRENT MODE

Range—−20.48 to +20.47 mA.
Accuracy—±20 μA (+20 to +30°C) ±40 μA (0 to +50°C).
Resolution (1 LSB)—10 μA.
Total Conversion Time (Maximum)—20 μs.
Output Ripple and Noise—<15 μA, p-p, at 5-MHz BW.
Compliance Voltage—±11 V.
Isolation—250 V RMS maximum to ground.
Digital-Data Transfer Format—12-bit word transferred in two bytes, high byte first. Lower six bits of each byte contain data, seventh bit is high byte/low byte indicator, eighth bit is unused.

ORDERING INFORMATION

50M20 Digital-to-Analog Converter Card **$910**
Includes: Interfacing cable; Instruction manual (070-3724-01); Reference guide.

50M30

Programmable Digital Input/Output Card

- **16 Digital Input and 16 Digital Output Lines**
- **Data Entry/Output Formats in Decimal, Binary, or Hex**
- **Triggered Externally or On Command**
- **Mnemonic Instructions**
- **Self-Test and Error Indicators**
- **UL 1244 Listed**

The 50M30 provides 16 digital input and 16 digital output lines. The digital inputs accept data from pushbuttons, switches, contact closures, and most digital devices capable of supplying TTL output levels. The digital outputs provide TTL levels to control various types of test and measurement instruments, relays, indicators, etc. The digital outputs can be configured for open-collector outputs by positioning internal jumpers and using power supplied by the user.

System commands sent to the MI 5010 microprocessor, along with specialized programming commands unique to the 50M30 control the selection of the data input/output channels and the arming/trigger functions of the card.

Four lines at the front-panel connector operate as input/output pairs to handshake data with the user's external system. One handshake pair allows the user's data source to be synchronized with the 50M30 data-input register and the other handshake pair allows the user's data storage device to be synchronized with the 50M30 data output register.

CHARACTERISTICS

Data Outputs Using Internal Supply—16 open-collector TTL with 2 kΩ pullup resistors. Logical "1": +5 V ±2% (open circuit). Source current is −2.5 mA ±7% maximum. Logical "0": 0.2 V. Sink current is −40 mA maximum.

Data Outputs Using External (User) Supply—Maximum Voltage: +15 V. Pullup Resistors: 2 kΩ. Logical "1" equal to external supply voltage (open circuit). Source current is 7.5 mA ±5% plus external supply tolerance. Logical "0": 0.2 V. Sink current is 40 mA maximum.

Data Inputs—Input Buffers: 16 Schmitt triggers. Logical "1" (+V Threshold): +1.6 V ±25%. Source current is −0.14 mA nominal, −0.16 mA maximum. Logical "0" (−V Threshold): +0.8 V ±40%. Source current is −0.18 mA nominal, −0.21 mA maximum.

ORDERING INFORMATION

50M30 Digital Input/Output Card **$495**
Includes: Interfacing cable; Instruction manual (0707-3722-00); Reference guide.

50M40

Programmable Relay Scanner Card

- **16 Mercury-Wetted Relay Contacts**
- **User-Configurable 1, 2, 4 Groups**
- **Triggered Externally or On Command**
- **Mnemonic Instructions**
- **Self-Test and Error Indicators**
- **UL 1244 Listed**

The 50M40 provides 16 independent, normally open relay contacts. The relay contacts can be used as switch closures to supply power to several external points from one source, or scan several sources and supply various inputs to a single measurement device.

The desired relay switch pattern is configured by the user with internal jumpers. When the configuration has been established, the relay-scanning sequence, open and close operations, and triggering events are programmed over the IEEE Standard 488 (GPIB) Bus.

Two logic signal lines on the front-panel connector are provided for externally controlling the 50M40—one as an output (Ready) to indicate to the user when the relays have settled, and the other as an input (Ext Trig) to tell the MI 5010 microprocessor that the user is ready for the relay switch configuration to close. Three possible configurations are:

4 groups of 4 individual relays
2 groups of 8 individual relays
1 group of 16 individual relays

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

CHARACTERISTICS

Type of Relays—Mercury wetted reed.
Possible Configurations (Jumper Selectable)—1 of 4, 4 each. 1 of 8, 2 each. 1 of 16, 1 of 12, and 1 of 4, 1 each.
Maximum Applied Voltage—40 V dc plus peak ac.
Maximum Carry Current—1 A.
Breakdown Voltage—100 V dc plus peak ac.
Contact Resistance—0.15 Ω nominal (end of life).

ORDERING INFORMATION

50M40 Relay Scanner Card **$695**
Includes: Interfacing cable (015-0430-00); Instruction manual (070-3723-00); Reference guide.

50M41

Programmable Low-Level Scanner

- **10 Differential Contact Pairs Plus Guard**
- **<1 μV Thermal Offset**
- **User Configurable**
- **Handshake Lines to Permit External Control**

The 50M41 provides ten pairs of guarded, normally open relay contacts with less than one microvolt of thermal offset in each channel. Each differential pair of contacts is accompanied by a third contact to switch the shield or guard connection. The ten sets of relay contacts can be configured as two groups of five individual relays with two commons, or as one group of ten individual relays with one common. The desired relay switch pattern is configured by internal jumpers. A tree relay can be included in the 1 of 10 configuration to reduce capacitive loading and potential noise problems when using more than one 50M41 in a system. Two handshake lines are provided for externally controlling the 50M41.

CHARACTERISTICS

Type of Relays—10 sealed low thermal EMF relays configurable as one 10-to-1 switch or two 5-to-1 switches.
Thermal Offset—<1 μV differential; <2 μV differential with tree switch.
Maximum Scan Rate—≥200 cycles/s.
Maximum Applied Voltage (High, Low or Guard of Any Channel to Chassis)—350 V dc + peak ac.
Maximum Switched Voltage—150 V dc + peak ac (not to exceed V A rating).
Maximum Carry Current—250 mA.
Maximum Switched Current—10 mA.
Maximum Switched V A—0.15.

ORDERING INFORMATION

50M41 Low-Level Scanner Card **$995**
Includes: Interfacing cable (015-0430-00); Instruction manual (070-4557-00); Reference guide.

50M50

Programmable Memory Card

- **16K-byte Digital Input/Output**
- **Single 16-Bit or Dual 8-Bit Channels**
- **Independent Dual-Channel Operation**
- **200-kHz Acquisition or Generation Rate**
- **TTL Levels**
- **External Handshake Lines**

This 16K-byte digital input/output device can be configured, under program control, as a single 16-bit input/output port or as two 8-bit input/output ports. These ports can be connected to any of 16 data buffers, which can be programmed to different lengths. The total memory of all the buffers cannot exceed 16K bytes.

The 50M50 is intended to be used as a digital-word generator and/or as a fast, digital-data acquisition buffer. As a digital-word generator, it can be used with a digital-to-analog converter, such as the Tektronix 50M20, to function as an arbitrary waveform generator. As a high-speed data-acquisition buffer, it can be used with an analog-to digital converter, such as the Tektronix 50M10, as an off-line, high-speed analog signal-measurement system or as a waveform digitizer.

The 50M50 can be programmed to input or output data on two different channels simultaneously, or to input data on one channel while outputting data on the other channel. System commands to the 50M50 control the selection of input/output channels, the control of the data buffers, and the arming functions of the card.

Four handshake lines are provided at the front panel to permit synchronization with the user's external system (one pair for each channel). Other external control lines permit pacing and control of data output and disabling of data input.

CHARACTERISTICS

Data Outputs—8 or 16 low-power Schottky TTL lines. Logical "1": +5 V ±2% (open circuit). Source current is 2.5 mA +2% −7% maximum. Logical "0": ≤0.7 V. Sink current is 40 mA maximum.
Data Inputs—8 or 16 low-power Schottky TTL lines. Logical "1" (+V Threshold): +1.5 to +2 V. Source current is −0.16 mA maximum. Logical "0" (−V Threshold): +0.6 to +1.1 V. Source current is −0.21 mA maximum.
Maximum Data-Transfer Rate—8-Bit Bytes: 200 kHz ±2%. 16-Bit Bytes: 125 kHz ±2%.

ORDERING INFORMATION

50M50 Memory Card **$995**
Includes: Interfacing cable (015-0430-00); Instruction manual (070-4550-01); Reference guide.

50M70

Programmable Development Card

- **32 Data I/O Ports**
- **Interrupt and Trigger Lines**
- **Vector Board Development Region**
- **Mnemonic Instructions**
- **Self-Test and Error Indicator**

The 50M70 provides the means of developing a unique circuit and interfacing it to the GPIB without the need for designing and building the GPIB interface itself. With the 50M70, the user can create a specialized function card to be used in the MI 5010/MX 5010 Multifunction Interface System. When completed, the circuit can be programmed in high-level language over the GPIB.

The 50M70 contains two 68B21 16-bit interface-logic registers (PIAs), address and data buffers, its own firmware, and a 4×4 inch breadboard area for circuit development. The 32 data lines of the PIAs can be individually programmed as inputs or outputs. The PIAs also provide three sets of programmable two-wire handshake lines to permit triggering of the external system by the 50M70 or of the 50M70 by the external system.

Typical 50M70 applications are specialized A/D and D/A converter functions, counter/timer applications, special communication interface functions, keyboard and display functions, digital comparators for triggering and interrupt functions, etc.

CHARACTERISTICS

Data Input/Outputs and Handshake Lines—Output High Level: +2.4 V minimum, +5.5 V maximum. Maximum Load Current: −200 μA. Output Low Level: 0 V minimum, +0.4 V maximum. Maximum Sink Current: 3.2 mA. Input Load Current: 1.3 mA nominal, 2.4 mA maximum.
DC Voltage Sources Available on the Card—+26 and −26 V ±9%, 100 mA maximum; +8 V ±5%, 600 mA maximum; +5 V ±5%, 1.5 A maximum. Total Combined Power Limit: 7.5 W.

ORDERING INFORMATION

50M70 Development Card **$410**
Includes: Interfacing cable; Instruction manual (070-3725-00); Reference guide.

OPTIONAL ACCESSORIES MULTIFUNCTION INTERFACE SYSTEM

Interfacing Cable—50-conductor flat ribbon cable with connector to mate with front-panel connector of any Multifunction Interface System function card. Other end of the 48-inch cable terminates in bare tinned leads. (This cable is a standard accessory with 50M20, 50M30, 50M40, and 50M70 cards.) Order 015-0430-00 **$80**

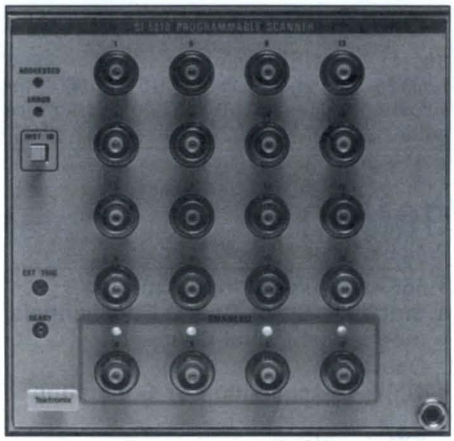
Single-Width Interfacing Adapter—Mates with any single Multifunction Interface System function card to permit customized interface wiring between cards or to external system under test. Will accommodate up to five screw-terminal blocks (131-3083-00 below). Order 015-0466-00 **$215**

Screw-Terminal Block—Mounts in 015-0466-00 Interfacing adapter above to permit wiring changes without soldering (ten terminals per block). Order 131-3083-00 **$10.25**

Triple-Width Interfacing Adapter—Mates with up to three Multifunction Interface System function cards in an MI 5010 or MX 5010 to permit interface wiring among cards or to external system under test. Contains two 131-3083-00 screw-terminal blocks. Order 015-0473-00 **$330**

Multifunction Interface System Card Extender—Permits operation of a function card while extended from the front of an MI 5010 or MX 5010. Order 067-1066-00 **$215**

Function Card Access Shield—Dummy function card of insulating material to protect against possible electrical shock or damage in partially filled MI 5010 or MX 5010. Order 020-0836-00 **$65**



SI 5010 Programmable Scanner

SI 5010

GPIB IEEE-488 The SI 5010 complies with IEEE Standard 488.1-1987, and with Tektronix *Standard Codes and Formats.*

- **Software Configurable as:**
  - **1 Group of 16 Channels**
  - **2 Groups of 8 Channels**
  - **4 Groups of 4 Channels**
- **350-MHz Bandwidth in 4-Channel Configuration**
- **External Handshake Lines**
- **Built-In Time-of-Day and Pacing Clock**
- **Command Buffer for Controller-Free Operation**

The SI 5010 Programmable Scanner provides the capability of switching and routing up to 16 high-frequency input and/or output signals. It always maintains a clean 50-Ω environment through the use of 50-Ω coaxial reed relays. The software-configurable basic four-channel arrangement allows the SI 5010 to be used for point-to-point switching (any connector to any other connector), or to be used in a wide variety of fan-in and/or fan-out configurations.

The SI 5010 has its own intelligence and a built-in command buffer capable of storing up to 300 system commands and executing them in sequence. It is paced by the on-board time-of-day and pacing clock or by signals from the system under test. This requires no interference from the system controller, thus freeing the controller to direct activity elsewhere in the system.

Two handshake lines are provided for externally controlling the SI 5010. An Ext Trig line is provided to allow the SI 5010 switching to be initiated by the external system under test, and a Ready line indicates to the external system when the relays have settled.

CHARACTERISTICS

RF Connectors—20 BNC connectors, 16 channels and four commons.
Control Input (Ext Trig)—External Trigger: TTL compatible
Control Output Data Accepted (Ready)—TTL compatible. Output goes high when relays have settled.
Channel Configuration (Software Selectable)—1, 2, 3, or 4 groups of 4 channels. 2 groups of 8 channels. 1 group of 16 channels.
Frequency Response—Any 1 Group of 4: −3 dB at 350 MHz, decreasing to −6 dB at 500 MHz or greater. Any 1 Group of 8: −3 dB at 175 MHz or greater. Any 1 Group of 16: −3 dB at 80 MHz or greater.
Port (Channel) Isolation—40 dB at 100 MHz.
Characteristic Impedance (Each Channel)—50 Ω. See VSWR specification.
Rise Time (Each Channel)—<1 ns.
Voltage Standing Wave Ratio (VSWR)—Any 4 Channel Group: 1.25:1 at 100 MHz, increasing to 1.8:1 at 350 MHz. Any Other Combination: 1.5:1 at 100 MHz. 2:1 at 225 MHz.
Insertion Loss—<1 dB at 100 MHz.
Channel Delay Matching—Any Group of 4: 50 ps. Any Group of 8: 110 ps. Any Group of 16: 310 ps.
Type of Relays—16 Form A, EAC 05Y21A1 40 BAB, or equivalent. 4 Form "C", TO-5, Teledyne 712-6, or equivalent. Pull-In Time: 3 ms. Release Time: 3 ms. Breakdown Voltage: 350 V (dc + peak ac). Series Path Resistance (End of Life): 0.5 Ω.
Peak Carry Voltage—Unterminated: 40 V maximum. 50-Ω Terminated: 12.5 V maximum.
Peak Contact Current—0.25 A maximum.
Peak Switching Voltages—Unterminated: 15 V maximum. 50-Ω Terminated: 3.73 V maximum.
Peak Switching Current—0.01 A maximum.

ORDERING INFORMATION

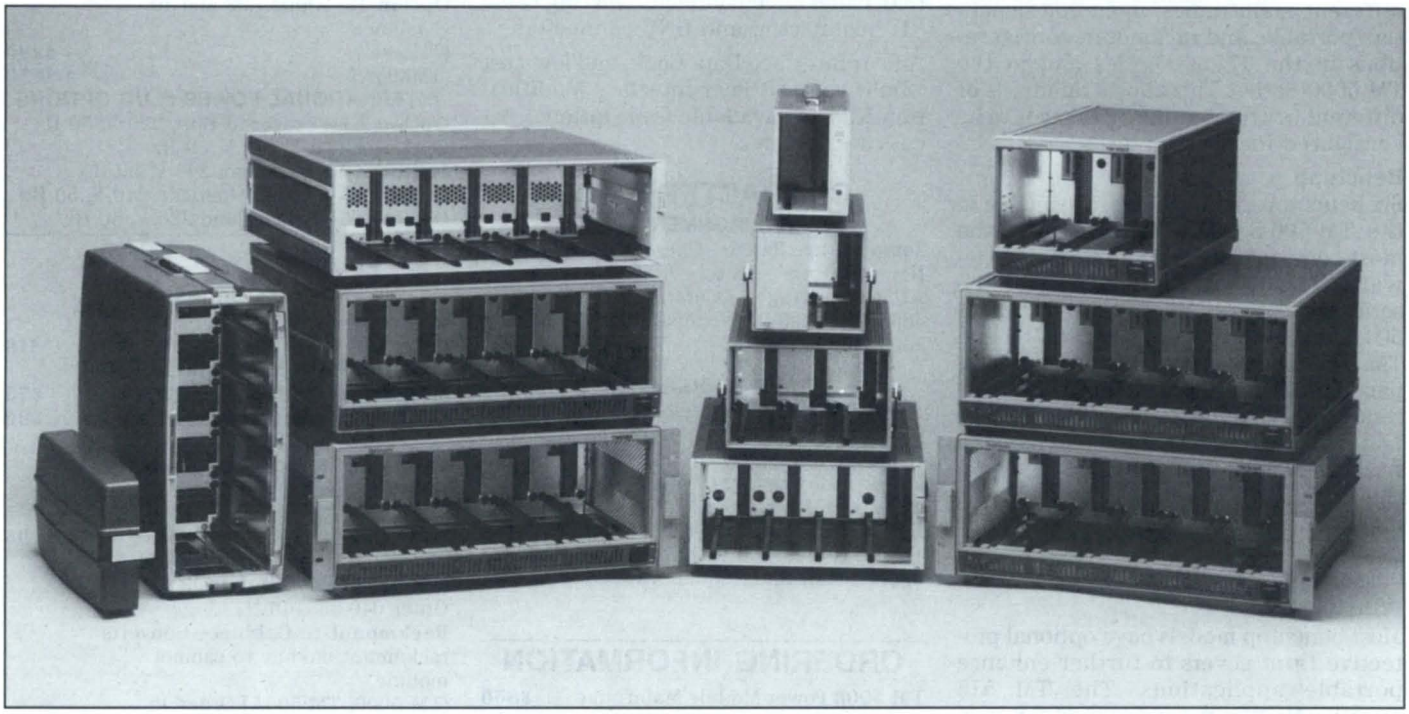
SI 5010 Scanner **$2,275**
Includes: Instruction manual (070-3721-00); Instrument interface guide; Reference guide.

RECOMMENDED PROBES

P6056—10X Passive **$200**
P6057—100X Passive **$195**
P6202A—FET **$735**
P6230—Bias/offset **$420**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

POWER MODULE MAINFRAMES



TM 5003/TM 5006

Power Module Mainframes

GPIB IEEE-488

The TM 5003 and TM 5006 comply with IEEE Standard 488.1-1987.

The TM 5000 mainframes extend the convenience of the TM 500 concept into the programmable instrument/IEEE Standard 488 area. The TM 5003 accepts up to three instruments at one time; the TM 5006 accepts up to six. These two TM 5000 mainframes were designed specifically for use with the Tektronix TM 5000 line of programmable, IEEE Standard 488 compatible test-and-measurement instruments. All of the TM 500 manual plug-in instruments will also operate in these same mainframes allowing manual and programmable instruments to be mounted together in adjacent slots. This capability permits unique compact combinations of test instruments to be assembled for specific test applications.

TM 5000 instruments cannot be operated in TM 500 mainframes.

Benchtop or Portability

The two benchtop mainframes are the TM 5003 and the TM 5006. The TM 5003 is the most compact, accommodating three single-wide plug-ins. The TM 5006 includes a high-power compartment at the right-hand end to supply higher current levels to instruments that provide higher performance or higher-output levels. Both the TM 5003 and TM 5006 incorporate a quiet fan for optimum cooling; have feet, tilt-bails, handles, and front-panel power switches. Both operate from 110 or 220 V ac.

All benchtop models have carry handles for portable applications.

Rackmount

The TM 5006 Option 10 is electrically identical to the standard TM 5006 and features a slide assembly and handles, plus a higher-power fan than the bench version to accommodate the higher ambient temperatures often found in enclosed racks and consoles. Kits are available to rackmount a TM 5003 with a 4041 System Controller.

CHARACTERISTICS

POWER REQUIREMENTS

Both mainframes have manually selectable taps on the power transformer that permit operation on 100, 110, 120, 200, 220, or 240 V ±10%.

Power-Line Frequency Range—48 to 66 Hz.
Maximum Power Consumption—Shown in Mainframes Dimensions and Weights chart.

PHYSICAL CHARACTERISTICS MAINFRAMES (WITHOUT PLUG-INS)

	TM 5003		TM 5006	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	230	9.0	445	17.5
Height	194	7.6	194	7.6
Depth	488	19.2	488	19.2
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	8.6	19.0	14.5	32.0
Shipping	12.0	26.5	20.9	46.0
Maximum Power Consumption*[1]	300 V A		650 V A	

*[1] *Actual power consumption depends on plug-in selection and operating modes.*

ENVIRONMENTAL

Temperature Range—Operating: 0 to +50 °C. Nonoperating: −55 to +75 °C.
Altitude Range—Operating: Sea level to 4600 m (15,000 ft). Nonoperating: Sea Level to 15,000 m (50,000 ft).

TM 500 Series

Power Module Mainframes

TM 500 plug-ins can operate in several different mainframes, including benchtop, portable, and rackmount configurations in the TM 500-Series and in the TM 5000-Series. This allows hundreds of different instrumentation packages to be configured for specific tasks.

Benchtop

Six benchtop mainframes are available in the TM 500-Series. The TM 501 is the most compact, accommodating a single-width TM 500 module. Others in the series include the TM 502A, TM 503A, TM 504, and new TM 506A. The TM 504 and TM 506A both include a high-power compartment at the right side for higher current levels. The "A" version mainframes feature a convenient switch for changing from a 110 V ac to 220 V ac source, and the TM 506A incorporates a quiet fan for maximum cooling. all bench-top moduls have feet, tilt-bails, and handles, and operate from 110 to 220 V ac.

Portability

Most benchtop models have optional protective front covers to further enhance portable applications. The TM 515 Traveler Mainframe is designed for even greater multi-instrument portability. The TM 515 is moisture and dust resistant, and will withstand the rigors of transport.

Rackmount

The TM 506A is designed for rackmounting with Option 10. This option includes a slide assembly and handles, plus a higher powered fan than the bench version to accommodate the higher ambient temperatures often found in enclosed racks and consoles. The TM 506A will accommodate all hardware options that apply to the TM 5006.

Mainframe Rear Interface

Both the TM 5000 and the TM 500 Mainframes offer the unique ability to have separate modular instruments interconnected through the internal rear interface board of each mainframe. For example, the rear trigger output of a signal source can be interconnected to speed precise voltage set-ups. Any module can be internally connected through the mainframe and externally interfaced at the rear panel.

Most modules have additional signal or control lines at the back of the instrument and can be connected via the rear interface board to an option 02 mainframe rear panel BNC's or a multipin "D" connector.

The TM 515 mainframe is available with an Option 05 interface that includes everything in the Option 02 except for the rear-panel male connector, mating cable "D" connector, and BNC connectors.

A Rear Interface Data Book, and low-cost "Do it yourself Rear-Interface Modification Kits are available (see Optional Accessories below).

CHARACTERISTICS

ENVIRONMENTAL

Temperature Range—Operating: 0 to +50°C. Nonoperating: −55 to +75°C.
Altitude Range—Operating: Sea level to 4600 m (15,000 ft). Nonoperating: Sea level to 15000 m (50,000 ft).

POWER REQUIREMENTS

The mainframes have selectable taps on the power transformer that permit operation on 100, 110, 120, 200, 220, or 240 V ±10%.
Power-Line Frequency Range—TM 501: 48 to 440 Hz. TM 502A/TM 503A: 48 to 400 Hz. TM504/ TM 506/RTM 506/ TM 515: 48 to 66 Hz. TM 515 (Purchased with Option 06): Extends upper power-line frequency range to 440 Hz.

ORDERING INFORMATION

TM 5003 Power Module Mainframe **$850**
Includes: Instruction manual (070-2955-00).
TM 5006 Power Module Mainframe **$995**
Includes: Instruction manual (070-2950-00).
TM 501 Power Module Mainframe **$500**
Includes: Instruction manual (070-1304-01).
TM 502A **$250**
Includes: Instruction manual (070-6502-00)
TM 503A Power Module Mainframe **$325**
Includes: Instruction manual (070-6568-00).
TM 504 Power Module Mainframe **$590**
Includes: Instruction manual (070-1716-01).
TM 506 Power Module Mainframe **$820**
Includes: Instruction manual (070-1786-02).
TM 506A Power Module Mainframe **$650**
Includes: Instruction manual.
RTM 506 Rackmount Power Module Mainframe **$900**
Includes: Instruction manual (070-1786-02).
TM 515 Power Module Mainframe **$760**
Includes: Instruction manual (070-2020-02).

OPTIONS

Option 02—Rear Interface
(TM 5003) **+$100**
(TM 5006) **+$190**
(TM 503A) **+$75**
(TM 504) **+$120**
(TM 506) **+$180**
(TM 506A) **+$150**
Option 05—(TM 515) Rear Interface **+$90**
Option 06—(TN 515) 48 to 440 Hz Fan. **+$170**
Option 10—Rackmount (TM 5006/TM 506A only) **+$100**
Option 11—(TM 502A/TM 503A) Deletes handle **−$10**
Option 13—(TM 502A/TM503A) Toolbox **+$75**
Option 12—Option 02 and 10 Combined
(TM5006) **+$290**
(TM506A) **+$250**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

OPTIONAL ACCESSORIES

Rear Interface Data Book—Order 070-2088-04 **$18**
Rear Interface Modification Kit—
(Three wide) Order 020-1611-00 **$75**
(No BNCs) Order 040-0846-01 **$90**

CONVERSION KITS

Cabinet-to-Rackmount—Includes slide out assembly and fan
(TM 5006, TM 506A) Order 040-0982-03. **$195**
(TM 5003) Order 040-1257-00.*1
(TM 5003 to 4041 Controller) Order 040-0984-01.*1
Rackmount-to-Cabinet—Converts rackmount module to cabinet module.
(TM 5006, TM 506A) Order 040-0983-00. **$90**

*1 *Contact your local sales office.*

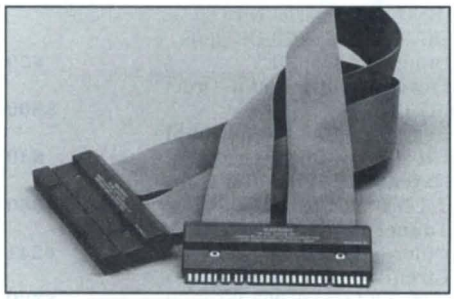
FLEXIBLE PLUG-IN EXTENDER CABLE

Designed to couple a TM 500 or TM 5000 Plug-in with the mainframe rear-interface board connection extender, cables provide a completely flexible connecting point outside the mainframe for plug-in operation during test or check-out. See page 421.

RECOMMENDED CARTS

See Cart section.
206—Utility Cart **$250**
K213—Lab Instrument Cart **$625**
K217—Rack Instrument Cart **$510**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

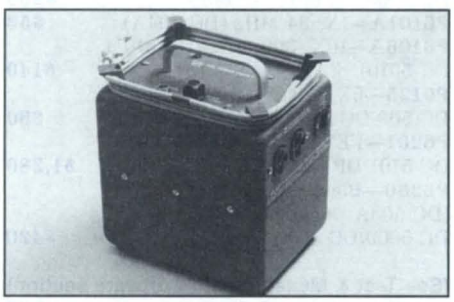


FLEXIBLE PLUG-IN EXTENDER CABLE

Designed to couple a TM 500 or TM 5000 Plug-in with the mainframe rear-interface board connection.

ORDERING INFORMATION

GPIB Extender Cable for TM 5000 mainframes. Order 067-0996-00 **$145**
Extender Cable for TM 500/TM 5000 mainframes. Order 067-0645-02 **$360**
GPIB Interconnecting Cables—
(0.5 m) Order 012-1015-00 **$85**
(2 m) Order 012-0630-01 **$105**
(2 m) Double Shielded. Order 012-0630-03 **$110**



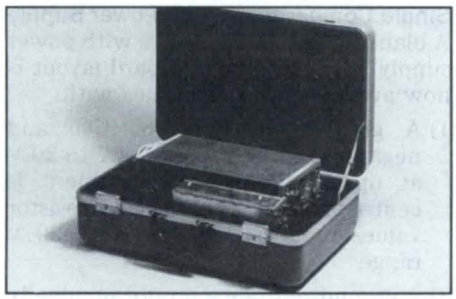
1105 Battery Power Supply

The Battery Power Supply is designed for use when suitable ac line power in unavailable. Operating time is dependent on the number and type of plug-ins being powered and their operating mode. The following table shows estimated operating time for a full mainframe in a typical situation.

TM 501	5.0 hours
TM 502A	2.5 hours
TM 503A	1.7 hours
TM 504	1.3 hours
TM 506	0.9 hours
TM 515	1 hour

ORDERING INFORMATION

1105 Battery Pack **$2,090**
Option 01—230 V Operation **NC**

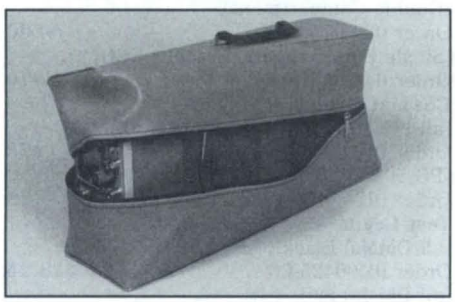


TM 500 Carrying Case

These luggage-type carrying cases for TM 500 equipment are molded of high-strength glass-epoxy. It is 610 mm long×216 mm thick×445 mm high, (24 in. long by 8.5 in. thick by 17.5 in. high) and weighs ≈14 pounds empty.

ORDERING INFORMATION

Carrying Cases
(TM 503A) Order 016-0565-01. **$500**
(TM 504) Order 016-0608-00 **$645**
(TM 515) Order 016-0643-00 **$695**

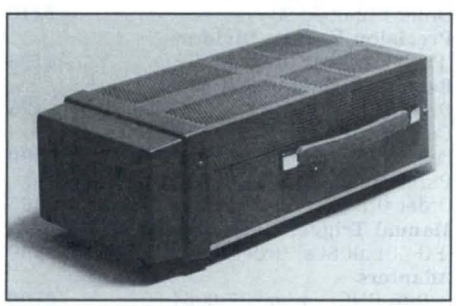


Rain Covers

These soft, weather-proof, vinyl-coated Rain Covers come in sizes for TM 503A and TM 504 instrument packages.

ORDERING INFORMATION

Rain Covers
(TM 504) Order 016-0621-00 **$45**
(TM 503) Order 016-0620-00 **$35**



Protective Front Cover

A snap-on front cover, molded of high-impact platic, is available for the TM503A (shown above), TM 504, and TM 506 mainframes.

OPTIONAL ACCESSORIES

Front-Panel Cover—
(TM 503A) Order 200-3554-00. **$25**
(TM 504) Order 200-1727-00. **$20**
(TM 506) Order 200-1728-00. **$21**

Mainframe Retainer Bar

Modifies the TM 504 or RTM 506/TM 506 mainframe; each has a separate kit. Initial installation requires replacement of an existing bottom member of the mainframe with a new part supplied in the kit.

ORDERING INFORMATION

Mainframe Retainer Bar Kit
(TM 504) Order 020-0548-00. **$55**
(TM 506/RTM) Order 020-0549-00. **$60**

Accessory Pouch

Made for carrying probes, cables, or other accessories, this soft vinyl pouch snaps on to the carrying handle of any TM 5000/TM 500 mainframe or Tektronix oscilloscope, or the straps can be snapped together to form a carrying handle. Dimensions are approximately 9¼ in. long X 5¾ in. wide X 2 in. high.

ORDERING INFORMATION

Accessory Pouch—Order 016-0351-00. **$32**

Lab Instrument Cart

The Lab Instrument Cart accepts all TM 5000/TM 500 mainframes that are up to four plug-ins wide, or an oscilloscope. See Cart section for additional information.

ORDERING INFORMATION

K213 Lab Instrument Cart **$625**

OPTIONS

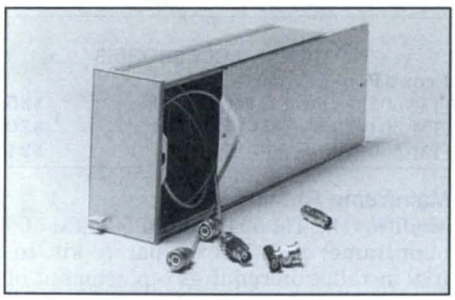
Option 05—Delete Power Strip. **NC**
Option 10—7854 keyboard drawer **+$95**
Option 12—5000/7000 Series plug-in storage cabinet **+$140**
Option 22—Combines Options 10 and 12. **+$295**
Additional Lower Shelf—
Order 436-0132-01 **$65**
Safety Belt to secure oscilloscopes or TM 5000/TM 500 to top tray or lower shelves (not needed for 5000 Series or 7000 Series on top tray). Order 346-0136-01 **$32**

Blank Plug-in Panel

The Blank plug-in Panel is used to cover unused openings in either the TM 5000 or the TM 500 mainframes.

ORDERING INFORMATION

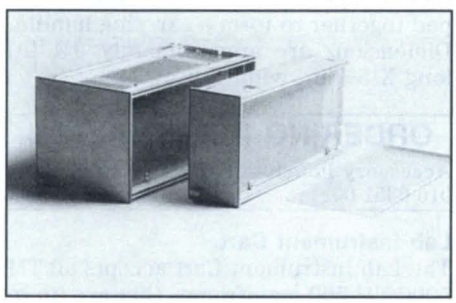
Blank Plug-in Panel
Order 016-0195-03. **$35**



Plug-in Storage Compartment
The plug-in storage compartment provides storage space for probes, cables, "tees," accessories, and small tools. Inside dimensions: 250 mm long × 51 mm Wide × 106 mm High (9-7/8×2×4-1/4 inches).

ORDERING INFORMATION

Plug-in Storage Component
Order 016-0362-02. **$75**



TM 500 Custom Plug-in Kits
Complete test and measurement configurations may include relay circuits or manual switches for routing signals; test oscillators at preset frequencies for alignment purposes and markers; digital logic circuits for sequencing, timing, and control; special processors or converters; or any number of system elements that require custom manufacture. This is why the TM 500 line includes custom plug-in kits. The kits provide perforated main circuit boards that allow rapid construction and wiring of circuits using both discrete components and integrated circuits. An instruction sheet details the voltages and currents available in the power module. The finished special purpose circuitry or instrument is physically compatible with other TM 500 instrumentation.

Single Compartment With Power Supply
A blank plug-in kit complete with power supply parts and circuit board layout is now available. The kit comes with:

1) A ground-referenced positive and negative supply, capable of 7 to 20 V at up to 400 mA. (Adjustment is centered at 15 V; change of resistor values required for total 7 to 20 V range.
2) A ground-reference supply, nominally 5 V, not adjustable, with up to 1 amp current capability.

A series of TM 500 construction notes provide direction for building custom circuits using the TM 500 Blank Plug-in Kits and standard components.

ORDERING INFORMATION

Custom Plug-in Kits—
(Single Compartment with Power Supply) Order 040-0803-02 **$135**
(Single Compartment)
Order 040-0652-05 **$135**
(Double Compartment)
Order 040-0754-07 **$200**
(Single Compartment Without ECB)
Order 040-0821-03 **$70**
Coaxial Cables, BNC F-F—
(all PGs) 10-inch, 50-Ω.
Order 012-0208-00 **$28**
(PG 502/PG 506/SG 503) 3-ft, 50-Ω
Order 012-0482-00 **$29**
Test Leads—
(all DMMs) Black, 4-ft.
Order 012-0425-00 **$13.25**
(all DMMs) Red, 4-ft.
Order 012-0426-00 **$24**
(DM5120/5520) Order 012-0941-01 **$49**
(all DMMs) Black, 4 ft.
Order 012-0426-01 **$24**
Test-Lead Set—(all DMMs)
Order 012-0427-00 **$30**
BNC-to-RF Cable Adapter—
DC 510/DC 5010) Order 012-0532-00 **$42**
GPIB Interconnect Cables—
(0.5 m) Order 012-1015-00 **$85**
(2.0 m) Order 012-0630-01 **$105**
(2.0 m, double shielded)
Order 012-0630-03 **$110**
Precision Voltage Divider—
(PG 506) Order 015-0265-00 **$195**
Remote Variable—(CG 5001)
Order 015-0309-01 **$475**
Comparator Head—(CG 5001)
Order 015-0310-01 **$690**
Pulse Head—(CG 5001)
Order 015-0311-01 **$1,495**
Manual Trigger Generator—
(PG 501/all SCs) Order 016-0597-00 **$260**
Adapters—
(GR-to-BNC) Order 017-0064-00 **$100**
(GR-to-BNC Female)
Order 017-0067-00 **$75**
(Female BNC-to-Dual Banana) For all DMMs. Order 103-0090-00 **$10**
(BNC-to-Tip Jack) For
DC 503A/DC 5010/DC 5009.
Order 175-3765-01 **$39**
Power Divider—50-Ω. Order
017-0082-00 **$800**
Rear-Interface Signal Cable Kit—(FG 5010) Order 020-0701-00 **$40**
Extender Cable—(TM 500/
TM 5000) Order 067-0645-02 **$360**
Tunnel Diode Pulser—(PG 506A)
Order 067-0681-01 **$241**
Circuit Board Extenders—
(Flexible) Order 067-0974-00 **$380**
(Rigid) Order 067-0975-00 **$125**
GPIB Extender Cable—(TM 5000 only) Order 067-0996-00 **$145**
Service Kit—(FG 5010)
Order 067-1041-00 **$510**
Rear-Interface Data Book—
Order 070-2088-04 **$18**

RECOMMENDED PROBES

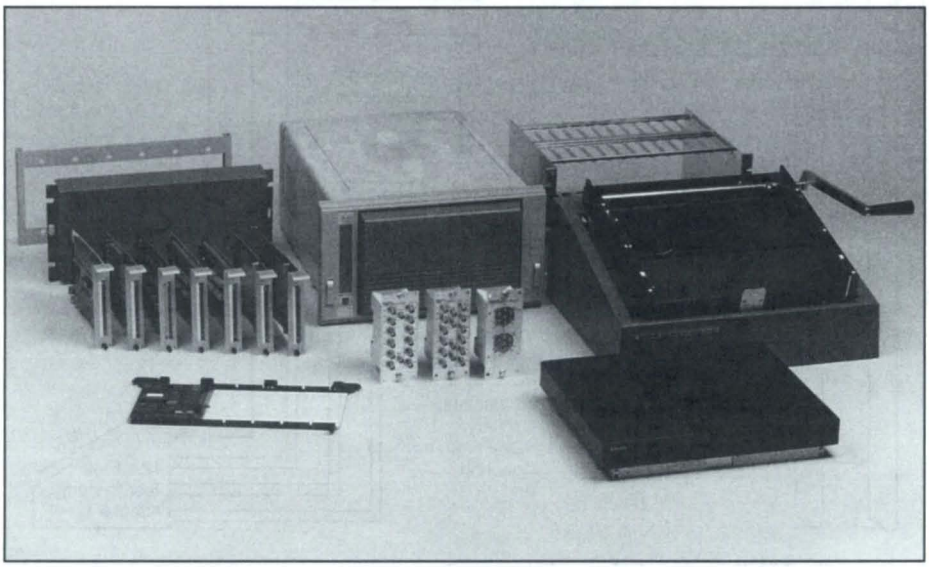
For DMMs
High Voltage—
(DM 501A/DM502A/DM5010)
Order 010-0277-00 **$185**
P6420—2-m RF (DM 501A/
DM 502A/DM 5010) **$155**
P6601—Temperature (DM 501A/
DM 502A) **$250**
For Counters
P6056—10X, 50-Ω, 3.5 GHz
(DC 503A/DC 509/DC 510/
DC 5009/DC 5010/DP 501) **$200**
P6101A—1X, 34 MHz (DC 504A) **$53**
P6106A—10X, 300 MHz (DC 510/
DC 5010) **$140**
P6125—5X Passive (DC 503A/
DC 509/DC 510/DC 5009/DC 5010 **$80**
P6201—FET, 900 MHz (DC 510/
DC 5101/DP 501) **$1,280**
P6230—Bias/Offset, 1.5 GHz
(DC 503A/DC 509/DC 510/
DC 5009/DC 5010/DP 501) **$420**

SOFTWARE

(See Test & Measurement Software section)
S45F030—TEK EZ-TEST PC **$1,795**
S45F902—Audio TPG for
AA 5001/SG 5001 with 4041 **$300**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

SIGNAL SWITCHING/FIXTURING DUT INTERFACING PRODUCTS



TSI 8150 (center rear) and family members.

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Complete Interfacing Packages
***NEW* TSI 8155 Test System Interface Package 435**

COMPLETE SIGNAL SWITCHING/DUT INTERFACING SOLUTIONS IN A SINGLE PACKAGE

The Test System Interface (TSI) family of off-the-shelf components can be easily and affordably configured to fit a majority of signal switching and DUT interfacing needs.

Systems can range in complexity from a mainframe and a single switching assembly, to DUT-interfacing adapters and multiple card/module switching configurations for up to 768 channels. DUT physical interfacing is accomplished with the Test System Adapter (TSA 8140). Cards and modules are available for switching signals ranging from microvolts to 2000 volts, from microamps to 10 amps, and from dc to 18 GHz.

With the addition of the new instrument cards that fit in the TSI mainframe, much of the measurement and stimulus can be done right in the mainframe, freeing up GPIB ports and reducing bus traffic.

Rackmounting is a standard feature of the TSI 8150, as well as IEEE-488 bus operation. Along with this, you get conformity with Tek *Codes and Formats*, plus Tektronix' high-quality documentation and after-sales support.

Tektronix offers the complete solution for your physical DUT-interfacing/signal-switching/multiplexing requirements.

TSI 8150

GPIB IEEE-488

The TSI 8150 complies with IEEE Standard 488.1-1987, and with Tektronix *Standard Codes and Formats.*

- **Complete Line of Scanner Cards, Modules, Plus "Instrument on a Card" Functionality**
- **Complete Line of Accessories for Switch-Mounting and DUT-Interfacing Requirements**
- **Flexible Mechanical Architecture Permits Signal Access From Front, Rear, or Both**
- **Low-Noise Linear Power Supply and Remote Switching (at the DUT) for Signal Integrity**
- **Intelligent Mainframe and Control Assemblies Free System Controller for Other Tasks**
- **Real-Time Sequencing Maximizes Throughput**

In applications where DUTs span a wide range of bandwidth, power, signal-routing, and physical-interfacing requirements, most test interfaces have had to be custom designed and built. In addition to being time-consuming and expensive, these custom fabrications were difficult and costly to maintain, and documentation was a problem.

Now, Tektronix offers the solution! The TSI 8150 family of off-the-shelf components can be easily and affordably configured to fit a majority of signal switching and DUT interfaceing needs. Whatever your signal-routing needs, the TSI 8150 has the answer: digital or analog; front or rear signal access (or both); remote switching; signal levels from microvolts to 2000 volts; currents from microamps to 10 amps; and frequency ranges to 18 GHz (with less than 0.6 dB insertion loss and VSWR better than 1.5:1). Two custom driver cards are available for routing specialty signals or for controlling devices such as actuators, solenoids, stepper motors, and robotics.

Physical interface to the DUT is provided by the TSA 8140 Test System Adapter. The TSA can be mounted horizontally, vertically, or in a system rack with optional rack slides. An extensive offering of interchangeable test adapters lets you test a wide variety of device types, such as hybrids, circuit boards, and components. Test adapters can be easily modified to accept various Zero Insertion Force (ZIF) sockets and adapters. An optional Test Head Receiver (021-0435-00) is Virginia Panel Corporation Series 3200 compatible, which opens the door to a large selection of vacuum bed-of-nails test adapters for circuit board testing.

Scanner cards and modules can be mounted in the mainframe, in the auxiliary mounting units, or in the test system adapter, up to 40 feet away from the mainframe. Mounting the assemblies in the test-system adapter puts the switching as close to the DUT as possible, helping the TSI 8150 to ensure signal integrity. Numerous other techniques are used to make sure your signals stay clean, such as individually shielded function cards and a low-noise linear power supply.

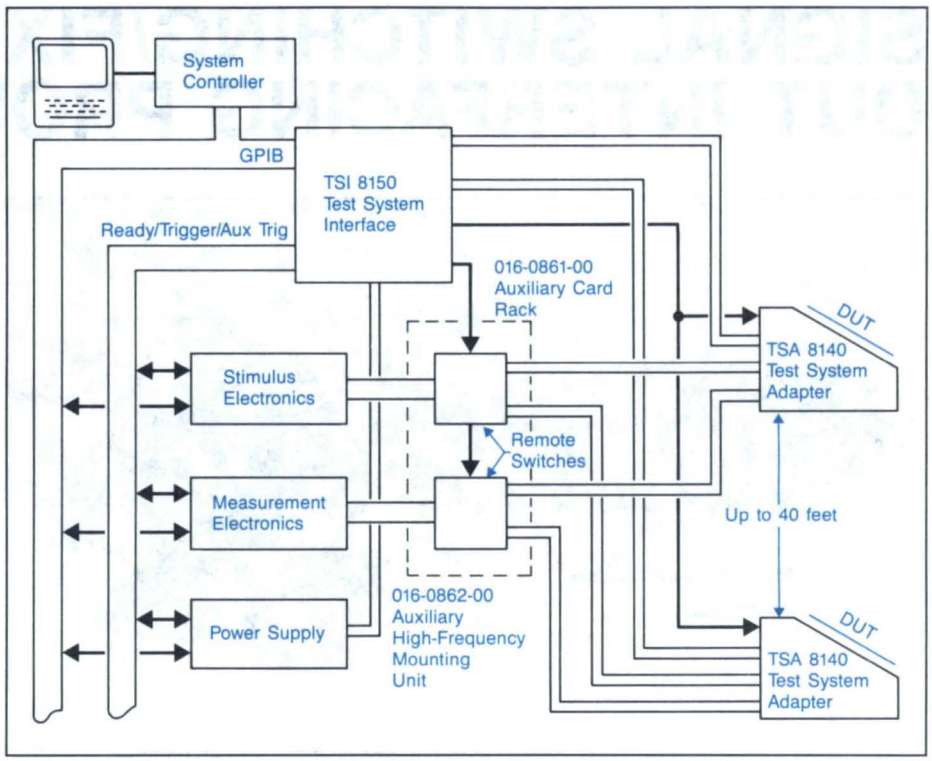
Each scanner card, or each two identical scanner modules, has a dedicated control card that provides real-time control for up to 32 switches in any closure pattern, with storage of up to 500 test sequences. Add programmable make-before-break (MBB) or break-before-make (BBM) for each switch, and you have unparalleled control over your switches.

Functionality of the TSI 8150 product family is further enhanced by a series of instrumentation cards. These cards go a long way toward providing "instrument-on-a-card" modularity. Unlike the scanner cards and modules and relay driver cards, these full-size cards do not require a control card. They are designed to work by themselves, or in combination with other TSI cards, in a variety of instrumentation applications.

Expandability is another of the TSI 8150's strong points. With a maximum configuration utilizing a TSX 8140 Expansion Chassis, and 016-0861-00 Auxiliary Card Racks or 016-0862-00 Auxiliary Mounting Units, up to 768 channels can be scanned.

The Basic Building Block

The TSI 8150 mainframe is the basic building block of the Tektronix TSI 8150 Test System Interface family. It is an intelligent and flexible interface mainframe that provides power, control, timing, and housing for TSI 8150 family scanner cards, modules, and instrument cards.



A wide variety of scanner cards and modules are available: low-frequency cards; low- and high-voltage cards; power switches; and microwave switches. (Refer to the individual card and module specifications and ordering information sheets.)

The TSI 8150 family mechanical architecture provides flexible front or rear access to installed cards and modules.

With the TSI 8150 family, one test set-up can combine total physical interfacing with the complete switching solution offered by the TSI 8150 line of scanner cards and modules. The result is a test system interface qualified for many automated test applications.

Test engineers will benefit from the flexibility and versatility of the TSI 8150 mainframe and other family members. The TSI 8150 family is especially well-suited for complex test requirements and for applications requiring periodic test set-up changes. Examples of these applications include testing of components, hybrids, circuit boards, sub-assemblies, and complete products.

In some test systems, the controllers don't lend themselves to real-time operation. For these systems, combining TSI 8150 mainframe local intelligence with its timing capability produces a powerful team. The TSI 8150 mainframe's handling of switch sequencing and timing frees the controller for other tasks.

The TSI 8150 mainframe provides scanner timing and control information through the TSS40 Scanner Control Assembly. This plug-in assembly controls TSI-family scanner cards and modules.

Real-Time Execution, Higher Throughput

The TSI 8150 mainframe receives instructions from the system controller over the GPIB, storing up to 500 test steps on each TSS40 Scanner Control Assembly. Each TSS40, in turn, passes the instructions to the scanners (one card or up to two modules of the same type) that it controls. The system can then use external triggers, internal triggers, or a single command to increment each test sequence step. Using stored settings and either a trigger or a single bus command, a test system can change the state of hundreds of switches at the same time.

TSI 8150 family control commands conform to the simple, English-like Tektronix *Standard Codes and Formats* guidelines. These commands are easy to remember and use. Each command performs a function, such as opening or closing a specific switch, opening or closing a combination of switches, or opening all switches. For example:

- The command 0CLOSE.F2 A3 . . A6 closes switches A3, A4, A5, and A6 on the second front scanner and opens all other contacts.
- The command OPENALL opens all switches—a useful software panic button. It can also serve as a "warm reset" without clearing sequence buffers.

Two independent programmable timers provide flexible control for sequencing and delay generation, thus offloading these tasks from the system controller.

The TSI 8150 also includes a 24-bit up/down totalizer. The timers and the totalizer can be tied to an extensive trigger system. This connection provides flexible real-time control of scanners. Unlike other scanning systems that have only one trigger, the TSI 8150 mainframe contains 10 general-purpose and three dedicated trigger lines.

Test-system engineers can program individual relays for Make-Before-Break or Break-Before-Make operation. The two capabilities can be mixed on the same card or module.

Signal integrity is maintained by features such as remote mounting of scanners to reduce noise induced in long cable lengths, and a low-noise linear power supply.

Variety of Configurations

The TSI 8150 mainframe can simplify test system configurations by providing connections to the scanners from both the front and rear of the mainframe.

The TSI 8150 mainframe contains mounting slots for instrumentation cards and scanner control assemblies. (Instrumentation cards do not use a scanner control assembly, all other cards and modules do.) Scanner cards and relay driver cards can be mounted either directly on the scanner control assembly, or remotely with an extension ribbon cable. Scanner modules can be mounted either remotely, or on brackets supplied on the front and rear of the TSI mainframe, using different lengths of ribbon cable.

Up to twelve TSS40 Scanner Control Assemblies can be mounted in the mainframe provided the scanner cards are mounted remotely.

When scanner cards are mounted directly on the scanner control assemblies, only six such combinations will fit in each mainframe. The same six-card restriction applies to full-size instrument cards. This restriction is because of the component clearances needed. (Instrument cards and scanner cards can be intermixed in a mainframe.) A cableway in the bottom of the mainframe allows convenient routing of cables between the front and rear of the system.

Remote mounting is available for a variety of configurations. To maximize signal integrity, the user can place scanner modules in the TSA 8140 Test System Adapter, close to the DUT itself. The user can also rackmount scanner and switch cards in the 016-0861-00 Auxiliary Card Rack and modules in the 016-0862-00 Auxiliary High Frequency Mounting Unit. These units can be placed anywhere in the test system up to 12 meters (40 feet) from the TSS40 Scanner Control Assemblies.

CHARACTERISTICS

TOTALIZER

General—Programmable gate, preload, reset, and source select. Can send SRQ on underflow/overflow.
Maximum Count—16,777,215 (24 bits).
Minimum Pulse Width—250 ns.
Maximum Repetition Rate—1 kHz.

TIMER

General—Two independent pulse generators, source and destinations are trigger lines; programmable source, destination, period, width, delay, burst pulse count, and gate; can generate an SRQ at end of last pulse count.
Resolution—10 ms.
Delay Accuracy—0.01% +10, −0 ms.
Period, Width Accuracy—0.01% +100, −0 μs.
Minimum Period—20 ms.
Maximum Delay, Period, Width—655.35 s.
Maximum Burst Count—66535 or continuous.
Input/Output—TTL-compatible.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	483	19.0
Height	264	10.4
Depth	641	25.3
Weight ≈	**kg**	**lb**
Net	23.9	52.5
Shipping	35.4	78.0

POWER REQUIREMENTS

Line Voltage Ranges—100, 110, 120, 200, 220, or 240 V ±10%.
Line Frequency—48 to 66 Hz.
Maximum Power Consumption—525 W (567 V A).

ENVIRONMENTAL

Ambient Temperature—Operating: 0 to +50 °C. Nonoperating: −40 to +75 °C.

For ordering information, see page 436.

TSX 8140

Expansion Chassis

- **Doubles TSI 8150 Channel Capacity**
- **Has Same High-Quality Power Supply as TSI 8150 Mainframe**
- **Same Scanner Options as the TSI Mainframe**

TSI 8150 users can now double their channel scanning capacity, while retaining single mainframe control. The TSX 8140 Expansion Chassis uses the same main interconnect as the TSI 8150 Mainframe, and can accommodate the same number of scanners. Another plus of the TSX 8140 is that twice as many channels can be controlled from a single GPIB address. Besides saving a bus address, this simplifies control and programming.

Control for the TSX 8140 is provided by the TSI 8150 mainframe. One TSX 8140 can be connected to each TSI 8150. To ensure adequate power for a maximum number of channels, the TSX 8140 has its own built-in power supply; the same high-quality, low-noise linear supply used in the mainframe.

Using the TSX 8140, a switching system can be configured with as many as 720 channels, using 016-0861-00 Auxiliary Card Racks and TSS42 General-Purpose Scanners, up to 768 channels of matrix switching, or up to 576 Coax, RF, or Microwave channels using 016-0862-00 Auxiliary Mounting Units.

TSA 8140

Test System Adapter

- **Configurable Top Panel for Dedicated Applications**
- **Optional Test Head Receiver, Allowing Easy Interfacing to a Wide Range of Devices Under Test**
- **Interchangeable Test Adapters Provide for Custom Interfacing (Hybrids, Components, etc.) plus Commercially Available Bed-of-Nails Test Heads**
- **Accepts the Entire TSI 8150 Family of Scanners to Maintain Signal Integrity by Minimizing Cable Lengths**
- **Rugged Steel Construction for Low-Frequency Noise Shielding**

Complete Link to Your DUT

The TSA 8140 Test System Adapter provides system builders with the direct link between the device under test (DUT) and the test system.

One-of-a-kind DUT interface designs are often expensive to build, inadequately documented, and difficult to service. When the original system builders change jobs, they take their design concepts with them. Another problem is that one-of-a-kind designs are difficult (or impossible) to adapt to changing test system needs.

Using the TSA 8140's commercially available test heads cuts DUT adapter development time and materials costs.

The TSA 8140 ensures excellent signal integrity by allowing system builders to place switching and custom signal conditioning circuits very near the DUT. Steel construction shields test circuits from low-frequency magnetic fields.

The removable top panel allows system builders to configure the TSA 8140 for a dedicated application.

The TSA 8140 can be mounted horizontally or vertically. In either configuration, rack slide rails can be added with the TSAF01 Rack Mounting kit.

For visual inspection of hybrid integrated circuits with a microscope, or other situations where a level stand is needed, the TSA F02 converts the TSA 8140 work surface from its normal slant to a level attitude.

For quick and easy DUT interconnections, the 021-0435-00 Test Head Receiver is used with TSA F09 and TSA F10 Quick Connect assemblies and 021-0434-00 and 021-0436-00 Interchangeable Test Adapter (ITA) assemblies. The TSA F09 Universal Low Frequency Quick Connect provides a connection from any one TSS4x scanner card, relay driver card, or TSD42 interface card. The TSA F10 LowFrequency Quick Connect provides connections from any two such cards to the DUT, but is optimized for use with the TSS42 General-Purpose Scanner card.

The TSA F11 High-Frequency Quick Connect and 021-0441-00 ITA provide the same quick and easy DUT interconnection capability for TSS44 and TSS45 scanner modules.

The TSA 8140 Test System Adapter is also compatible with Virginia Panel Corporation's 3200 Series test heads.

A Member of the TSI Family

The TSA 8140 is a fully compatible member of the Tektronix TSI 8150 Test System Interface family. By using Auxiliary Card Racks and Auxiliary Mounting Units, the TSI scanner cards and modules can be mounted right inside the TSA 8140 for maximum shielding. Scanner modules can also be mounted on the optional 021-0435-00 Test Head Receiver.

PHYSICAL CHARACTERISTICS

	TSA 8140	
Dimensions	**mm**	**in.**
Width	558	22.0
Height (front)	115	4.5
(back)	222	8.8
Depth	470	18.5
Weight ≈	**kg**	**lb**
Net	11.8	26.0
Shipping	14.0	31.0

PHYSICAL CHARACTERISTICS

	Test Head Receiver		Full Size Interchangeable Test Adapter		Half Size Interchangeable Test Adapter	
Dimensions	**mm**	**in.**	**mm*1**	**in.**	**mm*1**	**in.**
Width	597	23.5	450	17.7	450	17.7
Height	121	4.8	376	14.8	182	7.2
Depth	419	16.5	46*2	1.8	46*2	1.8

*1 *Usable area, top panel.*
*2 *Inside depth.*

For ordering information, see page 436.

AUXILIARY CARD RACK, AUXILIARY HIGH FREQUENCY MOUNTING UNIT

- **Fit into Standard 19 Inch Racks for Convenient Placement**
- **Accept Up to 12 Scanner Cards (Card Racks) or 6 Scanner Modules (HF Mounting Units)**
- **Can be Mounted in a Vertically or Horizontally Configured TSA 8140 Test System Adapter for Greater Flexibility**

Remote Location

In large ATE systems, system builders must sometimes distribute switching functions: some switches near the DUT, some near the stimulus instruments, and some near the measurement instruments. The Auxiliary Card Rack (016-0861-00) and the Auxiliary High Frequency Mounting Unit (016-0862-00) solve this problem by providing the hardware that system builders need to physically mount scanners in remote locations. The TSI 8150 mainframe provides the power and control for remotely mounted scanner cards and modules.

The 016-0861-00 and 016-0862-00 can be placed in standard 19 inch racks. They can be attached to either the front or back of a standard rack cabinet.

The 016-0861-00 accepts all TSI 8150 family scanner cards or relay driver cards, and can be placed in the back of a horizontally mounted TSA 8140 Test System Adapter. Two can be placed in the back of a vertically mounted TSA 8140.

The 016-0862-00 accepts all TSI 8150 family scanner modules. One 016-0862-00 can be mounted inside the TSA 8140.

PHYSICAL CHARACTERISTICS

	016-0861-00 Auxiliary Card Rack		016-0862-00 Auxiliary High Frequency Mounting Unit	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	483	19.0	483	19.0
Height	178	7.0	222	8.8
Depth	267	10.5	86	3.4
Weights ≈	**kg**	**lb**	**kg**	**lb**
Net	4.8	10.5	2.3	5.0
Shipping	5.5	12.0	2.7	6.0

For ordering information, see page 436.

TSS40

Scanner Control Assembly

- **Real Time Control of Up to 32 Switches for a Variety of Operations**
- **Storage of Up to 500 Test Steps for Higher System Throughput**
- **Programmable Trigger Sources for Flexible System Timing Coordination**
- **Switch Programming for Make-Before-Break or Break-Before-Make Switch Control**
- **Low Cost 32-Bit Output and 5-Bit Input Interface**

Intelligent Control of Switches

The TSS40 Scanner Control Assembly simplifies the system builder's task of controlling switches. In the Tektronix TSI 8150 family of scanners, each TSS40 controls one scanner card or up to two modules of the same type.

Switch control can be immediate or stored by use of either scan or sequence mode. In the immediate mode, commands from the host GPIB controller directly program the switches. In the stored mode, the switches can be scanned one relay at a time or a sequence of up to 500 steps can be preprogrammed. With this buffer, the sequence can open or close more than one switch with each step.

In either storage mode, a single command or one of 12 hardware triggers can increment the test sequence. The *output latch* provides a TTL latched output to drive the scanners. In the immediate or stored modes, TSI 8150 mainframe hardware synchronizes all switch state changes at each step. A single command can change the state of up to 768 switches.

The *control section* performs timing functions, senses the scanner type that the TSS40 is controlling, and provides programmable make-before-break or break-before-make control. The *trigger-line* select block is a programmable matrix that selects the lines that will trigger the TSS40.

Though designed to control scanners in the TSI 8150 family, the TSS40 can be used in a variety of special applications. In standalone applications, the TSS40 provides a TTL-compatible, 32-bit digital output and a 5-bit digital input interface. Typical applications are 32-bit pattern generation and reading an encoded word on interchangeable test heads (to assure installation of the proper test head).

Ready and Sequence-Done Outputs

The TSS40 includes two program maskable output signals. Both are wire ORed with the outputs of other scanner control assemblies.

The *ready* line signals a change in the switch pattern and then starts a timer preset for the switch closure and bounce time. After the preset time has passed, the Ready line signals the establishment of a new path. The *sequence-done* line signals completion of the last pattern in the switch storage buffer.

Configuration Check

At power-up, the TSS40 reads a relay code from the scanner card or module(s) that it controls. From this code, the TSS40 checks an internal table to determine the switch settling time and card configuration. When driving custom relays, the user can program the TSS40 with the switch settling time.

CHARACTERISTICS

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	35	1.4
Height	177	7.0
Depth	442	17.4
Weight ≈	**kg**	**lb**
Net	0.5	1.1
Shipping	1.0	2.2

ENVIRONMENTAL

Ambient Temperature—Operating: 0 to +50°C. Nonoperating: −40 to +75°C.

POWER REQUIREMENTS

The TSI 8150 mainframe or the TSX 8140 Expansion Chassis provides power to the TSS40.

For ordering information, see page 436.

TSD42

Digital Interface

- **Low Cost Digital Input/Output**
- **12 WPS Input/1K WPS Output**
- **Input and Output Latches**
- **All Signal Lines Protected**

General-Purpose, 32-Bit Digital Interface

The TSD42 can be used to interface other TSI 8150 system components to the DUT. The card provides 32 parallel non-isolated TTL input lines and 32 parallel non-isolated output lines. All signal lines have transient protection networks to prevent card damage when operated in adverse environments.

The 32-bit output port of a TSS40 Scanner Control Assembly provides the output data, in either immediate mode or from pre-stored patterns in the 500-step scanner sequence buffer. The input word is multiplexed and read through the TSS40's "relay type" input.

Control for the TSD42 is provided by a TSS40 mounted in a TSI 8150 Mainframe or TSX 8140 Expansion Chassis. The TSD42 can be mounted on the TSS40, or externally connected by a ribbon cable up to 12-meters long.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	35	1.4
Height	178	7.0
Depth	308	12.1
Weights ≈	**kg**	**lb**
Net	0.4	0.8
Shipping	0.5	1.0

TSI FAMILY SCANNER/SWITCH CARDS

The TSI 8150 family of scanner cards are controlled by a TSS40 Scanner Control Assembly mounted in a TSI 8150 Test System Interface mainframe. Each card can be mounted in a TSI 8150 mainframe, or mounted outside and connected to the TSI 8150 mainframe with a ribbon cable assembly, up to 12-meters (40 ft) long.

PHYSICAL CHARACTERISTICS

	TSS41		TSS42/ TSS43/TSS48	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	35	1.4	35	1.4
Height	178	7.0	178	7.0
Depth	308	12.1	308	12.1
Weights ≈	**kg**	**lb**	**kg**	**lb**
Net	0.7	1.5	0.5	1.1
Shipping	0.9	2.0	0.7	1.5

TSS41

Low Level Scanner Card

- **One 1 × 20 or Two 1 × 10 Switch Trees**
- **Multiplexes Signals With Differential Thermal Offset Down to 40 μV (1 μV With Option 01)**
- **Offers Fast Settling Time for High Throughput**
- **Switches High, Low, and Guard**

A Selection of Switch Trees

The TSS41 Low Level Scanner Card answers the system builder's need for multiplexing low level signals. The differential thermal EMF (electromotive force) is ≤40 μV (1 μV with Option 01). In its standard configuration, the TSS41 offers two 1 × 10 switch trees. Moving a jumper creates a 1 × 20 tree. An additional tree switch relay prepares the TSS41 for use in larger multiplexed systems by reducing parasitic capacitance when no channel in the 1 × 20 branch is selected.

The TSS41's ability to simultaneously switch two lines per channel enables the user to drive balanced inputs to DUTs. The guard line isolates capacitance around the signal channels and thereby improves bandwidth.

The standard TSS41 is well suited for applications as diverse as checking balanced transmission lines in audio testing and making transducer measurements in mechanical stress testing. The optional 1 μV differential thermal offset makes the TSS41 especially useful for many transducer measurements and most differential signal test set-ups designed to eliminate common mode problems.

TSI 8150 FAMILY SCANNER CARD SELECTION GUIDE

Features	TSS41	TSS42	TSS43	TSS48
Thermal Offset	Std: <40 μV differential (<80 μV with tree switch); Opt 01: <1 μV (<2 μV with tree switch)	<100 μV	<100 μV	<100 μV
Maximum Switched Current	500 mA dc or peak ac	1.0 A dc or peak ac	10 A dc; 60 A surge for 2 ms 4 mA dc or peak ac*1	1.0 A, dc or peak ac
Maximum Carry Current	1.0 A	2.0 A	10 A 2 A*1	2.0 A (through screw terminals) 1.0 A (through square pin header)
Maximum Switched Voltage	250 V dc or peak ac 175 V RMS	400 V dc or peak ac (250 V Opt 01)	150 V dc 250 V RMS 2000 V*1	400 V dc or peak ac (250 V Opt 01 and 03)
Maximum Switched Power	10 W	50 V A	2000 V A 50 W dc*1	50 W
Dielectric Standoff	300 V RMS, 400 V dc/peak ac	300 V RMS, 400 V dc/peak ac	300 V ac or 400 V dc 2000 V*1	300 V RMS, 400 V dc/peak ac
Settling Time	4 ms	4 ms	51 ms 5 ms*1	4 ms
Switch Life	10^8 @ signal level 10^6 @ rated load	10^9 @ signal level 10^7 @ rated load 10^8 @ signal level*1 10^6 @ rated load*1	3×10^7 mechanical 10^5 @ rated load 1×10^8 mech*1 10^6 @ rated*1	10^9 @ signal level 10^7 @ rated load 10^8 @ signal level*1 10^6 @ rated load*1
Switch Closures	20 3PST (High, low, guard)	30 SPST	10 SPDT 8 SPST*1	30 SPST 32 SPST*2
Channel Resistance	<2 Ω (each wire)	<150 mΩ <250 mΩ*1	<150 mΩ <300 mΩ*1	<150 mΩ <250 mΩ*1
Power Requirements	24 V dc supplied from TSI 8150 mainframe or external source			
Environmental	Operating: 0 to +50°C; Nonoperating: −40 to +75°C			

*1 *Option 01 (and 03 for TSS48).* *2 *Options 02 and 03.*

Board layout optimizes matching of parasitic capacitances of high and low signal paths to provide well balanced quality routing for critical signals.

TSS42

General Purpose Scanner Card

- **30 Cost-Effective Channels for Configuration Flexibility**
- **Bounceless Mercury-Wetted Contacts for Long Switch Life**
- **Consistent Channel Resistance (±20 mΩ Typical) Over Switch Life for Greater Test Reliability**
- **Dry-Reed Version (Option 01)**

A Selection of Switch Trees

The TSS42 General Purpose Scanner Card is a highly configurable, long-life switch assembly. It performs the many routine but essential multiplexing chores that complex test systems require. This versatile card arranges the channels in one group of 1 × 8, four groups of 1 × 4, and three groups of 1 × 2. Each channel is a single wire.

The TSS42 uses long-life mercury-wetted switches, minimizing system down time for switch replacement.

Printed circuit pads near the switches allow users to attach snubber networks for switching inductive loads.

The TSS42's many special features make it suited to a variety of applications. The long life, bounceless operation, consistent channel resistance over switch life and configuration flexibility qualify the TSS42 for many demanding manufacturing ATE test set-ups.

Multiple channels permit such uses as functional board testing. Other special uses include: audio switching; low-current power-supply switching into the DUT; bias-voltage control; and operations such as component testing that require high-repetition, long-life operations.

For users concerned about operating in mercury-prohibited environments or about mechanical positioning, Option 01 offers dry-reed switches in the same switch configuration.

For ordering information, see page 436.

TSS43 Power Switch Card

- **10 Independent Power Channels for Primary and Secondary Power Switching**
- **Transient Suppressors for Switch Protection With Inductive Loads**
- **Switches DC Through 400 Hz for Applying Power to a DUT**
- **High-Power Switch Applications (250 V, 10 A, 2000 V A)**
- **Useful for System Power-Up Sequencing**

A Versatile Power Switch Card

The TSS43 Power-Switch Card provides 10 independent switch lines designed to allow the user to switch primary or secondary supplies to the DUT.

Each channel consists of one normally open (NO) and one normally closed (NC) contact. Transient suppressors are wired between each NO and common and each NC and common. These suppressors protect the contacts when the card switches inductive loads.

The TSS43 can switch up to 10 A or 250 V (RMS), and is useful for switching power to the DUT. The most common use is dc or 60 Hz, but similar applications exist in 400 Hz avionic set-ups.

A special use is switching miscellaneous units such as device handlers, solenoids, and other line-operated fixturing actuators. The TSS43 has a 60-A inrush surge rating, enabling it to switch loads such as a one-quarter horsepower 120 V ac motor.

For high-voltage applications, Option 01 provides 8 Form A (SPST) switches rated to handle 2000 volts each.

For ordering information, see page 436.

TSS48 Matrix Switch Card

- **30 Switches, in Five Rows by Six Columns (Standard and Option 01)**
- **Bounceless Mercury-Wetted Switches for Long Switch Life (Std and Opt 02)**
- **Consistent Channel Resistance (±20 mΩ Typical) Over Switch Life for High Repeatability**
- **Dry-Reed Version (Options 01 and 03)**

A Versatile Matrix Switch Card

The TSS48 Matrix Switch Card is designed to route a variety of signals. Flexibility is provided by the choice of 5×6 (standard and Option 01) or 2×16 (Options 02 and 03) matrix configurations. Each crosspoint is a single wire.

The standard (and Option 02) switches are long-life, mercury-wetted relays. These relays minimize system down-time for switch replacement. Options 01 and 03 substitute dry-reed switches in place of the mercury-wetted contacts. This substitution allows operation in environments that prohibit the use of mercury, or in mechanical position-sensitive applications.

Each switch trace on the printed circuit board includes blank pads. The user may install snubber networks to allow switching inductive loads.

The TSS48's many special features make it suited to a variety of applications. The long life, bounceless operation, consistent channel resistance over the life of the switch, and configuration flexibility qualify the TSS48 for many demanding manufacturing ATE test set-ups.

The large number of channels available supports applications such as functional board testing. Other special uses include: Audio switching; low-current power supply switching to the DUT; bias-voltage control; operations that require high repetition and long-life operations, such as component testing.

Each row and column is connected to two connectors, allowing easy expansion of the matrix in a row dimension, the column dimension, or both dimensions by adding TSS48 cards.

The TSS48 is suited to testing a varied series of DUTs or anywhere a full crossbar matrix is needed. An example application is universal device test systems, which mix stimulus and measurement instruments on the same pins.

For ordering information, see page 436.

Relay-Driver Cards

High-Current Driver Card/60-mA Driver Card

- **Control Up to 24 User-Supplied Relays for Custom Applications**
- **Open Collector, NPN Darlington Drivers**
- **Allow 24 Channels of Control for Solenoids, Actuators, Handlers, and Other Devices**
- **Low-Voltage Detection Circuit Generates Error Message If Power Supply Fails**
- **Blank Prototype Area for User Wiring**
- **Back EMF Diodes for Switching Inductive Loads**

Two Current Driver Cards

The High-Current Driver Card (021-0417-00) and the 60-mA Driver Card (021-0418-00) are functionally identical.

Each driver card provides printed circuit board prototyping features for users who want to interface their own relays into the TSI 8150 Test System Interface family. Uses for these cards include special relays such as optical switches, microwave transfer switches, and picoamp low-current switches.

Other uses include driving dc devices such as air valves, solenoids, handlers, and actuators. These cards provide easy interface of the devices to the General Purpose Interface Bus (GPIB) IEEE Standard 488.

The card's output drivers contain internal diodes that clamp the back EMF generated by a relay-coil opening to the coil supply voltage. Coil voltage for the relays passes through a limiting fuse. The return path connects to chassis ground.

Command Functions Available

All of the TSS40 command functions are available for the driver cards. The configuration command always returns 1 of 24. On the 021-0417-00, multiple switch channels can be closed simultaneously, providing the total current does not exceed 4 A. Other features available on these prototype cards include: sequence storage, break-before-make and make-before-break capability, timing control, and user-programmable bounce timing.

A TSI Family Member

The 021-0417-00 and 021-0418-00 driver cards conveniently interface user-supplied relays and other devices to the TSI 8150 Test System Interface mainframe. The 021-0417-00 switches up to 1 A per channel; the 021-0418-00 switches up to 60 mA per channel.

The driver cards are controlled by a TSS40 Scanner Control Assembly mounted in a TSI 8150 mainframe. The cards can be mounted in the TSI 8150 mainframe, or mounted outside and connected to the TSI 8150 mainframe with a ribbon cable assembly, up to 12-meters (40 ft) long.

PHYSICAL CHARACTERISTICS

	021-0417-00 High-Current Driver Card		021-0418-00 60-mA Driver Card	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	35.6	1.4	35.6	1.4
Height	178	7.0	178	7.0
Depth	307	12.1	307	12.1
Weights ≈	**kg**	**lb**	**kg**	**lb**
Net	0.4	0.8	0.3	0.7
Shipping	0.5	1.0	0.5	1.1

ENVIRONMENTAL

Ambient Temperature—Operating: 0 to +50 °C. Nonoperating: −40 to +75 °C.

For ordering information, see page 436.

TSI-FAMILY SCANNER MODULES

The TSI-Family of scanner modules are controlled by a TSS40 Scanner Control Assembly (SCA) mounted in a TSI 8150 Test System Interface or TSX 8140 Expansion Chassis mainframe. Each module has an expansion connector that allows a second identical module to be controlled by the same TSS40.

The modules can be mounted in a TSI 8150 or TSX 8140, or externally in an Auxiliary Mounting Unit or Test Head Receiver frame. Remote mounting up to 12 meters (40+ feet) from the TSS40 is possible. A 50-conductor ribbon cable assembly provides control from the TSS40 to the module, and from module-to-module when in the extended (two modules controlled by one TSS40) mode of operation.

A control cable, approximately 21-inches long, is included with each module; longer cables are required for external (remote) mounting. Two extended cable accessories are available: part number 198-5581-00 provides six preassembled 2-meter (6+ feet) cables; part number 198-5579-00 is a kit that includes 30.5 meters (100 feet) of ribbon cable and 24 connectors.

300 MHz Probe Scanner

Optional probe scanner accessory kits are available for the TSS44 and TSS45. These kits provide hardware support to let the TSS44 and TSS45 scan P6513 300 MHz, 50-Ohm, 10X probes. With these kits, automated bed-of-nails test fixtures with standard 100 mil spacing, low circuit loading, and high bandwidth can be built.

Each basic Probe/ITA Support Kit (part number 021-0443-00) provides a carrier (mounting) plate for up to twelve P6513 probes, plus a power connector for twelve probes. The Probe/ITA/Power Support Kit (021-0444-00) provides the carrier, power connector, and a power supply that derives probe power from a source in the TSI8150 or TSX8140. Each system must include at least one of the power support kits (021-0444-00). Additional interchangeable fixtures can then be built using the basic ITA kit. Probe carrier plates mount on the 021-0441-00 Extended-Frame ITA.

CHARACTERISTICS

PHYSICAL CHARACTERISTICS

	TSS44		TSS45		TSS46	
Dimensions	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**
Width	74	2.9	74	2.9	74	2.9
Height	184	7.3	184	7.3	184	7.3
Depth	89	3.5	89	3.5	89	3.5
Weights ≈	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
Net	0.5	1.0	0.5	1.0	0.4	1.0
Shipping	0.6	1.4	0.6	1.4	0.6	1.4

TSI 8150-FAMILY SCANNER MODULE SELECTION GUIDE

Features	TSS44	TSS45 (Std.)	TSS45 (Opt 1)	TSS46
Insertion Loss (any port to common)	<0.1 dB at 100 kHz <0.25 dB at 50 MHz <1.0 dB at 200 MHz	<0.75 dB at 800 MHz <1.0 dB at 1.2 GHz <3.0 dB at 2.0 GHz	<0.75 dB at 400 MHz <1.5 dB at 1.0 GHz	<0.1 dB at 3.0 GHz <0.3 dB at 12 GHz <0.5 dB at 18 GHz
Channel Isolation (any port to common)	>80 dB at 100 kHz >45 dB at 50 MHz >40 dB at 200 MHz	>60 dB at 800 MHz >50 dB at 1.2 GHz >40 dB at 2.0 GHz	>60 dB at 700 MHz >50 dB at 1.0 GHz	>90 dB at 3.0 GHz >70 dB at 12 GHz >60 dB at 18 GHz
Crosstalk Isolation (between any two ports with common and all unused ports terminated)	>80 dB at 100 kHz >45 dB at 50 MHz >40 dB at 200 MHz	>60 dB at 800 MHz >40 dB at 1.2 GHz >30 dB at 2.0 GHz	>60 dB at 700 MHz >50 dB at 1.0 GHz	>90 dB at 3.0 GHz >70 dB at 12 GHz >60 dB at 18 GHz
VSWR (any port to common)	<1.05:1 at 100 kHz <1.2:1 at 50 MHz <2.1:1 at 200 MHz	<1.3:1 at 800 MHz <1.5:1 at 1.2 GHz <3.5:1 at 2.0 GHz	<1.5:1 at 400 MHz <2.3:1 at 1.0 GHz	<1.1:1 at 3.0 GHz <1.3:1 at 12 GHz <1.5:1 at 18 GHz
Maximum Switched Current	500 mA dc or peak ac	1.0 A dc or peak ac	1.0 A dc or peak ac	50 mA dc or peak ac
Maximum Switched Voltage	150 V dc or peak ac	24 V dc or peak ac	24 V dc or peak ac	15 V dc or peak ac
Maximum Carry Current	1.0 A			3.0 A
Maximum Switchable Power	10 W (resistive) 200 mW (RF into 50 Ohms)	10 W (RF into 50 Ohms) 5 W (RF into mismatched load)	10 W (RF into 75 Ohms) 5 W (RF into mismatched load)	125 mW (RF into 50 Ohms)
Maximum Carry Power	500 mW (RF into 50 Ohms)	10 W (RF into 50 Ohms) 5 W (RF into mismatched load)	10 W (RF into 75 Ohms) 5 W (RF into mismatched load)	450 W to 100 MHz 200 W to 700 MHz 100 W to 3.5 GHz 50 W to 1.8 GHz (all into 50 Ω)
Dielectric Standoff	250 V dc or peak ac	50 V dc or peak ac	50 V dc or peak ac	50 V dc or peak ac
Switch Life	5×10^7 operations	10^5 operations	10^5 operations	10^6 operations
Settling Time	4 ms	31 ms	31 ms	41 ms
Power Requirements	24 V, from dc coil supply in TSI 8150 mainframe, TSX 8140 expansion chassis, or from external source			
Environmental	Operating: 0 to +50°C; Nonoperating: −40 to +75°C			

TSS44

Coax Scanner Module

- **Two Independent 1×6 Trees**
- **Shield-Common Isolated From Chassis Ground, Preventing Low-Frequency Ground-Loop Problems**
- **High Level of Isolation and Low Crosstalk for Low-Level Measurements**
- **BNC Connectors for Easy and Economical Interconnections**

A Versatile Coax Scanner Module

The TSS44 Coax Scanner Module multiplexes moderate bandwidth signals through shielded conductors.

The TSS44 uses coaxially shielded relays arranged in two 1×6 trees. Each channel consists of one switched signal wire and an unswitched shield that is common to the other shields in the same tree.

To eliminate low-frequency ground loops, the shield common is isolated from chassis ground.

For ordering information, see page 436.

NEW TSS45

RF Scanner Module

- **Two independent 1×6 Binary Switch Trees (standard and Option 01)**
- **Choice of 50-Ohm or 75-Ohm Switching Environments, for ATE, Data Acquisition or Video Switching**
- **Wide Bandwidth for TDR and Communication Frequency Tests**
- **Back-Termination Available (Option 02)**

A High-Performance RF Scanner

The TSS45 RF Scanner Module provides 6-to-1 multiplexing of VHF/UHF signals in either 50-ohm or 75-ohm environments. Two independent 1×6 trees contain the switches. Each channel consists of a switched center-conductor, and an unswitched shield that is common to the other shields and chassis ground.

The binary tree switching technique used allows selection of only one channel at a time in each tree. This eliminates unterminated stubs and equalizes path lengths through all channels.

In the Standard and Option 01 units, both switch trees include a port (A TERM, B TERM) that can be used to terminate the Commons (A COM, B COM) when no switch is selected. The A TERM connector can also be jumpered to B COM to form a 1×12 switch tree with reduced specifications.

Option 02, available only with 50-ohm switches, provides eight back-terminated channels, arranged in two 1×4 switch trees. A similar binary switching method is used, with the switch contacts arranged so the signal lines are terminated in 50 Ohms when not selected. The terminators do not affect switch specifications or performance when the signal line is connected. The TERM port for terminating the Commons is not available with this option.

The TSS45 can be used in areas such as: Time-domain and frequency-domain testing across the UHF range; Frequency-domain device testing without switch characterization in the HF and VHF ranges; Routing single-ended logic signals (for example, in GaAs testing); Testing general communications equipment; video distribution and routing of video test signals (75-ohm option).

For ordering information, see page 436.

TSS46

Microwave Scanner Module

- **18 GHz Bandwidth (−0.5 dB) for Microwave Test Setups**
- **Two Independent 1×6 Switch Trees**
- **SMA Connectors for Attaching Flexible and Semi-Rigid Coaxial Signal Paths**
- **Back-Terminated Option Available**

A Wide-Bandwidth Microwave Scanner

The TSS46 Microwave Scanner Module provides an extremely wide bandwidth (18 GHz), with flat frequency response. These attributes allow use in systems with reduced bandwidth requirements without concern for insertion loss or risetime degradation.

The TSS46 is matched for use in 50-ohm environments. Each module contains two independent 1×6 switch trees. Each channel consists of a switched center-conductor and an unswitched shield that is common to the other shields and to chassis ground.

The TSS46 allows more than one channel in a switch tree to be connected to Common at a time. Any two channels in a tree can be closed concurrently with a 100% duty factor.

An option provides back-termination for all twelve channels. The switch contacts are arranged so that each signal line is automatically terminated in 50 Ohms when its switch is open. Switch performance and specifications are not affected when the switch is closed.

The TSS46 is useful in applications such as: UHF and low-end microwave testing without switch characterization; Multiplexing of TDR tests for hybrid, stripline, microstrip, and controlled-impedance testing; broadband parametric testing that requires two switches to be closed concurrently.

TSI-FAMILY INSTRUMENTATION CARDS

TSI 8150 instrumentation cards are designed to operate with other TSI-family components or by themselves. They add functionality and convenience to an ever-expanding product family. Future additions will move the product line toward complete "instrument-on-a-card" modularity.

These full-size cards operate without a TSS40 Scanner Control Assembly; all operational control and power is taken directly from the TSI 8150. The cards mount only in TSI 8150 mainframe main interconnect mounting slots, not in the TSX 8140 Expansion Chassis nor any Auxiliary Card Rack. The cards can be mounted in either the front or rear Main Interconnect board.

Up to six of these cards can be mounted in a single TSI mainframe. They can be intermixed with TSS40 and scanner card/module combinations in a mainframe. All TSI instrumentation cards require TSI 8150 firmware version 3.0 or later.

PHYSICAL CHARACTERISTICS

	TSD20, TSM20		TST20, TSAS22, TSDM20	
Dimension	**mm**	**in.**	**mm**	**in.**
Width	36	1.4	36	1.4
Height	178	7.0	178	7.0
Length	414	16	414	16
Weight	**kg**	**lb**	**kg**	**lb**
Net	0.75	1.5	0.93	2.1

NEW TSAD22

8-Input Analog-to-Digital Converter

- **12-Bit Vertical Resolution**
- **Up to 100 kS/s Digitizing Rate**
- **Separate Track/Hold Amplifier for Each Channel**
- **32K Words Data Memory On-Board**

The TSAD22 is an 8-input, 12-bit analog-to-digital converter function card for the TSI 8150. The inputs can be configured as 8 single-ended channels or 4 differential channels. Throughput is 100 kS/s (10 μS/point) or 80 μS for all eight channels.

Each channel features a separate Track/Hold amplifier; this permits time-coincident or sequential acquisition of multiple inputs. In the time-coincident, or parallel mode, all selected channels are sampled at the same time, then converted in order. In the sequential mode,

each measurement trigger initiates a conversion on a single channel, and advances a channel counter to the next trigger event. The maximum sequence length in the sequential mode is 8 channels.

The TSAD22 can be triggered from any of the TSI 8150's internal trigger lines, or from the Line Frequency signal. Multiple trigger sources can be assigned to provide dual time base and event marking capability.

Two signal monitor outputs are available. Each monitor channel can select a normalized (±3 V full-scale) representation of any of the 8 inputs. The monitor can drive 330-ohm or greater loads.

The TSAD22 includes 32K words of onboard data storage memory. Data can also be directed to the TSI 8150's internal high-speed bus and stored in the TSM20 Memory Assembly.

CHARACTERISTICS

Number of Input Channels—8 single-ended, ground-referenced; 4 differential.
Ranges and Resolution—

Full-Scale	Resolution (1 LSB)
±0.4096V	200 μV
±4.096V	2.0 mV
±40.96V	20.0 mV
±409.6V	200 mV

Maximum Safe Input Voltage—500 V dc.
Input Impedance—1 MΩ ±1%, shunted by 27 pF ±10%.
Throughput Rate—100 KS/s; 10 μs conv.
Accuracy—DC: <±0.05%; AC: <±0.4% @20 kHz.
CMRR, Differential Mode—>66 dB @1 kHz; >60 dB @10 kHz.

NEW TSDM20

Digital Multimeter Assembly

- **AC/DC Voltage and Current, dB, 2-wire and 4-wire Ohms**
- **Programmable Math Operations**
- **6.5-Digit Resolution**
- **Free Running or Triggered**

The TSDM20 Digital Multimeter Assembly provides high-resolution measurement capability in the TSI 8150 package. DMM measurement functions include: AC and DC Voltage, AC and DC Current, dB, and 2-wire and 4-wire Ohms. All AC functions are true RMS. In addition, the TSDM20 can perform math operations such as: MX +B, Hi/LO/PASS limits testing, and software averaging. Maximum resolution is 6.5 digits.

All measurement functions, math operations, and operating parameters such as zero ohms, dB offset, and reading rate/resolution can be initiated by immediate mode commands or under program control. Readings are available over the GPIB when complete, or can be stored in an on-board, 100-reading buffer.

The TSDM20 will operate in a free-running mode, or will take readings only on command or when triggered by a line in the TSI 8150's internal Trigger Bus. The TSDM20 can also generate a trigger or an SRQ when its reading is complete.

All calibration, except AC Compensation, is done with software calibration constants.

CHARACTERISTICS

DC VOLTAGE MEASUREMENTS

Accuracy (90-day, 6.5 digit, +18° to +28°C)*1
300 mV Range: ± (.005% of reading +20 counts)*2
3 V Range: ± (0.003% of reading +20 counts)
30 V Range: ± (0.006% of reading +20 counts)
300 V Range: ±(0.009% of reading +20 counts)
CMRR—>120 dB at DC, 50 Hz, or 60 Hz, (±0.05%)
NMRR—>60 dB at 50 Hz, or 60 Hz (±0.05%)
Analog Setting Time—<1 msec (<2 msec on 300 mV range), to 0.01% of Step change
Maximum Resolution—0.1 μV.
Input Resistance—
300 mV Range: > 1 GΩ.
3 V Range: >1 GΩ.
30 V Range: 11 MΩ.
300 V Range: 10.1 MΩ.

*1 *For 5.5-digit accuracy, divide 6.5-digit count error by 10; for 4.5-digit accuracy, count error is 5 (except 15 on 300 mV range); for 3.5-digit accuracy, count error is 5. 24-hour and 1-year specifications available from factory.*
*2 *When properly zeroed.*

AC VOLTAGE MEASUREMENTS

Accuracy All Ranges (1-year, 5.5 digit, +18° to +28°C)*1.
20 Hz to 50 Hz: ±(2% of reading +100 counts)
50 Hz to 200 Hz: ± 0.3% of reading +100 counts).
200 Hz to 10 kHz: ± (0.15% of reading +100 counts).
10 kHz to 20 kHz: ±(0.4% of reading +200 counts).
20 kHz to 100 kHz: ±(1.5% of reading +300 counts)*2.
Maximum Resolution—1 μV.
Input Impedance—
HI to LO: 1 MΩ shunted by <120 pF.
LO to GND: >1 GΩ paralleled by <400 pF.
CMRR—>60 dB at 50 Hz or 60 Hz (±0.05%).
Settling Time—1 second to within 0.1% of change in reading.

*1 *For 4.5-digit accuracy, divide 5.5-digit count error by 10; for 3.5 and 4.5-digit modes, specifications apply for input >200 Hz.*
*2 *Specification for 300 mV range is ± (2% of reading +300 counts).*

dB (AC VOLTAGE) MEASUREMENTS

Accuracy (1-year, +18° to +28°C)—
−34 to +49 dB
20 Hz to 20 kHz: ±0.2 dB
20 kHz to 100 kHz: ±0.4 dB
−54 to −34 dB
20 Hz to 20 kHz: ±1.1 dB
20 kHz to 100 kHz: ±3 dB (typical).

OHMS MEASUREMENTS

Accuracy (6.5 digit, 90-day, +18° to +28°C)*1—
300 Ω Range: ±(0.008% of reading +20 counts)*2.
3 k/30 kΩ Ranges: ± (0.005% of reading +20 counts).
300 k/3 MΩ Ranges: ± (0.02% of reading +20 counts).
30 MΩ Range: ± (0.1% of reading +50 counts).
300 MΩ Range: ±2.0% of reading +5 counts)*3.
Open Circuit voltage—≤5.5 V.
Maximum Resolution—100 μΩ.

*1 *For 5.5-digit accuracy, divide count error by 10; for 4.5-digit accuracy, count error is 5 (except 15 on 300 Ω range); for 3.5-digit accuracy count error is 5. 24-hour, 1-year, and other temperature range specifications available from factory.*
*2 *When properly zeroed.*
*3 *Resolution limited to 5.5 digits.*

DC CURRENT

Accuracy (5.5 digit, 1-year, +18° to +28°C)*1—
300 μA Range: ± (0.09% of reading +20 counts).
3 mA/30 mA/300 mA Ranges: ±(0.05% of reading +10 counts).
3 A Range: ± (0.09% of reading +10 counts).
Maximum Resolution—1 nA.

*1 *For 4.5-digit error is 20 counts; 3.5-digit error is 5 counts.*

AC CURRENT

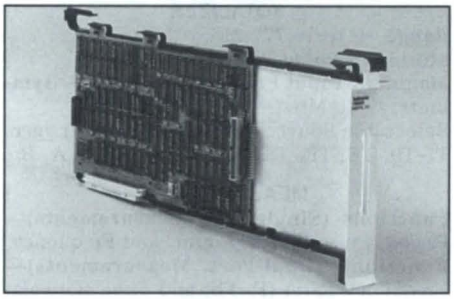
Accuracy (5.5-digit, 1-year, +18° to +28°C)*1—
3 mA/30 mA/300 mA/3A Ranges
20 to 45 Hz: ±(2.0% of reading +100 counts).
45 Hz to 10 kHz: ± (0.6% of reading +100 counts).
300 μA Range
20 to 45 Hz: ± (2.0% of reading +100 counts).
45 Hz to 1 kHz: ±(0.9% of reading +100 counts).
1 kHz to 10 kHz: ±(4.0% of reading +100 counts).
Maximum Resolution—1 nA.
Setting Time—
1 second within 0.1% of change in reading.

*1 *For sinewave inputs >2000 counts; for 4.5-digit accuracy, divide count error by 10; for 3.5-digit accuracy, count error is 5; for 4.5-digit and 3.5-digit modes, specifications apply for sineave inputs >200 Hz.*

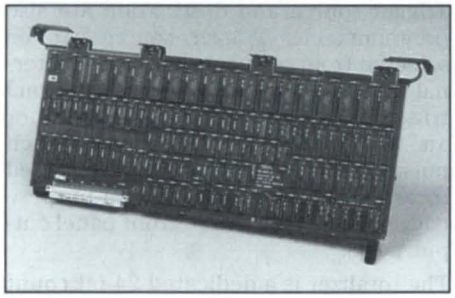
MISCELLANEOUS

Maximum Reading (6.5-digit)—3029999.
Warm-up Time—2 hours to rated accuracy.
Maximum Input Voltage—
HI to LO: 300 V RMS (425 V peak), or 10^7 V-Hz product, whichever is less.
Any Input to GND: 350 V peak ac + dc, or 5×10^5 V-Hz product, whichever is less
LO to AMPS: 3A, 250 V.

For ordering information, see page 436.



TSD20



TSM20

NEW TSD20

Digital I/O Assembly

- **Dual 16-Bit Bidirectional Ports**
- **I/O at Up to 2 MHz**
- **Synchronous or Asynchronous Data Transfer**
- **Static/Dynamic Magnitude Comparisons**

Digital I/O Interfaces TSI 8150 to DUT

The TSD20 Digital I/O Assembly interfaces other TSI 8150 components or other GPIB components to the Device Under Test (DUT). TTL logic levels are used. The card has two ports; each port provides 16 data input/output lines, plus two handshake lines, control signals, and power. The two ports have separate handshake lines, and can be individually set to input or output data.

The TSD20 acts as a GPIB input or output through the TSI 8150 local controller's data bus. The local controller data bus also provides access to cards being controlled by the TSI. The TSD20 interfaces to other TSI components (such as the TSM20 Memory card) through the TSI 8150's internal High-Speed (HS) bus.

Data transfers through the TSD20 can be asynchronous using the handshake lines, synchronous using the TSI 8150 trigger bus, or through GPIB commands.

The TSD20 can do magnitude comparisons in which input or output values on Port A are compared to a reference value. The compare functions available can then generate a trigger pulse or an SRQ when the condition becomes true. This feature can be used to place the TSI 8150 into a Stop state, in which TSI operation is suspended.

Compare values can be static, constants that do not change over time, or they can be dynamic, changing with each Port A value. Dynamic compare values are loaded from a TSM20 Memory card over the TSI 8150's internal HS bus.

One or two compare values can be used. Two compare values can create a window, in which a Port A value is compared against upper and lower limits.

The TSD20 has a space allocated to accept signal conditioning cards. Specialty interfaces, or "personality modules," can be developed for this purpose.

The TSD20 Digital I/O Assembly is useful in applications such as: Providing a digital stimulus to the DUT; Comparing digital data coming from the DUT (at speeds up to 2 MHz); Comparing digital data with long record lengths (in conjunction with the TSM20 Digital Memory card); Sending digital data over a high-speed data link to a computer (using a personality card).

CHARACTERISTICS

Number of Data I/O Lines—32 bidirectional (two 16-bit ports); signal direction determined by PORT command.
Data Transmission Mode—Synchronous or asynchronous.
Data Transmission Rate—2 MHz maximum (for 16 bits) using both TSI 8150 internal HS channels; 1 MHz maximum using one HS channel.
Comparator Functions (Port A)—
Single Value: $<$, $>$, $=$, $<>$ (not equal), $\leq$ (less than or equal), $\geq$ (greater than or equal).
Two Values: $\leq/\geq$ (out of window, exclusive); $\leq/\geq$ (out of window, inclusive).
Comparator Outputs—Trigger to internal bus or SRQ to GPIB.
Logic Levels, Data Input—Logic 1: >2.0 V; Logic 0: <0.8 V.
Logic Levels, Data Output—Logic 1: 2.7 V to 3.4 V; Logic 0: <0.5 V.

NEW TSM20

Memory Assembly

- **256K×16-Bit Words of Fast (2 MHz) Static Memory Per Card**
- **Read or Write Access From TSI 8150 Internal High-Speed Bus or Over GPIB**
- **Auto-Chaining for Ease in Adding More Memory**
- **Supports Two Open Files at Same Time**

Add-on Memory Card for TSI Components

The TSM20 Memory Card operates over the TSI 8150's internal high-speed bus (HSBUS) with other cards in the TSI product line. Users can also read to or write from the memory card over the GPIB, via the TSI 8150's local controller. Its primary use, however, is as additional memory for other TSI 8150 components, such as the TSAD22 Analog-to-Digital Converter, and the TSD20 Digital I/O Assembly.

Each TSM20 Memory card has 256K words ×16 bits of high-speed (2 MHz) static memory. Up to 120 files can be defined in each memory card's directory, but the total space used by all the defined files cannot exceed the 256K words available.

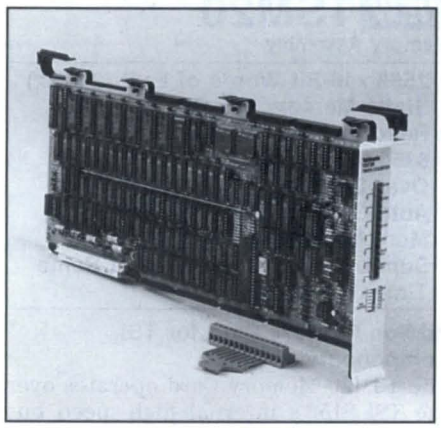
The memory card can have two files open simultaneously, each running at 1 MHz. (In order to run at 2 MHz, only one file can be open.) The files are referred to as the ODD channel and EVEN channel files. The files can be made cyclic (to operate as a circular buffer).

If more than 256K words are needed, additional memory cards can be inserted into the same TSI main interconnect board and chained. All memory in the same main interconnect board appears to reside in the same slot. This allows the two possible open files to run independently across card boundaries and to be cyclic. Firmware keeps track of the addressing, freeing the user from keeping track of multiple directories.

CHARACTERISTICS

Memory Size—256K ×16 bits.
Data Word Transfer Rate (Over TSI 8150 Internal HSBUS)—2 MHz for one open file; 1 MHz for two open files.

For ordering information, see page 436.



TST20

NEW TST20

Timer/Counter Assembly

- **Five Independent Programmable Timing Generators**
- **Programmable 24-Bit Up/Down Totalizer**
- **Period, Frequency, Frequency Ratio, Pulse Width, and Time Between Events Measurements**
- **Up to 15 Triggering Sources for Each Timing Generator**

A Versatile Timing Generation and Measurement Device

The TST20 augments the timing generation and measurement capabilities of the TSI 8150's local controller. Timing generation allows control of operations within the TSI 8150 main chassis, as well as triggering external devices, without direct supervision of the system controller. A totalizer provides up/down counting of events that occur internal or external to the unit. The TST20 also provides the means for measuring time parameters of internal and external signals, and elapsed time from one event to another.

The TST20 Timer/Counter Assembly is useful in applications such as: Providing timing generation and universal timer/counter measurements in functional board test; Providing precise timing pulses for triggering other instrument cards in the TSI 8150.

The five independent, identical timing generators provide pacing clocks or delay timing for use within the TSI 8150, or elsewhere in the test system. Each generator allows programmable period, pulse width, delay, and burst count parameters.

Trigger source and destination are also programmable. Trigger source can be selected from ten general-purpose internal trigger lines, two dedicated internal trigger lines, two analog trigger inputs, or an immediate mode command. Each pulse generator's output can be assigned to any one of the ten general-purpose trigger lines, or to TST20 front panel output ports.

The totalizer is a dedicated 24-bit count chain. Separate inputs for up and down counting are program-selectable. Commands allow presetting or clearing the counter at any time. An SRQ can be generated over the GPIB (command maskable) on detection of counter overflow or underflow.

Time measurements can be made for: Period, Frequency, Frequency Ratio, Pulse Width, and Time Between Events. The measured parameter is command-selectable. The input command source is program-selectable from the internal trigger lines or the external analog inputs. The measurement slope (for Width and Time Between Events) is also programmable.

Two analog inputs are available to use as trigger sources into the TST20. Threshold Level and Slope are programmable.

CHARACTERISTICS

TIMING GENERATOR

Number of Timing Generators—5.
Timing Resolution—100 nsec, 1 μsec, 10 μsec, or 100 μsec (selected automatically).
Time Base Accuracy—±0.01%.
Selectable Destination—TSI 8150 internal trigger lines T1–T9 and TE; External Output.
Burst—1-65535, or continuous.

TOTALIZER

Range—0 to 16,777,215.
Minimum Pulse Width—250 nsec.
Maximum Input Frequency (with 50% Symmetry)—10 MHz
Selectable Source—TSI 8150 internal triggers T1–T9, TE, TR, TS, TG; analog inputs A, B.

MEASUREMENT

Functions (Single-Port Measurements)—Period, Pulse Width, Count, and Frequency.
Functions (Dual-Port Measurements)—Frequency Ratio (Fa/Fb) and Time Between Events (Time A→B).
Number of Digits—6.
Frequency Range—Dc to 10 MHz.
Accuracy—
Analog Input Measurements: ±100 nsec.
Trigger Bus Measurements: ±100 nsec.
(Add 600 nsec for each rising edge).
Minimum Trigger Pulse Width—100 nsec.
Measurement Range—100 nsec to 4.194 sec.
Resolution—100 nsec.
Selectable Source—TSI 8150 internal triggers T1–T9, TE, TR, TS, TG; analog inputs A, B.

MISCELLANEOUS

Analog Input Level:
Range—Programmable, −3.0 V to +3.0 V.
Resolution—50 mV.
Sensitivity—150 mV peak-to-peak.
Accuracy—±60 mV.
Input Impedance—Selectable; 1 MΩ shunted by 20 pF (typical), or 50 Ω.
Maximum Input Voltage—200 V peak from dc to 50 kHz; 400 V peak-to-peak, linearly derated to 15 V peak-to-peak, from 50 kHz to 2 MHz.
External Outputs A, B, C, D, E:
Logic Levels—Logic "0" = <0.4 V, logic "1" = >2.4 V (logic switch set to TTL; with logic switch set to Open Collector, external pull-up resistors can be connected with voltages not to exceed +24 V).
Maximum OFF Voltage—24 V.
Drive—One standard TTL load.
Maximum Low-Level Sink Current—50 mA.

For ordering information see page 436.

Programmable Ranges*[1]—

PERIOD	WIDTH	DELAY
0.5 – 6553 μS	0.3 – 6553 μS	0.3 – 6553 μS ±0.1 μS
6.553 – 65.53 mS	6.553 – 65.53 mS	6.553 – 65.53 mS ±1 μS
65.53 – 655.3 mS	65.53 – 655.3 mS	65.53 – 655.3 mS ±10 μS
655.3 – 6553 mS	655.3 – 6553 mS	655.3 – 6553 mS ±100 μS

*[1] *NOTE: PERIOD is the pulse generator output time from pulse to pulse. WIDTH is the time the pulse generator output is active during each period. DELAY is the time from receipt of the source trigger to initiation of the first pulse. Output is active low.*

NEW TSI 8155

Test System Interface Package

- **Standard Switching for DMMs, Power Supplies, Oscilloscopes, Counters, Signal Sources, and All Signals to 2 MHz**
- **Package options provide switching and configuration for coaxial, RF, and Microwave signals to 18 GHz**

Flexible Package Makes Building Test Systems Easier

The TSI 8155 Test System Interface Package is a collection of TSI 8150-family hardware, selected to simplify the job of building a test system. The TSI 8155 package by itself can provide a complete test interface and fixturing solution; its "add-on" flexiblity serves a wider variety of testing applications.

The package is based on the TSI 8150 Test System Interface. Standard hardware includes switch cards, auxiliary mounting units, a test system adapter, interchangeable test adapters, plus all the cables and connectors needed to complete the interface. The basic package provides DMM switching, power supply switching, and general-purpose switching. Tree and matrix switching are supported for both stimulus and measurement.

Options are available for adding high-frequency switching up to 18 GHz. The switches are mounted right in the TSA 8140 Test System Adapter, using the 016-0862-00 Auxiliary Mounting Unit. This provides a benefit unique to Tek and the TSI 8150; switching right at or very near the DUT. The reduced cable lengths to the DUT, plus the additional shielding of the TSA 8140, yields a major improvement in signal integrity.

Deluxe coaxial and RF option kits enhance signal integrity and convenience even more; switches are mounted in a 021-0435-00 Test Head Receiver, then interfaced to the DUT with a TSA F11 High-Frequency Quick Connect. This eliminates one set of connectors and some cabling.

The DMM, power supply, and general-purpose switches are remote-mounted too, using the 016-0861-00 Auxiliary Card Rack. An added advantage of remote switch mounting is that it frees the TSI 8150 mainframe to be mounted in the most convenient place, thus optimizing valuable rack space.

Switches can be mounted up to 24 feet from the mainframe without affecting switch performance. The standard package comes with a 198-5579-00 Extension Cable Kit. This kit includes 100 feet of switch control wire (50-lead ribbon cable) and 24 connectors, enough for twelve control cables.

Each scanner card is customer-wired to a 64-pin Virginia Panel Corporation connector module installed in the Test Head Receiver. Each of two 021-0477-00 GP Virginia Panel kits provides 128 36-inch signal patchcords for this purpose. Mating connector modules and signal pins for DUT interconnection are also provided.

The TSI 8150 mainframe provides the GPIB interface and power supply for all the switching cards and modules. The basic system configuration uses six of the twelve available slots in the mainframe. These slots hold the six TSS40 Scanner Control Assembly (SCA) cards that control six switch cards mounted in the Auxiliary Card Rack. When optional coaxial, RF, or microwave scanners are added, more TSS40 cards are mounted in the TSI 8155 mainframe.

Standard Package Components

The following lists show components of the basic TSI 8155 package and options. For more information about individual items, refer to their listings elsewhere in this catalog.

Basic Package:
1 TSI 8150 Test System Interface
6 TSS40 Scanner Control Assembly
1 198-5579-00 Extension Cable Kit
1 016-0861-00 Auxiliary Card Rack
1 016-0862-00 Auxiliary Mounting Unit
2 TSS41 Low-Level Scanner Card
2 TSS42 General-Purpose Scanner Card
1 TSS43 Power Switch Card
1 TSS48 Matrix Switch Card
1 TSA 8140 Test System Adapter
1 TSA F01 Rackmount Hardware Kit
1 021-0435-00 Test Head Receiver
1 TSA F09 Universal LF Quick Connect
1 TSA F10 Low-Frequency Quick Connect
1 021-0434-00 Single-tier ITA
2 021-0447-00 GP Virginia Panel Kit

Option 01 Basic Coaxial Kit:
2 TSS44 Coaxial Scanner Module
1 TSS40 Scanner Control Assembly
1 021-0454-00 RF Virginia Panel Kit

Option 02 Deluxe Coaxial Kit:
2 TSS44 Coaxial Scanner Module
1 TSS40 Scanner Control Assembly
1 021-0441-00 Extended-frame ITA
2 TSA F11 HF Quick Connect

Option 03 Basic RF Kit:
2 TSS45 RF Scanner Module
1 TSS40 Scanner Control Assembly
1 021-0454-00 RF Virginia Panel Kit

Option 04 Deluxe RF Kit:
2 TSS45 RF Scanner Module
1 TSS40 Scanner Control Assembly
1 021-0441-00 Extended Frame ITA
2 TSA F11 HF Quick Connect

Option 05 Microwave Kit:
2 TSS46 Microwave Scanner Module
1 TSS40 Scanner Control Module
3 021-0455-00 Microwave VP Kit

Option 09 Digital I/O Kit:
1 TSD42 32-bit Digital I/O Card
1 TSS40 Scanner Control Assembly
2 TSA F09 Universal Quick Connect

ORDERING INFORMATION

TSI 8150 Test System Interface $3,495
Includes: Rackmounting hardware; front and rear switch access; User's Manual; Configuration Manual; Programer's Reference Guide; power cord.
TSI 8155 Test System Interface Package. $13,995
Includes: See hardware list elsewhere in catalog under item description.
TSX 8140 Expansion Chassis $3,095
Includes: Rackmounting hardware, front and rear switch access; Instruction sheet; TSI 8150 interconnection cable and buffer board; ground strap; power cord.

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

TSA 8140—Test System Adapter. $495
016-0861-00—Auxiliary Card Mounting Rack. $265
016-0862-00—Auxiliary High-Frequency Mounting Unit. $145
TSAD22—8-input, 100 K S/s Analog-to-Digital Converter Assembly.*1
TSD20—32-bit High-Speed Digital I/O Assembly. $1,195
TSDM20—6.5-digit DMM Assembly*1
TSD42—32-bit General-Purpose Digital Interface Card. $395
TSM20—256K × 16-bit Memory Assembly. $995
TSS40—Scanner Control Assembly. $275
TSS41—Low-Level Scanner Card. $595
TSS42—General-Purpose Scanner Card. $655
TSS43—Power Switch Card. $475
TSS44—Coax Scanner Module. $665
TSS45—RF Scanner Module. $995
TSS46—Microwave Scanner Module. $1,995
TSS48—Matrix Switch Card. $695
TST20—Timer/Counter Assembly. $1,995
021-0417-00—High-Current Driver Card. $375
021-0418-00—60 mA Driver Card. $265

OPTIONS

TSI 8155

Option 01—Basic Coaxial Kit. +$1,995
Option 02—Deluxe Coaxial Kit. +$2,795
Option 03—Basic RF Kit. +$2,595
Option 04—Deluxe RF Kit. +$3,495
Option 05—Microwave Kit. +$9,995
Option 09—Digital I/O Kit. +$1,350

TSS41

Option 01—Substitute 1 μV thermal differential relays. +$400

TSS42

Option 01—Substitute dry-reed relays. NC

TSS43

Option 01—Substitute 2000 V, Form A Relays (8 Channels). +$50

TSS45

Option 01—Substitute 75-ohm relays. +$105
Option 02—Add back-termination (2 1×4 trees). NC

TSS46

Option 02—Add back-termination. +$500

TSS48

Option 01—Substitute dry-reed relays. NC
Option 02—Substitute 2×16 matrix configuration. NC
Option 03—Substitute dry-reed relays in 2×16 matrix. NC

OPTIONAL ACCESSORIES

TSI 8150

System Service Manual—Order 070-5767-00. $50
Function Card Service Extender Package—Order 067-0162-00. $295

TSA 8140

Test Head Receiver—Compatible with test fixtures from Virginia Panel Corporation. Order 021-0435-00. $2,995
Interchangeable Test Adapters—
(Full-size) Order 021-0434-00. $495
(Half-size) Order 021-0436-00. $495
(Extended-frame) Order 021-0441-00. $695
TSA F01—Rackmounting Hardware Kit. $145
TSA F02—Hybrid Fixture (leveling) Kit. $295
TSA F09—Universal Low-Frequency Quick Connect. $395
TSA F10—Low-Frequency Quick Connect. $395
TSA F11A—High-Frequency Quick Connect. $395
128-Channel General-Purpose or 42-Channel Low-Level/4-Channel Power Virginia Panel Fixturing Kit—Order 021-0447-00 $395
128-Channel Bed-of-Nails Virginia Panel Interface Fixturing Kit—Order 021-0448-00 $155
Virginia Panel Interface Fixturing Tool Kit—Order 021-0450-00 $1,695
24-Channel RF Virginia Panel Interface Fixturing Kit—Order 021-0454-00 $495
8-Channel Microwave Virginia Panel Interface Fixturing Kit—Order 021-0455-00 $2,100

SCANNER/SWITCH/DRIVER CARDS

Auxiliary Card Mouting Rack—(for TSD42, TSS41, TSS42, TSS43, TSS48, 021-0417-00, 021-0418-00). Order 016-0861-00. $265
Extension Cable Kit—Includes 30.5 m (100 feet) of cable and 24 connectors. Order 198-5579-00. $400
Extension Cable Assembly—Six Preassembled 2 m (6.5 feet) extension cables. Order 179-5581-00.*1

SCANNER MODULES

Auxiliary High-Frequency Mounting Unit—(for TSS44, TSS45, TSS46). Order 016-0862-00. $145
Extension Cable Kit—Incl. 30.5 m (100 feet) of cable and 24 connectors. Order 198-5579-00 $400
Extension Cable Assembly—Six Preassembled 2 m (6.5 ft) extension cables.*1
P6513 Probe/ITA Support Kit—(for TSS44, TSS45). Order 021-0443-00 $95
P6513 Probe/ITA/Power Support Kit—(for TSS44, TSS45). Order 021-0444-00. $175

*1 *Contact your local sales office*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

CONTROLLERS

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PEP301 Systems Controller 437
PEP303 Systems Controller 439
PEP303R Rackmount Systems Controller 439

PEP 301

Systems Controller

GPIB IEEE-488

The PEP 301 complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

FEATURES

- **16-MHz Intel 80386 System With the 80387 Coprocessor Standard**
- **1M-Byte Memory Standard—Expandable to 16M Bytes**
- **1.2M-Byte Floppy and 40M-Byte Hard Disk Standard**
- **Includes Signal Processing and Display (SPD) Software for Waveform Analysis and Hardcopy**
- **Includes GURU II Software for Compatibility With Tekware and Other Existing Applications**
- **14-Inch Color Graphics Display With CGA, EGA, and 800 X 600 Resolution Modes Standard**
- **Detached 101 Advanced Keyboard With Tactile Keys**
- **Disk Cache, Display, and Keyboard Accelerator and Other Utilities Included**
- **Clock Speed Controllable to 4.77, 6, 8, or 16 MHz to Permit Maximum Compatibility With Existing User Software**
- **Compatible With PC/XT and PC/AT Software Including Tekware Software from Tektronix for Instrument Control**
- **Calendar/Clock Battery Backup**

The PEP 301 Systems Controller brings 32-bit 80386/80387 data-acquisition and processing power to instrument systems control. With processing power 3–4 times a standard 8-MHz 80286-based system, tasks that took too long or were too big to tackle, become reasonable. Computation is an important part of the task of a controller when used to help analyze the data. The processing power is also essential to acquire data and convert it to engineering units. The PEP 301 has disk, memory, and processor speeds optimized for demanding applications.

GPIB hardware and software are included to make the controller productive quickly.

GURU II software (included) provides flexible instrument access through interpreted BASIC or Menu selection. Signal Processing and Display functions are included to provide access to waveform acquisition, analysis, arithmetic, and display on a variety of hardcopy devices.

GURU II software includes six applications programs written in interpreted BASICA. They may be used as is or modified by the user.

For applications needing more speed than the interpreter can provide, GURU connects to compiled BASIC. Supplemental software provides the link to Microsoft QuickBASIC.

Signal Processing and Display (SPD) software is both a menu driven analysis program and a development tool kit for use with Microsoft QuickBASIC and C. SPD can directly acquire waveforms from the following Tek digitizers: 2430, 2430A, 2432, 2440, 2230, 2221, 2220, 7D20, 7912 (AS and HB), 5223, 7854, 11401, 11402, and RTD710.

MS-DOS compatibility protects users investment in existing instrument control software, and of other software used in the Engineering environment that run on PC/XT, PC/AT, or compatibles.

PEP 301 Hardware

System Unit

The main processor uses a 16-MHz Intel 80386 32-bit processor and 80387 numeric coprocessor. The 80387 supports the instruction set of both the 80287 and 8087, offering additional enhancements that include full compatibility with the IEEE Floating-Point Standard, draft 10. The performance of a 16-MHz 80387 is about eight times faster than a 5-MHz 80287.

The 1M-Bytes of Random Access Memory, included as standard in the PEP 301, uses interleaving and 100 ns access ports to keep the processor from having to wait for instructions or data—*zero wait states.* Upon initialization, the ROM BIOS is loaded into random-access high memory. By loading a copy of the BIOS into zero-wait-state memory, performance is kept at top operating speed.

Memory includes 256K bytes above the 1M-Byte address space that can be configured to conform to the Lotus/Intel/Microsoft Expanded Memory Standard. Many applications, such as Framework II and Lotus 1-2-3, use Expanded Memory (EMS area) for data.

Hardware clock speed is software selectable to speeds below 16 MHz to provide maximum compatibility with existing software.

To aid set-up, CMOS RAM retains stored settings, and "INSTAL" utilities simplify installing memory management, ram drivers, and hard disks. Set-up is through simple menu and form-fillout sequences.

Mass storage peripheral space is available for up to two more half-height or one more full-height disk. This means that the system can grow to meet future needs.

Keyboard

The system keyboard is a 101-key "Enhanced AT" style with key click and tactile feel.

Display System

The display controller installed in the systems unit has 256K bytes of video memory providing 16 colors out of a palette of 64. The display card installed in the system unit and the monitor (a multisync display) provide maximum compatibility with Tekware and other software while providing capability to meet demanding color graphics needs.

PEP 301 Software

The PEP 301 controller includes operating system, language, and applications:
SPD—For Signal Analysis and Display of waveforms from a variety of oscilloscopes and digitizers.

MS-DOS 3.3 (later versions when available).
GW-BASIC for running interpreted BASIC programs.
GURU II—GPIB Users Resource Utility Software.

SPD takes advantage of the 640×480 resolution graphics on the PEP301. To simplify use with the SPD Menu mode a keyboard overlay is included with easy to follow labeling. The "Help", F1, key provides basic information and the F3 key returns to the main menu.

As a menu driven application program, almost all of the function library is accessible without writing software. Functions include:

Process menu—For developing a sequence of functions to be invoked as a batch file. This provides repeatable customized measurement sequences.

Waveform Arithmetic—Addition, subtraction, multiplication, division of a waveform by another or by a constant, find minimum, maximum, log, exponentiation, power, or square root of a waveform.

Signal processing—FFT, IFFT, Derivative, Integral, Interpolate, Decimate, Taper (with a variety of window functions), Correlation, and Convolution.

Measurements—Determine pulse parameters, statistics, and frequency components of waveforms.

Input/Output—Read or write to disk, read user files from other applications (ASCII, IBM BASIC Binary, and Binary), perform a user process on a waveform, and acquire from digitizers.

Complex Arithmetic—Polar, rectangular conversion and arithmetic functions on complex arrays.

Waveform Generation—Mathematically create waveforms for experimentation; sine, square, sinc (sine $(\times)/\times$), sine squared, binary random, gausian random, uniform random.

Extensive context sensitive help is available in the menu mode.

Programs may also be written using the 196 functions in SPD using C, QuickC, or QuickBASIC.

Accelerator and Utility Software— Utilities include: disk cache, disk file defragmenting software, display accelerator, keyboard accelerator and command line editor.

MS-DOS 3.3 is upwardly compatible with MS-DOS 3.2 and provides new commands and extensions to existing ones.

In addition to the extensions of MS-DOS, commands added to the controller MS-DOS include:

A system speed command, to set the speed of the processor to 4.77, 6, 8, or 16 MHz clock speed. This allows speed-dependent programs written for a PC/XT, for example, to be executed properly on the PEP 301. In the "Smart" mode, the PEP runs at 16 MHz until floppy-disk access is required. This assures reading floppy disks brought from other PC-compatible products.

A memory manager for installing and using memory above the 1M-byte address limit following the Lotus/Intel/Microsoft Standard.

GW-BASIC, like BASICA, allows quick interactive programming in interpreted BASIC. In addition to features found in IBM Advanced BASIC, GW-BASIC provides additional screen types including MGA (monochrome graphics adaptor) modes. The screen editor is improved with help modes and improved editing.

GURU II includes: Test-procedure generation suited for programmable power supplies, digital voltmeters, signal sources, and counters.

Menus mode for selecting pre-written BASIC routines for interrogating and transmitting information on the GPIB, string comparisons, waveform acquisition (in ASCII or binary format), waveform storage and recall from disk, plus 9 other frequently needed functions.

Digitizer support for 2220, 2221, 2230, 2430, 2430A, 7D20, 7912AD, 7854, 11401, 11402 and RTD 710.

Pulse-Analysis program to simplify characterizing waveform data by rise, fall, and commonly used pulse-measurement parameters.

Sample applications are included that the user can run as is or modify to meet individual needs that do:

Rise- and fall-time pulse measurements with the 2445 and 2465 oscilloscopes.

Scope verification using the CG 5001 programmable oscilloscope calibration generator.

Audio-distortion analysis using the AA 5001 Programmable Distortion Analyzer and SG 5010 Programmable Oscillator.

GURU II provides waveform storage in ADIF (Analog Data Interchange Format) common to it and Signal Processing and Display software (SPD) to simplify transferring data to signal processing environment.

For more information on GURU II, SPD, and other TEKWARE MS-DOS software products, see the Test and Measurement Software section.

NEW PEP 303

Systems Controller

GPIB IEEE-488 The PEP 303 complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

- **20MHz Intel 80386 System with the 80387 Coprocessor Standard**
- **4 MBytes Memory Standard—Expandable to 16 MBytes**
- **1.2 MByte Floppy and 130 MByte Hard Disk Standard**
- **Includes Signal Processing and Display (SPD) Software for Waveform Analysis and Hardcopy.**
- **Windows/386 for Multi-Tasking, and Graphical User Interface**
- **Signal Analysis Library for Data Analysis and Display**
- **Includes GURU II Software for Compatibility with Existing Tekware and User Written Software**
- **14 Inch Color Graphics Display with CGA, EGA, and 800 X 600 Resolution Modes Standard**
- **Detached 101 Advanced Keyboard with Tactile Keys**
- **Mouse Included**
- **Clock Speed Controllable to 4.77, 6, 8, 12, 16, or 20 MHz to Permit Maximum Compatibility with Existing User Software**
- **Disk Cache, Display, and Keyboard Accelerator and Other Utilities Included**

The PEP 303 Systems Controller brings windowed multi-tasking software to benchtop and laboratory data acquisition, data analysis, and instrument systems control.

GPIB hardware and software are included to make the controller productive quickly. GURU II software provides flexible instrument access through interpreted BASIC or Menu selection. Signal Processing and Display functions provide waveform acquisition, analysis, arithmetic, and display on a variety of hardcopy devices.

As a PC based instrument controller, the PEP 303 preserves the usefulness of existing instrument control programs, and of many other programs used in the Engineering environment that run on PC/XT, PC/AT, or compatibles.

PEP 303 Hardware

System Unit

All hardware features are identical to the PEP301 except for the following. Memory – 4 MBytes of Random Access Memory is standard. Optional added 4 MBytes is also available for a total of 8 MBytes. Additional memory uses a proprietary 32 bit bus and does not require any of the standard AT-bus slots. Main memory and add-on memory use interleaving and 80 ns access parts for fastest, zero wait state, performance.

The main processor uses a 20 MHz Intel 80386 32 bit processor and 80387 numeric coprocessor. The 80387 supports the instruction set of both the 80287 and 8087, offering additional enhancements that include full compatibility with the IEEE Floating-Point Standard, draft 10. The performance of a 20MHz 80387 is about ten times faster than a 5 MHz 80287.

Hard Disk–The standard hard disk is 70 MBytes, 28 ms access time. Users wanting more mass storage may specify a substitute option that replaces the 70 MB disk with a 120 MByte 28 ms disk.

PEP 303 SOFTWARE

The PEP 303 controller software includes all software supplied with the PEP301 with the addition of:

Window/386 to add graphical windows interface and multi-tasking.

A text processing program for report preparation.

A graphics drawing and editing program.

A data communications program.

Revision control software for maintaining configuration control throughout program development.

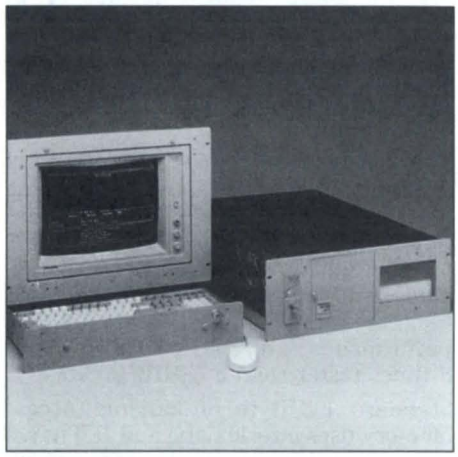
Data acquisition, display and signal processing libraries.

Users can acquire waveforms from most Tektronix digitizers and perform signal analysis (FFT, IFT, etc.) and paste the graphics directly into engineering or quality control reports. With multitasking, up to 16 tasks can be operating on the PEP303 at one time. Lengthy sorting, or communications transfers can be done in the background mode. Most important is the ability to connect the results of one application to another.

MS-DOS

In addition to standard MS-DOS 3.3 commands, extensions added to the controller MS-DOS include:

A system speed command, to set the speed of the processor to 4.77, 6, 8, 12, 16 or 20 MHz. Speed dependent programs written for a PC/XT may be executed properly on the PEP303. In the "SMART" mode, the PEP runs at 20 MHz, until floppy disk access is required. This assures reading floppy disks brought from other PC-compatible products.



NEW PEP 301R

Rackmountable Systems Controller

GPIB IEEE-488 The PEP 301R complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

- **16 MHz Intel 80386 System with 80387 Coprocessor, 1 MBytes Memory, and 70 MByte Disk Standard**
- **System Unit, Monitor, and Keyboard are Rackmountable Conforming to EIA RS-310 Standard**
- **101 Key Keyboard is Mechanically and Electrically Lockable**
- **All Disk Drives are Enclosed and Shock Mounted to Protect Them from Harsh Environments**
- **Includes Signal Processing and Display (SPD) Software for Waveform Analysis and Hardcopy**
- **Includes GURU II software for Compatibility with Existing Tekware and User Written Software**
- **14 Inch Color Graphics Display with CGA, EGA, and 800×600 Resolution Modes Standard**
- **Clock Speed Controllable to 4.77, 6, 8, 12, or 16 MHz to Permit Maximum Compatibility with Existing User Software**
- **Disk Cache, Display, and Keyboard Accelerator and Other Utilities Included**

The PEP 301R Rackmountable Systems Controller brings 32 bit processing and windowed multi-tasking software to rack mounted ATE systems.

GPIB hardware and software included make the controller productive quickly.

GURU II software (included) provides flexible instrument access through interpreted BASIC or Menu selection. Signal Processing and Display functions are

are included to provide access to waveform acquisition, analysis, arithmetic, and display on a variety of hard-copy devices.

PEP301R HARDWARE

System Unit

The main processor uses a 16 MHz Intel 80386 32 bit processor and 80387 numeric coprocessor. The 80387 supports the instruction set of both the 80287 and 8087, offering additional enhancements that include full compatibility with the IEEE Floating-Point Standard, draft 10. The performance of a 16 MHz 80387 is about 8 times faster than a 5 MHz 80387.

Standard 1 MByte of Random Access Memory uses interleaving and 100 ns access parts to keep the processor from having to wait for instructions or data-zero wait states. Upon initialization, the ROM BIOS is loaded into random access high memory. By loading a copy of the BIOS into zero wait state memory, performance is kept at top operating speed.

Hardware clock speed is software selectable to speeds below 16 MHz to provide maximum compatibility with existing software.

Mass storage peripheral space is available for up to two more half-height or one more full height disk. This means that the system can grow to meet future needs.

Mass storage and floppy disks are enclosed and protected from access of foreign material from the physical site with access doors.

Compared to the benchtop PEP301 additional cooling and shock mounting are provided. Shock mounting extends the application of hard disks to more severe environments. Additional cooling not only provides additional air flow, but provides positive pressure inside the system unit to limit acess to air-borne particulate material.

Keyboard

The system keyboard is a 101-key "Enhanced AT" style with key click and tactile feel. The keyboard is mounted in a drawer that can be closed and locked to protect the system mechanically. When opened for access the edge of the drawer acts as a rest for the keyboard user's hands.

Display System

The display controller installed in the systems unit has 256K bytes of video memory providing 16 colors out of a palette of 64. The display card installed in the system unit and the monitor (a multisync display) provide maximum compatibility with Tekware and other software while providing capability to meet demanding color graphics needs.

The display is rackmountable in a standard EIA rack.

PEP CHARACTERISTICS

SYSTEM UNIT

System board with Intel 80386 processor and 80387 numeric processor. 16-MHz operation, zero wait state, 1M byte RAM on board, 32- bit address, 32-bit data bus, 7 DMA channels, 15 interrupts, 3 programmable timers. System memory is expandable to 16M bytes.

SYSTEM PANEL

Key lock for protecting the system from access when the key is turned to lock position and removed. Two indicators show the speed mode and light when the hard disk is being used. The front panel also has a system reset switch that provides a complete restart of the system without having to turn off power. This reset is positioned to prevent accidental operation, yet convenient to find when needed.

KEYBOARD

The keyboard keys have click and tactile positive feedback. Versions available in the U.S. have 101 keys, those for non-U.S. distribution use 102 keys. The keyboard is detachable with 10-ft. coil cable. Key layout is the standard IBM PC/AT 101-key format. LED indicators show Power, Caps Lock, Numeric Lock, and Scroll Lock status.

MASS STORAGE

1.2M byte 5.25-in. floppy disk ("A:" drive), half-height, double-sided, double density, 94-ms average access time. The disk is read compatible with 360M-byte drives.

40M-byte Hard-Disk Drive, 5.25 in. with 28-ms average access time. In addition to the standard disk drives, the controller board can handle one more floppy disk drive and one more hard disk.

DISPLAY SYSTEM

The PEP 301 Systems Controller includes a display monitor and interface card installed in the main system unit. A number of graphics modes are available to support both Tektronix Tekware software and user written or provided applications.

Graphics Modes

Fully CGA, EGA compatible. Supports standard EGA modes with 640×350, 16-color graphics, and other modes shown below:

Type	Format	Char.Box	Res	Colors
Text/Graphics	40x25	8x16	640x400	16
Text/Graphics	80x25	8x16	640x400	16
Text/Graphics	80x60	8x8	640x480	16
Text/Graphics	80x66	8x8	640x480	16
Text/Graphics	100x75	8x12	752x410	16
Text/Graphics	114x60	8x8	800x600	16

Software drivers are supplied with the PEP 301 support advanced graphics features with applications software users may already own, such as: GEM (version 2.1), Microsoft Windows (version 1.0 or greater), Lotus 1-2-3 (version 2.0 for 132×25 – 44), Framework (version 1.1 or greater), Ventura Publisher (version 1.1 or greater), and AutoCAD (version 2.5 or greater).

Monitor—The display monitor is an Automatic Synchronizing (multi-sync) display.
Scan Rates: Horizontal is 15.5 to 37 kHz.
Vertical is 45 to 75 Hz
Display Area: 250 by 180 mm
Dot Pitch: 0.31 mm
Video Bandwidth: 30 MHz

INTERFACES

Communications—Two RS-232-C serial ports: One 9-pin "D" male connector, one 25 pin male "D" connector. Programmable baud rate from 50 to 9600 baud.
GPIB—The GPIB port conforms to IEEE Standard 488.
Printer Interface—The printer connector is a Centronics-compatible 25-pin "D" female connector.

POWER REQUIREMENTS

Power Consumption—System Unit: 200 W. Display. Monitor: 85 W.

ENVIRONMENTAL

Temperature—Operating: −10 to +40°C. Nonoperating: −10 to +60°C.
Humidity—Operating: 20 to 80% noncondensing. Nonoperating: 10 to 90% noncondensing.
Altitude—Operating: to 10,000 feet. Nonoperating: To 15,000 feet.

PHYSICAL CHARACTERISTICS

	System Unit		Keyboard		Display Monitor	
Dimensions	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**
Width	533	21.0	485	19.1	395	15.6
Height	165	6.5	19.1	0.8	291	11.5
Depth	432	17.0	208	8.2	400	15.8
Weights	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
Net	19.0	41.9	2.7	6.0	14	30.8

PEP301R SOFTWARE

The PEP301R software is identical to the PEP301 software.

CHARACTERISTICS PEP303

All system Characteristics are identical to the PEP301 except:

SYSTEM UNIT

System board with Intel 80386 processor and 80387 numeric processor. 20MHz operation, zero wait state, 4MB RAM on board, 70MB Hard Disk Drive, 5.25″ with 28ms average access time. In addition to the standard disk drives, the controller board can handle one more floppy disk drive and one more hard disk.

CHARACTERISTICS

(PEP303R)

All system characteristics are identical to the PEP301R except the following:

SYSTEM UNIT

System board with Intel 80386 processor and 80387 numeric processor. 20 MHz operation, zero wait state, 1 MB RAM on board, 32-bit address, 32-bit data bus, 7 DMA channels, 15 interrupts, 3 programmable timers. System memory is expandable to 16 MB.

MASS STORAGE

1.2 MB 5.25 inch ("A:" drive), half-height, Double-sided, double density, 94 ms average access time. The disk is read compatible with 360 MByte drives.

40 MB Hard Disk Drive, 5.25 inch with 28 ms average access time. In addition to the standard disk drives, the controller board can handle one more floppy disk drive and one more hard disk.

ORDERING INFORMATION

PEP 301 Systems Controller **$7,995**
Includes: 1.2 M-byte floppy and 40M-byte hard disk, display monitor, and graphics/display card, GPIB interface and cable, IM-byte RAM, GURU II Software, MS-DOS 3.3, and GW-BASIC.

PEP303 Systems Controller*1
Includes: 1.2 Mbyte floppy and 70Mbyte hard disk, Display monitor and graphics/display card, GPIB interface and cable, 4MB RAM, Software including, Windows/386, Signal Processing Library, Write, Paint, and communications program; GURU II Software, Disk cache and other utility software, MS-DOS 3.3, and GW BASIC.

PEP 301R Systems Controller*1
Includes: 1.2MB Floppy and 40MB hard disk, Display monitor and graphics/display card, GPIB interface and cable, 1MB RAM, GURU II, SPD, Disk cache and utility software, MS-DOS 3.3, and GW-BASIC.

PEP303R Systems Controller*1
Includes: 1.2Mbyte floppy and 70Mbyte hard disk, Display monitor and graphics/display card, GPIB interface and cable, 4 MB RAM, GURU II Software, SPD, Disk cache and other utility software, MS-DOS 3.3, and GW BASIC.

OPTIONS

Option 21—Adds 3.5 in. 1.44 MB disk drive*1
Option 22—Substitute 120 MB Hard Disk (PEP 301, 301R)*1 (PEP303, 303R)*1
Option 24—Adds 5.25 in. 360KByte floppy disk*1
Option 32—Delete Monitor and EGA Display hardware*1
Option 35—Add Serial Mouse*1
Option 37—RS-232 Controller hardware only*1
Option 38—Delete rackmount of keyboard and display (PEP301R, 303R)*1
Option 39—Delete 80387 Coprocessor*1
Option 43—Total 3MB RAM for PEP301, 301R only*1
Option 44—Total 5MB for PEP301, 301R*1 Total 8MB for PEP303, 303R*1
Option 45—Total 9MB for PEP301, 301R*1 Total 12MB for PEP303, 303R*1
Option 4A—UK keyboard **NC**
Option 4B—French keyboard **NC**
Option 4C—Swedish keyboard **NC**
Option 4F—Danish keyboard **NC**
Option 4G—German keyboard **NC**
Option 4I—Italian keyboard **NC**
Option 4S—Spanish keyboard **NC**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 60 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

*1 *Contact your local sales office.*

TECHNICAL ASSISTANCE SERVICES

When you need technical assistance to supplement your own resources, Tektronix can arrange the services of an application engineer skilled in meeting your needs. For more information, see the Total Solution Section or consult your local sales engineer.

TRAINING

Tektronix Instrument Group customer Training offers operation and application training to help you get full value out of your instrumentation investment. See Customer Training Section for information. For further information, or to enroll, call us at 1-800-835-9433 ext. 430.

DIGITIZERS

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DIGITAL OSCILLOSCOPES AND WAVEFORM DIGITIZERS

Type	Analog Digitizing BW	Maximum Digitizing Rate	Vertical Resolution	Data Words per Waveform	Maximum Stored Waveforms	Useful*1 Storage BW (SS)	Equiv*2 Storage BW (rep)
RTD710A	100 MHz	200 MS/s single channel	10 bits	1K to 256K	256	100 MHz*4	100 MHz
7912HB	750 MHz	100 GHz	9 bits	512	1	750 MHz	750 MHz
7250	6 GHz	1000 GS/s	11 bits	512	15	6 GHz	6 GHz

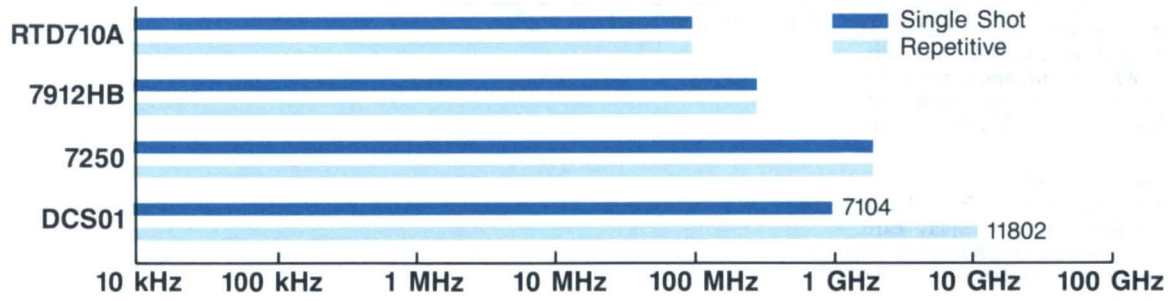
*1 *Useful Storage Bandwidth is a measure of the highest frequency sine wave that can be stored in a single sweep and displayed in a visually useful manner. USB depends on both the maximum digitizing rate and the display reconstruction technique used.*

*2 *Equivalent Storage Bandwidth is the highest frequency repetitive signal that can be stored and displayed with less than 3 dB loss of signal amplitude using equivalent-time digitizing techniques.*

*3 *14 bits with averaging.*

*4 *Nyquist criteria.*

WAVEFORM ACQUISITION CAPABILITY



NEW RTD710A

Programmable Waveform Digitizer

GPIB IEEE-488

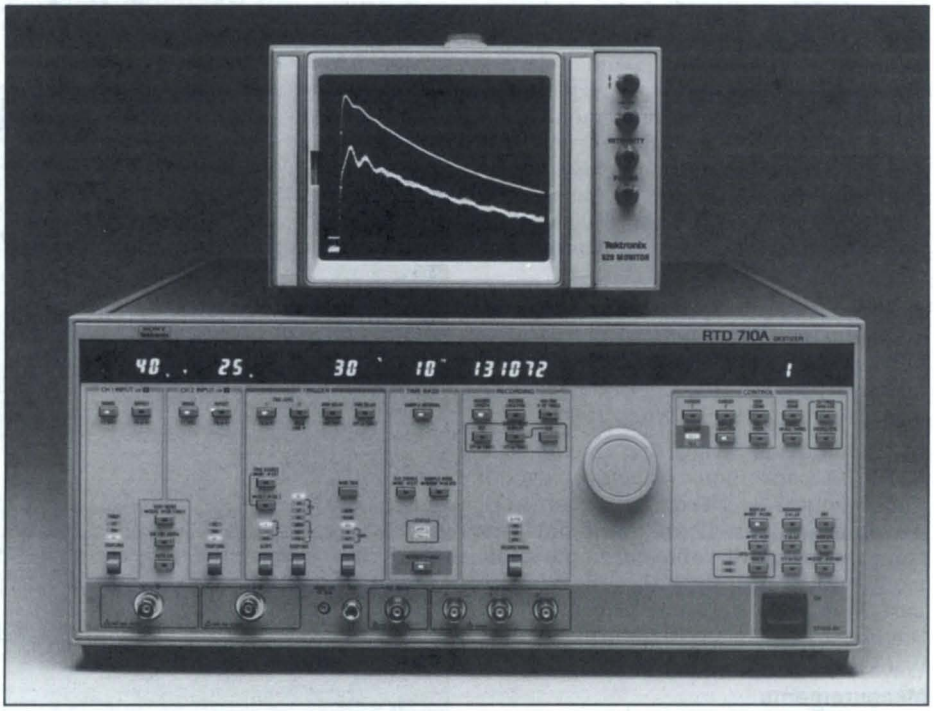
The RTD 710A complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

TYPICAL APPLICATIONS

- **High Energy Physics**
- **Ultrasonics, Sonar, Radar, Lidar**
- **High Voltage Impulse Testing**
- **Power Conversion**
- **Storage Media Testing**
- **Communications and EW**
- **Video and CCD Development**
- **Semiconductor and Hybrid Test**

FEATURES

- **200 Megasamples/sec Single Channel**
- **100 Megasamples/sec Dual Channel**
- **100 MHz Analog Bandwidth**
- **10-Bit Vertical Resolution with ±0.4% Range Accuracy**
- **256K Word Waveform Memory**
- **Hardware Signal Averaging**
- **Comprehensive Triggering**
- **Cursor Measurements of Time, Voltage, & Frequency**



RTD710A Programmable Waveform Digitizer

High Resolution, Accuracy and Speed

The RTD710A Waveform Digitizer provides 10-bit vertical resolution at sample rates up to 200 Megasamples per second (MS/s). This is four times the resolution of an 8-bit digitizer. With 60 dB of dynamic range, the RTD710A provides excellent resolution of fine signal details.

The RTD710A provides real-time digitizing up to 200 MS/s in the single-channel mode and to 100 MS/s in dual-channel mode. The high performance amplifier and attenuator system, along with Autocal circuitry assures signal fidelity prior to conversion from analog to digital form. The input system also provides fine control of full scale input range and offset, maximizing use of the 1024 available digitizing levels.

Other key features of the input system are accurate step response and rapid overdrive recovery. Clean step response is important for accurate capture of transient events. The fast overdrive recovery allows accurate recording of small events occurring near large impulses, such as in pulse-echo applications and decaying exponential signals.

Long Memory and Flexible Recording

The RTD710A contains 262,144 (256K) words of high-speed memory for storing waveform data. Memory can be allocated entirely to one channel or split between channels for simultaneous dual-channel digitizing.

Record length can be selected from 1024 points to the full 262,144 in powers of two. When using shorter lengths, a correspondingly larger number of records are available. With a record length of 1024 points, up to 128 records per channel are available in the dual-channel mode, or up to 256 records if one channel is used.

Direct Output of A/D Data

For applications where the large internal memory of the RTD710A is not enough, an external output port is provided. The output of both A/D converters is available up to the full 200 MS/s rate. External memory caches may be added for capture of extremely long time windows with high resolution. Contact your Tektronix Sales Engineer for further information on memory cache products.

Other Recording Modes

The Auto-Advance recording mode takes advantage of multiple records by capturing new waveform data on successive trigger events. In this manner, a series of transient events can be captured in rapid succession and held for later analysis. Auto-Advance recording is very powerful for capturing a series of lightning strikes, monitoring the time-varying output of a laser system, or recording other sequential transient phenomena.

In addition to the transient recording modes, the RTD710A has built-in hardware signal averaging capability. This provides selectable powers-of-two averaging up to 16K to reduce random signal noise.

Envelope capture mode records minimum and maximum values for each data point over successive acquisitions. This offers a powerful technique for capturing spurious events and for monitoring signal drift.

Internal and External Sample Control

In addition to 66 internal timebase settings, external strobing of the A/D converter system is supported. This provides the ability to synchronize sampling with external phenomena. The RTD710A can be strobed from dc to 200 MHz. One typical application is CCD development where sampling can be synchronized with the CCD shift clock. Other applications are storage media testing and multiplexed data systems.

Sample rate switching is a unique feature provided to optimize usage of waveform memory. With sample rate switching, it is possible to perform fast sampling during periods of interest and switch to a slower rate during quiescent periods. Up to 5 breakpoints (sample rate changes) are available within a record. One application is ultrasonics, where delay time between impulse and echo events can be sampled at a low rate while maintaining fast sampling over the events of interest. This can significantly reduce the amount of data transferred for processing in the computer.

Versatile Triggering Modes

The RTD710A offers many trigger modes to simplify the capture of complex signals. Standard oscilloscope-like triggering is provided, along with enhancements such as LF and HF Reject, Bislope triggering, and a Hysteresis trigger mode. Hysteresis mode allows the user to set an analog qualifying level as well as a trigger level, providing noise immunity and additional trigger selectivity.

A Video Trigger Option is available to allow the user to trigger on horizontal or vertical video sync pulses. This option makes it possible to trigger on a specific line number within a video field.

In Comparison triggering mode, the RTD710A continuously acquires events and compares them to reference-waveform values. If an event deviates from the range of values (Compare Out mode) or lies entirely within them (Compare In mode), the waveform is held for further analysis.

Waveform Zoom and Cursor Measurements

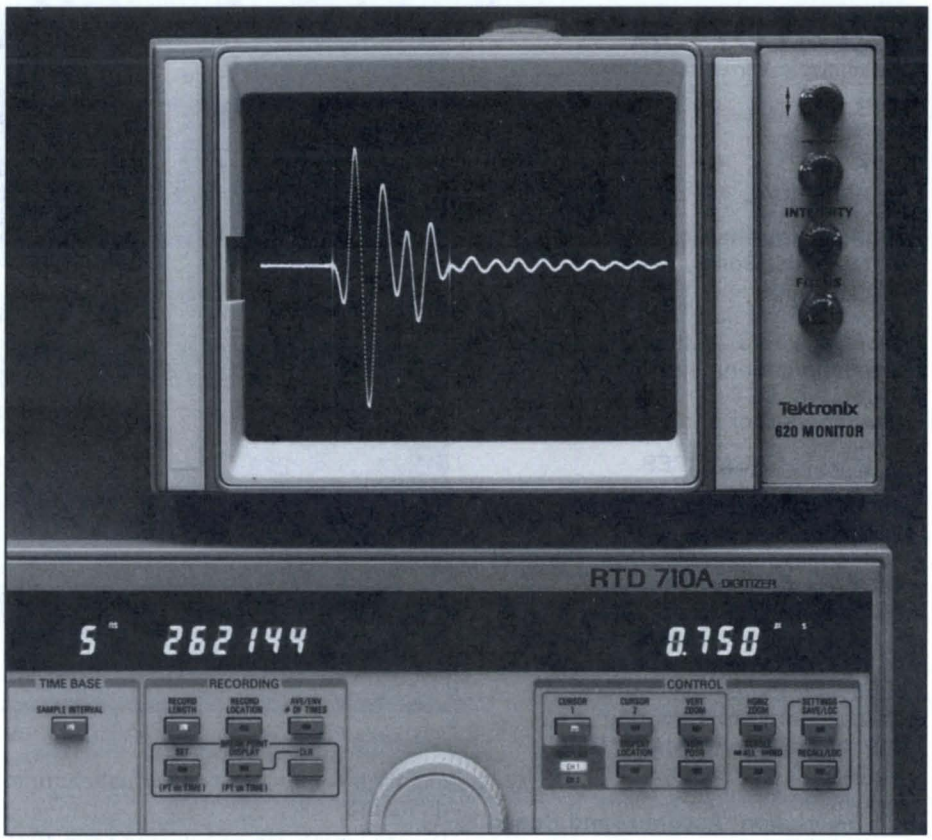
When used in conjunction with an optional X-Y-Z monitor, captured waveforms can be viewed and measured in several ways. Cursors offer the capability to measure time, voltage, and frequency. The RTD710A offers horizontal and vertical display zoom, vertical positioning, and horizontal scrolling for easy viewing of the entire waveform or expansion of smaller portions. Both YT and XY types of displays are available.

System Digitizer or Stand Alone

The RTD710A is fully programmable via the GPIB (IEEE-488) and conforms to Tektronix *Standard Codes and Formats*. It also contains several useful waveform analysis commands, such as Min, Max, and Cross to increase throughput in test systems.

Hardcopies of the display can be made with the HC100 Color Plotter via the GPIB. Option 19 provides a blank instrument front panel. This eliminates the RTD710A front-panel controls, reducing power consumption, instrument cost, and susceptibility to undesired operator adjustment. This is particularly important in test-system environments.

Quicker system set-up time and the convenience of choosing from several previous instrument states is standard on the RTD710A via non-volatile settings storage. Up to 20 different instrument states can be stored and recalled either by a front-panel pushbutton or under computer control. Measurement accuracy and proper functioning of the RTD710A are confirmed by auto-calibration and self-test procedures. Self test is automatically performed at power-on, and can be user-activated during operation.



RTD710A Cursor Display on Tektronix 620 X-Y-Z Monitor.

CHARACTERISTICS

VERTICAL

Input Channels—Two, single ended. Supports X10 and X100 encoded probes for high input voltage applications. Simultaneous digitizing in dual-channel mode.

Input Range—±100 mV to ±50 V (200 mV to 100 V p-p) in 28 steps.

Input DC Offset Voltage—±199% of input range, selectable in either percent or volts. Accuracy ±1.5% at ±100% dc offset.

Analog Bandwidth—DC to 100 MHz, 0 to 40°C; DC to 90 MHz, 40 to 50°C. Selectable bandwidth limiting at 20 MHz.

AC-Coupled Lower -3-dB Point—10 Hz or less.

Input R and C—1 MΩ ±2%; ≈24 pF.

Maximum Input Voltage—250 V (dc + peak ac); ac component, 500 V p-p maximum at 1 kHz or less.

Auto Calibration—Range Accuracy: ±0.4%.

TIME-BASE

Internal Clock Frequency—200 MHz ±0.001%.

Sample Rate: Internal Clock—Channel 1 Only Mode, 200 MS/s to 5 S/s, 66 sampling steps; Dual Channel Mode, 100 MS/s to 5 S/s, 65 sampling steps.

External Clock—Channel 1 Only Mode, dc to 200 MHz; Dual Channel Mode, dc to 100 MHz.

Sample-Rate Switching—5 breakpoints maximum per record.

DIGITIZING

Vertical Resolution—10 bits (1024 discrete levels).

Maximum Sample Rates—Single Channel Mode, 200 MS/s; Dual Channel Mode, 100 MS/s.

Record Length per Channel

CH 1 Only Mode		Dual-CH Mode	
Records	Length	Records Per CH	Length Per CH
1	262144		
2	131072	1	131072
4	65536	2	65536
8	32768	4	32768
16	16384	8	16384
32	8192	16	8192
64	4096	32	4096
128	2048	64	2048
256	1024	128	1024

Averaging—Selectable from 2 to 16384 in a 2-4-8 binary sequence, 8K maximum record length averaged.

Enveloping—Selectable from 1 to 16384 or infinite in a 2-4-8 binary sequence.

TRIGGERING

Sources—Internal from Ch 1 or Ch 2, or External.
Trigger Coupling—AC, AC LF Reject, DC HF Reject, DC.
Slope—Positive, Negative, Bislope.
Modes—Auto, Normal, Single, Compare In, Compare Out, Hysteresis.
Postrigger Delay—From 0 to 262136 samples in Normal Mode, from 0 to 262128 samples in high-speed (200 MS/s) mode.
Pretrigger Capture—To full record length less 8 for normal mode and full record length less 16 samples for high-speed (200 MS/s) mode.
Arming Delay—Internal: 0, 10 ms to 10 s in a 1-2-5 sequence; External arm input on rear.

DISPLAYS

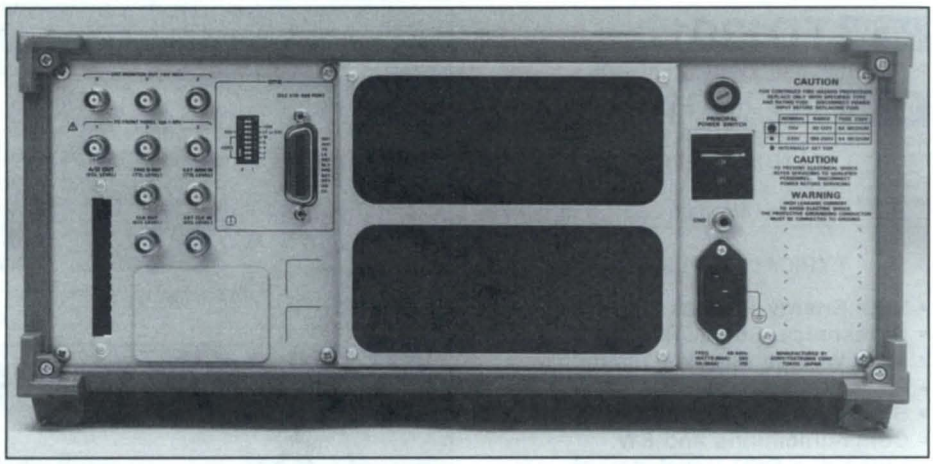
Cursor Readout—7-digit LED display for time, voltage, and frequency.
Trigger Readout—6-digit LED display for trigger level.
Record Length Readout—5-digit LED display for record length and breakpoint location.
Range/Offset Readout—4-digit LED display for range and offset settings; two displays, one for each channel.

IEEE STANDARD 488 INTERFACE

Standard—IEEE Standard 488.1-1987.
Interface Functions—SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0.
Maximum Transfer Rate—>250K bytes/second.
Programmable Functions—All instrument settings and operating modes are programmable except the power switch.
Plotter Interface—HPGL protocol, IEEE-488 interface.
Waveform Analysis Routines—Window, Maximum, Minimum, Top, Base, Positive Cross, Negative Cross, Mid, Mean, Peak-to-Peak.

EXTERNAL SIGNALS

CRT Display—X, Y, and Z: ±1 or 5 V p-p, internally selectable (set to +1 V at factory).
Trigger Output—Positive true, TTL-compatible.
External Arm In—TTL-compatible.
External Clock Input—ECL signal level, 50 Ω DC to 200 MHz.
Clock Output—ECL signal level (open emitter out into 50 Ω).
Probe Calibration Output—0 to +4 V ±1% square wave at 1 kHz ±0.005% into 1 M Ω.
Feed-Through Connectors—Three 50-Ω coaxial cables for rear signal connections.
Direct A/D Output—50-pin AMPMODU MT connector. Channel 1 and Channel 2 digitized signals available. ECL-compatible signal levels. Maximum data rate is 100 Mega-Words per second (20-bit word). Contact Tektronix Sales Representative for information on memory cache products.



RTD710A Rear Panel.

ENVIRONMENTAL

Temperature Range—Operating 0 to 50°C; Nonoperating −30 to +70°C.
Humidity—0 to 95% relative humidity (noncondensing).
Altitude—Operating 15,000 ft (4.5 km) maximum; Nonoperating 50,000 ft (15 km) maximum.
Line Frequency—Operational from 48 to 440 Hz.
Power Consumption—350 W fully optioned.
Line-Voltage Range—90 to 132 V ac (115 V); 180 to 250 V ac (230 V).
Electromagnetic Compatibility-The RTD 710A qualifies under test limits specified in FCC Part 15, subpart J Class A and VDE 0871 Class B.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	429	16.9
Height	177	7.0
Depth	643	25.3
Weight ≈	**kg**	**lb**
	23.5	51.8

ORDERING INFORMATION

RTD710A Programmable Waveform Digitizer **$20,950**
Includes: Power cord (161-0123-00), Fuses, 8A & 4A, Instruction Manual (070-7204-00), RTD 710A Instrument Interfacing Guide (070-7207-00).

OPTIONS

Option 05—Video Trigger **+$1,495**
Option 19—Blank Front Panel **−$500**
Includes: Rack mount assembly.
Option 1R—Rack Mount. **+$395**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 240 V
Option A2—UK 240 V
Option A3—Australian 240 V
Option A4—North American 240 V
Option A5—Swiss 240 V

OPTIONAL ACCESSORIES

Rack Mount Kit—Order 016-0886-00 **$600**
Service Manual—
Vol. 1. Order 070-7292-00 **$50**
Vol. 2. Order 070-7293-00 **$50**
GPIB Cable—2 meters.
Order 012-0991-00 **$160**
A/D Out Cable—2 meters.
Order 012-1117-01 **$150**
HC100 Color Plotter—
Opt. 01 GPIB Cable **$965**

NEW TD1301
Acquisition and Viewing Package

NEW TD2301
Acquisition and Analysis System

GPIB IEEE-488

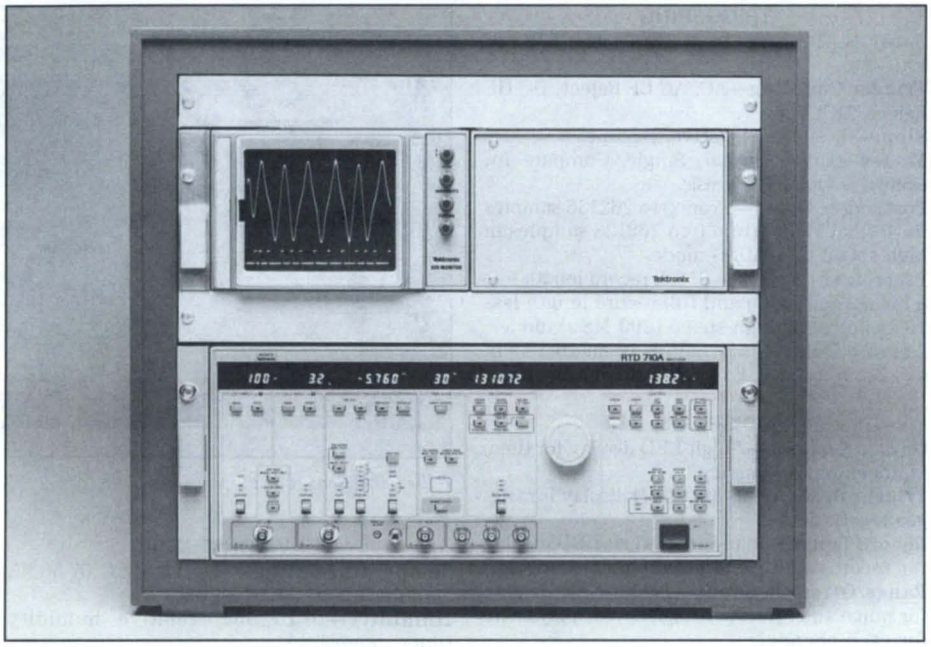
The TD1301 and TD2301 comply with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

TYPICAL APPLICATIONS

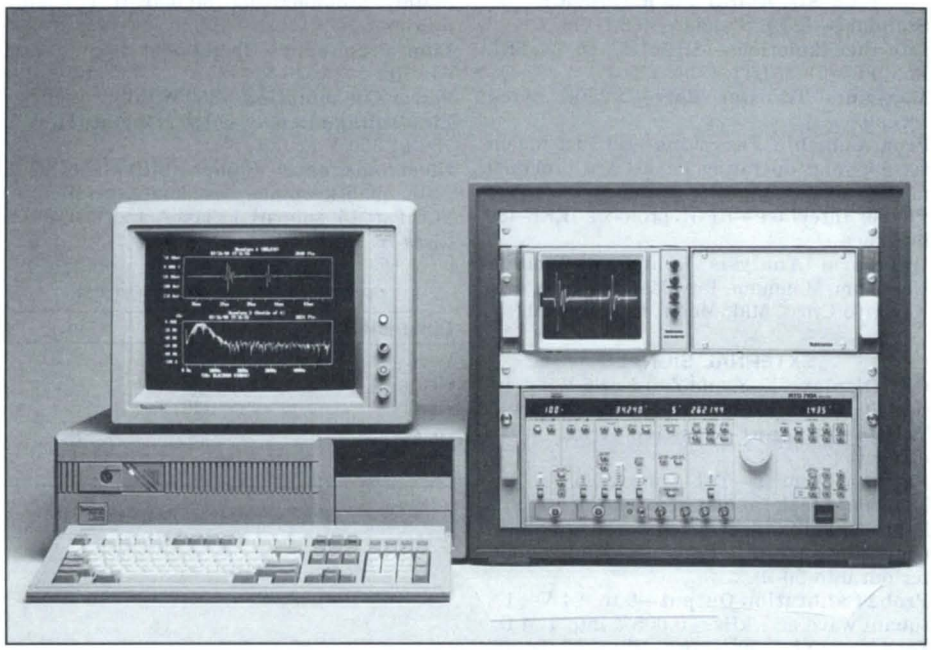
- **High Energy Physics**
- **Ultrasonics, Sonar, Radar, Lidar**
- **High Voltage Impulse Testing**
- **Power Conversion**
- **Storage Media Testing**
- **Communications and EW**
- **Video and CCD Development**
- **Semiconductor and Hybrid Test**

FEATURES

- **Automated Setup of Instrumentation**
- **Multi-Channel Waveform Acquisition**
- **Time and Frequency Domain Analysis**
- **Flexible Graphing Formats**
- **Interactive Operation from Menu**
- **User-Defined Macros for Efficiency**
- **MS-DOS Platform Provides Broad Software Compatibility**



TD1301 Acquisition and Viewing Package



TD2301 Acquisition and Analysis System

High-Performance Digitizer Systems

TD1301 supports the high-resolution transient digitizing capabilities of the RTD 710A. It provides an integrated viewing package with digitizer and monitor enclosed in a standard instrument rack.

The TD2301 system includes a Tektronix PEP 301 controller and interactive software. This package provides waveform capture, processing, analysis, display, and storage. Instrument settings, measurement environments, and application macros can also be stored and recalled as needed.

The system software package contains broad support for waveform analysis and graphic display of results. An interactive mode is provided through a direct menu scheme. As familiarity increases and operations become more repetitive, the keystroke macro feature can be used to reduce many operations to a single menu selection. Collections of macros can be stored and recalled as needed to suit the measurement problems at hand. Each macro is assigned a user-provided description to facilitate selection.

The Tektronix PEP 301 controller provides excellent processing power for waveform analysis and high quality graphics. This high-performance MS-DOS compatible platform provides support for data collection and analysis, report generation, database management, and communications with other computing resources.

Acquisition

Waveform data can be acquired from one or several RTD 710A digitizers. Probes and transducers are directly supported with scaling and unit correction for proper data representation.

Processing

Waveform processing operations such as multiplication and integration for power and energy measurements are provided. Other functions such as subtraction, differentiation, and cross-correlation are also available.

Analysis

Analysis of transient and periodic waveforms is supported through routines that extract a large number of time and amplitude parameters. Timing measure-

ments can be made on one or several waveforms with flexible control over event determination. An FFT magnitude and phase function provides frequency domain information with a number of scaling and display options.

Display

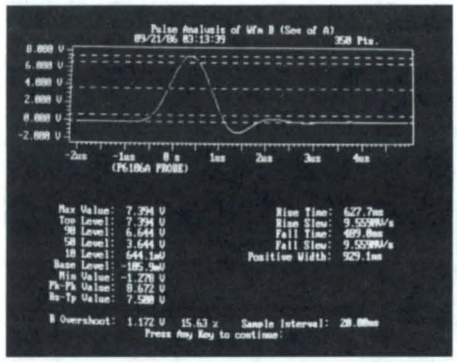
High-performance display capabilities of the PEP 301 controller are well-supported with many flexible graphing formats. The user can select single or multiple waveform displays and graphs with a variety of axis styles. Hardcopy support for a large number of output devices is provided.

Storage and Recall

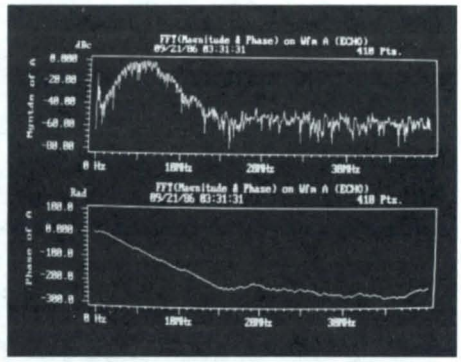
Waveform data, instrument settings, measurement environment information, and user macros can all be stored and recalled from files. This reduces the time it takes to set up the system and make accurate, repeatable measurements.

Measurement Solutions

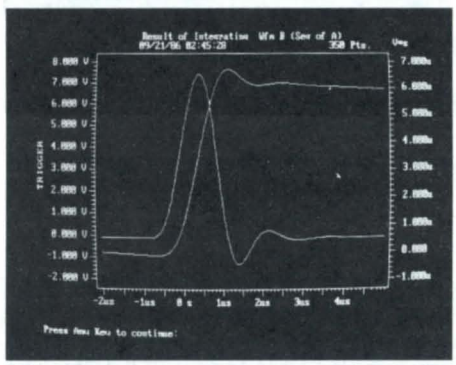
The TD2301 system provides a solution to many measurement problems in research and development applications. Flexible, efficient software and MS-DOS compatibility provide support for today's needs as well as future requirements.



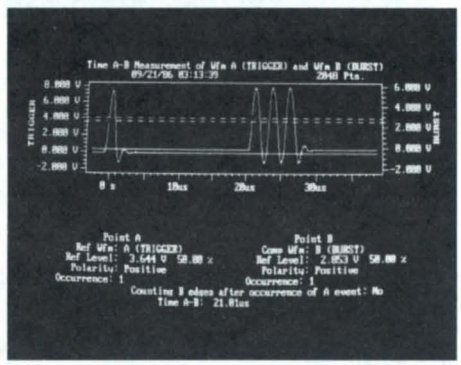
Pulse Analysis



FFT Magnitude and Phase



Integration



Time A-B Measurement

ORDERING INFORMATION

TD1301 Waveform Acquisition and Viewing Package. **$23,650**
Includes: RTD 710A, 620 Monitor, cables, mounting hardware, accessories, and cabinet.

TD2301 Waveform Acquisition and Analysis System.*[1]
Includes: RTD 710A, 620 Monitor, PEP 301 Controller, interactive software (S45D010), cables, mounting hardware, accessories, and cabinet.

OPTIONS

Option 1D—Delete Cabinet.*[1]
Option 2D—Delete RTD 710A Front Panel (Blank Panel).*[1]
Option 05—Add RTD 710A TV Trigger.*[1]
Option 1H-Add HC100 Plotter (120 V).*[1]
Option 2H—Add HC100 Plotter (240 V).*[1]

INTERNATIONAL POWER PLUG OPTIONS

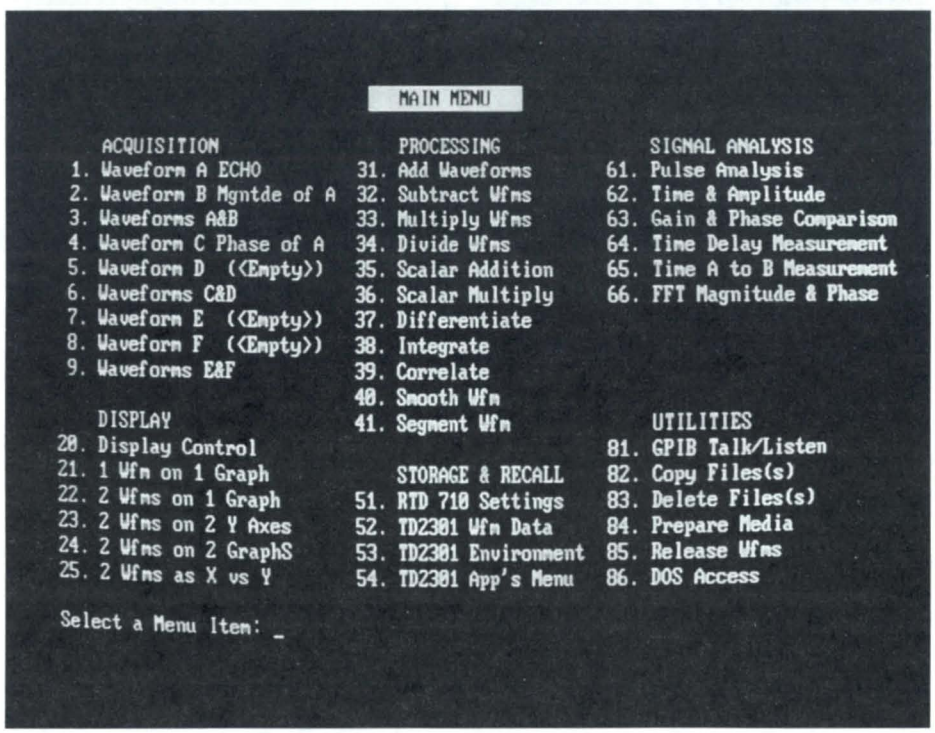
Option A1—Universal Euro 240 V.
Option A2—UK 240 V.
Option A3—Australian 240 V.
Option A4—North American 240 V.
Option A5—Switzerland 240 V.

S45D010 Interactive Measurement Software.*[1]
Includes: Interactive software on 5-¼'' floppy disk, documentation, function key overlays.

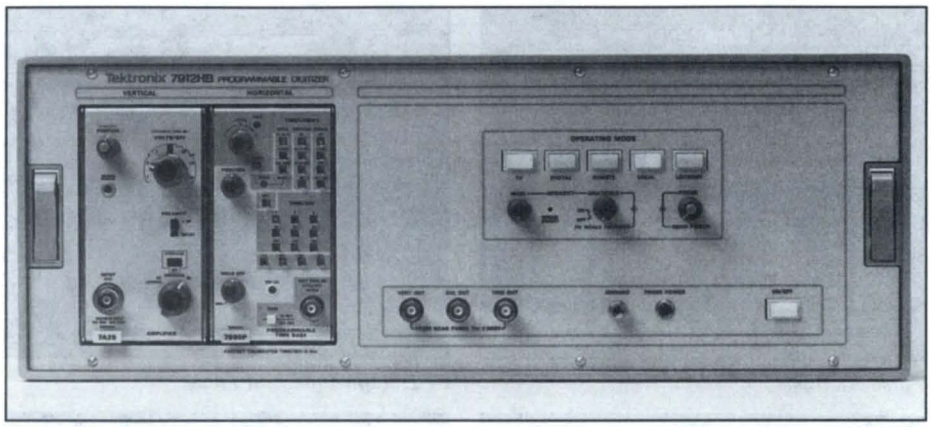
[1] Contact your local sales office.

RELATED SOFTWARE

SPD Signal Processing and Display Library—Order S3FG130. **$995**



Main Menu



7912HB Programmable Transient Waveform Digitizer

7912HB Programmable Digitizer

GPIB IEEE-488

The 7912HB complies with IEEE Standard 488-1975, and with Tektronix *Standard Codes and Formats.*.

TYPICAL APPLICATIONS

- **Laser Research and Applications**
- **EMP**
- **High-Voltage Testing**
- **RADAR/LIDAR**
- **High-Energy Physics**
- **Communications**
- **High-Energy Pulsed Power Sources**
- **Semiconductor/Hybrid Characterization**

FEATURES

- **750 MHz Analog Bandwidth with 7A29P Programmable Vertical Amplifier**
- **9-Bit Vertical Resolution**
- **Maximum Acquisition Rate 10 psec/point (100 GS/s)**
- **Time Windows From 5 nsec to 10 msec (512-Point Record)**
- **Fully Programmable Over the GPIB**
- **Built-In Signal Averaging**

The 7912HB is a high analog bandwidth transient waveform digitizer. Based on scan converter digitizer technology, the 7912HB can acquire waveform data at a maximum rate of 100 GS/s over a 5 nsec time window. Amplitude and time resolution are both 9 bits (1 part in 512), providing high resolution for signal acquisition. When used with the 7A29P programmable vertical amplifier, the instrument's bandwidth is 750 MHz. The 7B90P provides a programmable time base.

CHARACTERISTICS

DIGITIZING METHOD AND RESOLUTION

Digitizing Method—Scan conversion.
Amplitude Resolution—9 bits.
Time Resolution—9 bits covering time windows from 5 nsec to 10 msec.
Writing Rate—Full-scale sine wave of at least 500 MHz in a single sweep and full-scale pulse with rise time of 1 nsec or less.

VERTICAL

Channels—Single plug-in compartment accepts 7000-Series amplifier plug-ins. Fully programmable and highest bandwidth with 7A29P.
Bandwidth (Determined by Amplifier Plug-In)—7A29P: 750 MHz. 7A16P: 200 MHz.
Delay Line—Permits viewing leading edge of trigger event.

HORIZONTAL

Channels—Single plug-in compartment accepts 7000-Series time bases. Fully programmable with 7B90P.
Fastest Calibrated Sweep Rate—500 ps/div with the 7B90P or 7B92A time bases, provides 100 GS/s (10 psec/point) acquisition.
Slowest Recommended Sweep Rate—1 ms/div in Digital mode, provides 20 μsec/point acquisition.

GPIB INTERFACE

Standard—Conforms to IEEE Standard 488-1975.
Interface Function Subsets Implemented—SH1, AH1, TE6, LE4, SR1, PP0, DC1, C0, DT1.

ENVIRONMENTAL

Temperature Range—Operating: 0 to +40°C. Nonoperating: −55 to +75°C.
Altitude—Operating: Up to 4600 m (15,000 ft). Nonoperating: Up to 15 000 m (50,000 ft).
EMC (Plug-Ins Inserted)—Meets MIL-STD-461A and 462 radiated and conducted interference from 30 Hz to 1 GHz.

POWER REQUIREMENTS

Line-Voltage Range—90 to 132 V ac and 180 to 250 V ac.
Line Frequency —48 to 440 Hz.
Power Consumption (Including Plug-Ins)—360 W maximum.
Remote Control—Remote power On/Off capabilities provided.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	483	19.0
Height	178	7.0
Length	679	26.8
Weight ≈	**kg**	**lb**
Net	24.7	54.6

7A29P Programmable Amplifier

- **Fully Programmable Plug-In for 7912HB or 7912AD Digitizers**
- **750-MHz Bandwidth (with 7912HB)**

CHARACTERISTICS

Bandwidth (– 3 dB Point)—DC Coupled: DC to 750 MHz when used with the 7912HB; DC to 500 MHz when used with the 7912AD. AC Coupled: 1 kHz to 750 MHz when used with the 7912HB; 1 kHz to 500 MHz when used with the 7912AD.

Gain Accuracy and Deflection Factor—Accuracy (DC) is within 2% when adjusted at 0.1 V/Div. Calibrated: 10 mV/Div to 1 V/Div in a 1-2-5 sequence of 7 steps. 8 divisions represents full scale input.

Input Impedance—50 ohms.

Input Protection and Maximum Input Voltage—Internal protection circuit automatically disconnects signals exceeding 5 V RMS (0.25 watt-seconds).

Maximum Safe Input Voltage—DC Coupled: 25 V peak at less than 0.25 watt seconds; AC Coupled: add 100 V DC.

7B90P Programmable Time Base

- **Fully Programmable Plug-In for 7912HB Digitizer Only**
- **400-MHz Trigger Bandwidth**
- **Single-Sweep Operation**

CHARACTERISTICS

7B90P PROGRAMMABLE TIME BASE

Sweep Rates—1 msec/div to 10 nsec/div in a 1-2-5 sequence of 24 steps. Magnifier extends the fastest calibrated sweep speed to 500 psec/div.

Sweep Accuracy—Measured over center 8 div, +15 to +35°C.

Time/Div	Unmagnified	Magnified
500 ms to 100 ns/div	2%	3%
50 to 10 ns/div	3%	4%
500 ps/div	—	5%

Trigger Modes—Peak-to-Peak Auto; Normal; Single-Sweep.

Trigger Bandwidth—400 MHz DC Coupled: Internal Trigger 1.5 div; External Trigger 250 mV.

Internal Trigger Jitter—100 psec or less at 400 MHz.

Trigger Coupling—DC, AC, AC LF Rej, and AC HF Rej.

Trigger Sources—Internal, Line, External, and External /10.

Trigger Slope—Positive and Negative.

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

7912HB Programmable Digitizer **$20,500**
Includes: Power cord (161-0066-00); set of rack slides (351-0375-01); GPIB cables (012-0630-03); operator manual (070-6411-00).

OPTIONS

Option 13—Change TV Scan to 625 lines at 50 Hz. **NC**
Option 25—Add PEP 301 Instrument Controller. **+$7,995**
7A29P Programmable 750 MHz Vertical Amplifier. **$3,540**
7B90P Programmable Time Base. **$3,200**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

MP1101

A complete rack-mounted system, the MP1101 includes one each 7912HB, 7A16P, 7B90P, 620, 634, instrument rack and associated cables. See page 486 for more information.

ORDERING INFORMATION

MP1101 7912HB Viewing Package. **$26,000**

OPTIONS

Option 01—Delete Plug-ins. **– $2,500**
Option 10—Delete cabinet.*1
Option 13—Change scan to 50 Hz. **NC**
Option 2S—Substitute 7A29P for 7A16P. **+$750**
Option 25—Add PEP 301 Instrument Controller. **+$7,995**
Option 3D—Delete 7A16P plug-in. **– $1,000**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

*1 *Contact your local sales office.*

7250 Transient-Digitizing Oscilloscope

GPIB IEEE-488

The 7250 partially complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

- **6-GHz Bandwidth**
- **50-ps Rise Time**
- **5-V Full-Scale Sensitivity**
- **11-Bits (2048 Points) Vertical Resolution**
- **50-ps/Div Fastest Sweep**
- **9-Bits (512 Points) Horizontal Resolution**
- **Trigger Jitter 100 ps or Less**
- **Fully Programmable Via GPIB**
- **Programmable Sweep Delay**
- **Internal Memory To Save 15 (Optional 31) Waveform Acquisitions And 4 Front-Panel Setups With Five-Year Battery Backup**
- **Target-Defect Correction**
- **Filtering And Smoothing**
- **On-Screen Cursors**
- **Built-In Waveform-Parameter Measurements**
- **Sinusoidal Sweep (Rossi) Input Capability**

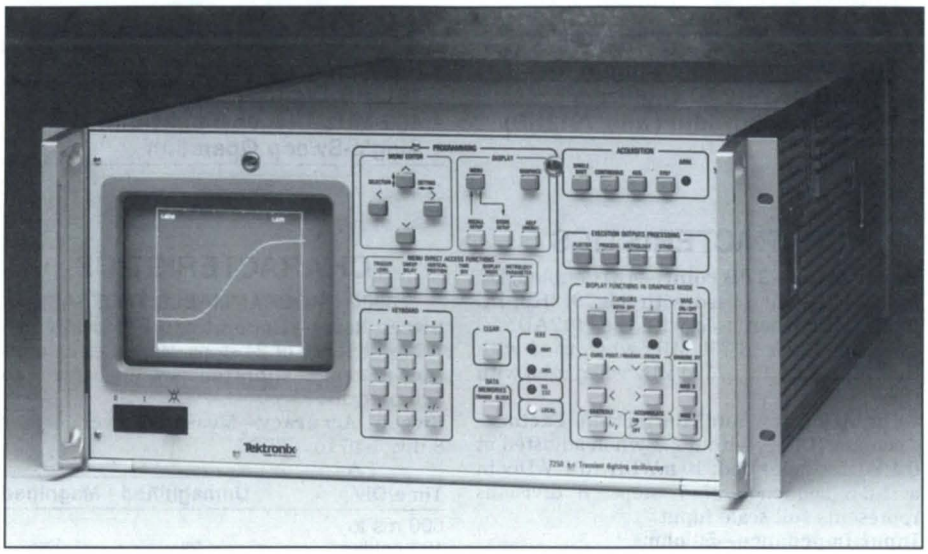
The Tektronix 7250 Transient-Digitizing Oscilloscope is a high-speed instrument that can acquire fast single-shot or repetitive signals and display them digitally. It is designed specifically to capture and record very high-frequency, fast rise-time pulses. The instrument provides a dc to 6-GHz (−3 dB) bandwidth, 50-picosecond rise time, and is fully programmble via GPIB.

Transient Digitizing Lets You View and Digitize Single-Shot Events or Non-repetitive Waveforms.

The scan conversion used in the 7250 lets you do all this at very high frequencies and fast rise times, something most digitizing oscilloscopes cannot do. Waveforms are processed for display on the TV-type monitor.

Other major features of the 7250 are menu-driven operation and on-screen cursors for ease of operation. Fast setup, immediate feedback with the built-in monitor, and interactive controls also contribute to operating ease.

Split-screen operation lets you compare a stored waveform with a newly acquired waveform or display two acquisitions on one screen. The ability to measure important waveform parameters is built-in, and it is fully programmable via GPIB. Also, the instrument is designed to rigorous standards for modularity, easy repair, and ruggedness. It is built to maintain its performance in adverse environments.



APPLICATIONS

Particle Physics Research

The challenge in this type of research is the recording of nonrepetitive, high-voltage, fast-rise, narrow pulses. The 7250 was built specifically for these kinds of measurements and handles them with ease. These types of signals cannot be measured on most digitizers or digital-storage scopes because they require repetitive waveforms and typically do not handle the high frequencies and fast transition times involved.

High-Power Laser Research

A transient-digitizing oscilloscope is the ideal instrument for capturing transient electrical phenomena in laser research. The 7250 can capture and digitize this data and, because the instrument is fully programmable and GPIB compatible, the data can be fed directly to a minicomputer for fast analysis after each laser shot.

CHARACTERISTICS

VERTICAL

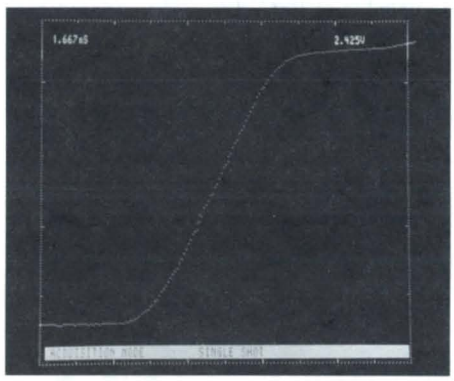
Bandwidth—DC to 6 GHz (−3 dB).
Rise Time—50 ps ±5 ps.
Sensitivity—5 V±15%, full scale.
Input Impedance—50 Ω ±2 Ω.
Input VSWR—Less than 1.5 (0 to 2 GHz), less than 2.5 (2.5 to 7 GHz).
Loop-Through Transmission-Line Loss—Less than 2 dB (0 to 5 GHz).
Maximum Input Voltage—2 kV (1-μs duration).
Vertical Position—0 to 100% in 1% steps.

HORIZONTAL

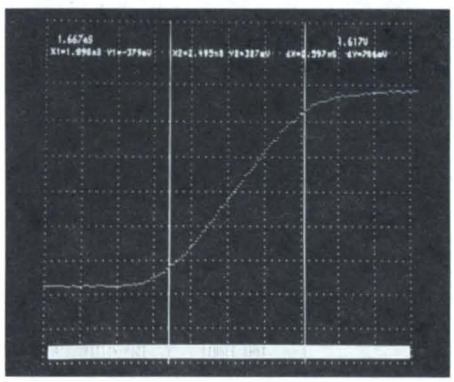
Sweep Rates—1 μs to 50 ps/div, 14 ranges in a 1,2,5 sequence.
Sweep Accuracy—2% over center 8 divisions.
Sweep Linearity—1.5% of full scale on center 8 divisions. No worse than 0.15 division in any one division.

TRIGGERING

Source—External triggering only. Requires 50-ns, ± slope pre-trigger signal. Optional delay line provides trigger pick-off.
Coupling—direct.



7250 CRT display of pulse rise-time measurement.



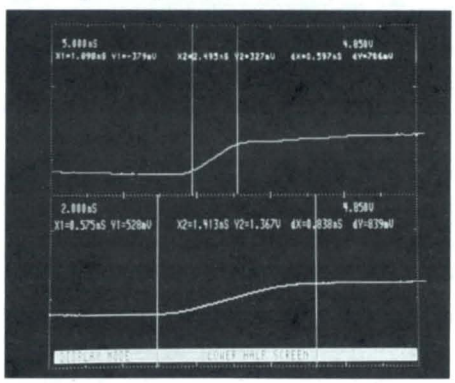
7250 CRT photo of on-screen cursors. Cursors show the vertical and horizontal setting at any two points on the display, plus the difference between these two points.

Level—Programmable 50 mV to 10 V in two ranges.
Modes—Normal: pulse duration greater than 10 ns; Fast: pulse duration greater than 400 ps and less than 20 ns.
Input Impedance—50 Ω ±5%.
Maximum Input—250 mW, 500 V peak-to-peak at 1-μs duration.
Jitter—100 ps or less (peak-to-peak).
Delay Drift—±500 ps, over the period of 10 minutes to 1 hour at 50 ps/div and 100-ns sweep delay.
Sweep Delay—Minimum delay 50 ns ±2 ns. Adjustable in 5 ranges: 50 to 100 ns (50-ps resolution), 100 to 150 ns (100-ps resolution), 150 to 500 ns (500-ps resolution), 500 ns to 1 μs (1-ns resolution), and 1 to 5 μs (5-ns resolution).

DIGITIZER

Resolution—11 bits vertical, 9 bits horizontal (2048 vertical points, 512 horizontal points).
Memory—Internal memory to save 15 waveform acquisitions (31 acquisitions with optional additional memory) with five-year battery backup. Can also save 4 front-panel setups.

7250 CRT photo of MAIN MENU. The MAIN MENU lets you select and change the parameter you want. Other menus available are secondary MENU for setting internal parameters and a HELP MENU for viewing the choice of settings available.



7250 CRT photo of split-screen display. The split screen lets you display and make measurements on two waveforms simultaneously.

WAVEFORM PROCESSING

Target Defect Correction—Corrects for defects in the reading-tube image target.
Filtering—Redundant y values are suppressed and missing y values are created.
Smoothing—Mathematical smoothing operation based on averaging over adjacent points.

Acquisition Modes

Single Shot—Acquires and displays a waveform one time.
Continuous—Continuously acquires and displays waveforms.
Burst—Acquires and stores several waveforms in successive memory blocks. Number of acquisitions is set by the user up to the maximum memory locations.
Average—Acquires and averages a number of waveform acquisitions, then displays the averaged waveform. Number of averages is set by the user, 256 maximum.
Envelope—Acquires a number of waveforms set by the user, 256 maximum. After the last acquisition, the envelope is updated, and the curve is displayed.
Defects Correction—Acquires a waveform a number of times set by the user. A table of faults from the waveform is updated in memory for subtraction from any stored curve.
Electrical Zero—Allows acquisition of an electrical baseline, and acquires a waveform a number of times set by the user. At each acquisition, an average curve in a buffer area is updated. After the last acquisition, an electrical zero value is calculated, stored, and can then be used with the cursors.

WAVEFORM MEASUREMENT

Electronic Graticules—Full screen or border only.
Cursors—Two vertical cursors with CRT readout of x and y coordinates of cursor and waveform crossing point, plus delta time and voltage between cursors.
Magnifier—Cross-hair type cursors for setting display window to be magnified. Provides up to 16 times magnification both vertically and horizontally.
Automatic Measurement—Min/max, peak-to-peak, average value, rms value, rise time/fall time, pulse width, delay time, delta time.

INPUTS/OUTPUTS

Signal Input, Signal Output, GPIB*[1], Control Video, Trigger Input.
RS 232C—Plotter output.
Video Monitor-CCIR output and sync input.
External Sweep Input—Allows use of sinusoidal (Rossi) sweep to 3 GHz.

*[1] *Does not comply with all provisions of IEEE 488.1-1987 or with Tektronix Standard Codes and Formats.*

OPTION 01 EXTERNAL DELAY LINE

Bandwidth—≥4.5 GHz.
Attenuation—4.5 dB ±0.5 dB.
Delay—55 ns ±2 ns.
Rise Time—≤75 ps.
Maximum Input Voltage—5 Vdc.
Maximum Pulse Input—60 V.
Input Impedance—50 Ω ±5%.
Input/Output Connectors—N type.
Trigger Pickoff—Attenuation, 20 dB±1 dB; rise time 300 ps; connector, BNC.
Dimensions—19-in. rack width; 2 rack units height; 32.5-in. (800 mm) depth.

ENVIRONMENTAL

Temperature—Operating: 0 to 40°C. Nonoperating: −10 to 70°C.
Altitude—Operating: 3 km (10,000 ft). Nonoperating: 12 km (40,000 ft).
Humidity—Operating: 90% at 40°C.

POWER REQUIREMENTS

Line Voltage—115 V ±10%, 220 V ± 10%.
Line Frequency—50 to 60 Hz ±4%.
Power Consumption—200 W.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	483	19.0
Height	222	8.7
Depth	915	36.0
Weight ≈	**kg**	**lb**
Net	60	132.3
Shipping	110	242

ORDERING INFORMATION

7250 6-GHz Transient-Digitizing Oscilloscope **$99,995**

OPTIONS

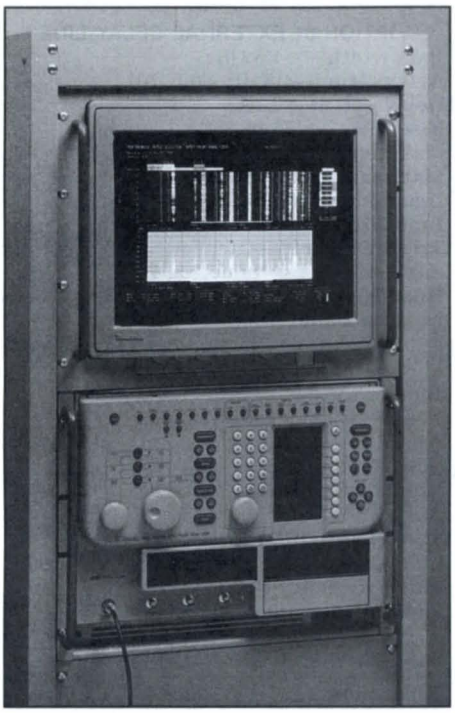
Option 01—External delay line **+$12,500**
Option 2D—Extended Memory **+$2,400**

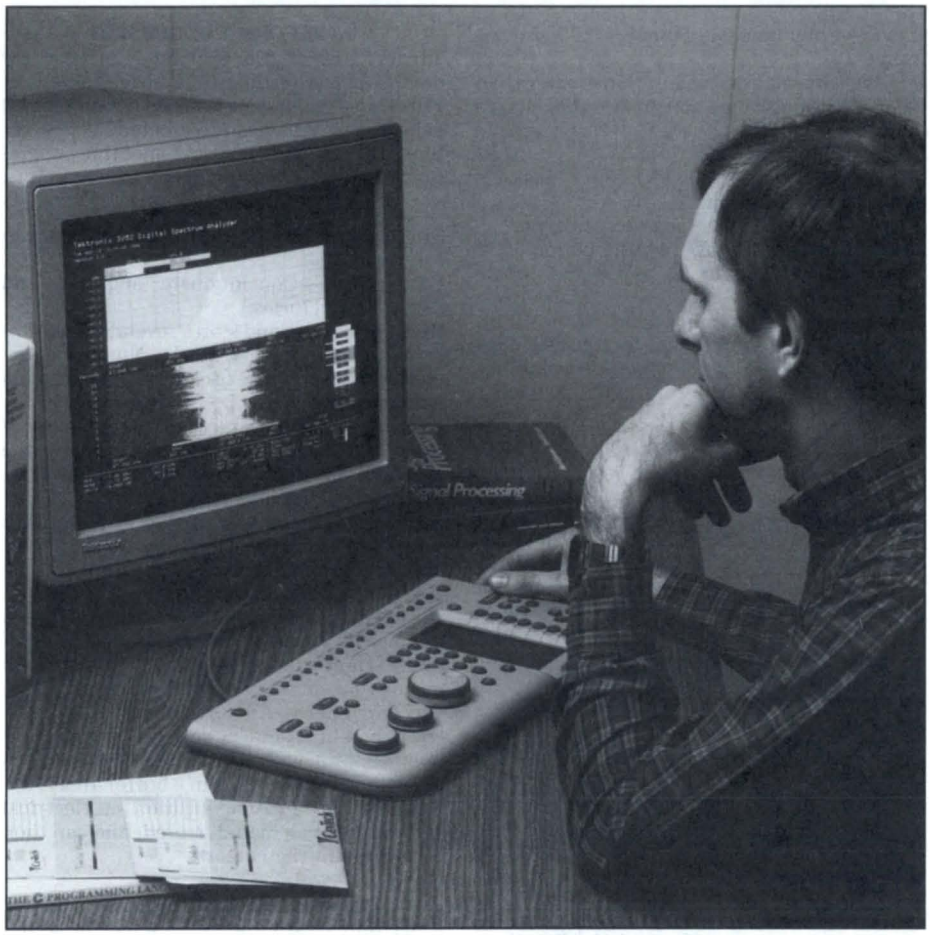
INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220V, 50 Hz.
Option A2—UK 240V, 50 Hz.
Option A5—Switzerland 220V, 50 Hz.

OPTIONAL ACCESSORIES

HC01—4×5 in. Video Copier. See page 502. **$1,235**
HC02—8×10 in. Video Copier. See page 502. **$1,645**





The 3052 is a viable signal-processing system component where speed and accuracy are especially important.

3052 Digital Spectrum Analyzer System

TYPICAL APPLICATIONS

- **High Throughput Manufacturing Test**
- **Radar Signal Processing**
- **Telecommunications ATE**

FEATURES

- **Three-Dimensional Signal Analysis**
- **Digitizes Time-Domain Signals, Continuously Transforms to Frequency Domain**
- **Viable Signal Processing System Component for Rigorous Test and Analysis Applications**
- **UNIX™-Type Operating System and C Compiler**

The 3052 offers users high throughput frequency domain characterization of signals from complex electronic subsystems. With a real time bandwidth of 2 MHz, the analyzer continuously digitizes and transforms time domain signals to the frequency domain for rigorous modulation analysis and characterization. Users can then look at difficult-to-capture spectral transients, frequency response, distortion products, and harmonics. These can be viewed on a three dimensional basis (time, frequency and amplitude) using the 3052's advanced graphics modes.

An advanced design, the 3052 utilizes a bank of parallel bandpass filters to separate the input time domain signal into its constituent frequency components. For many manufacturing test applications, it offers a viable alternative to conventional FFT techniques, with advantages in speed and amplitude accuracy. For more information, please turn to page 94.

ORDERING INFORMATION

3052 Digital Spectrum Analyzer System. **$75,000**
Includes: Operators manual; maintenance manual; and operators guide.

OPTIONS

Option 01—GPIB (IEEE-488.2) Interface. Functions as a "listener/talker." **+$1,995**
Includes: VME board and driver software.
Option 10—Real-Time Interface **+$9,500**
Includes: Two RS422 compatible digital data outputs; Spectral Event Detect output; and analog outputs for Tek 608 monitor, oscilloscope and oscillographic recorder.
Option 11—Compatibility with Tek 4696 Color Ink-Jet Primter. **+$1,495**
Includes: Parallel printer port, cable and driver software.

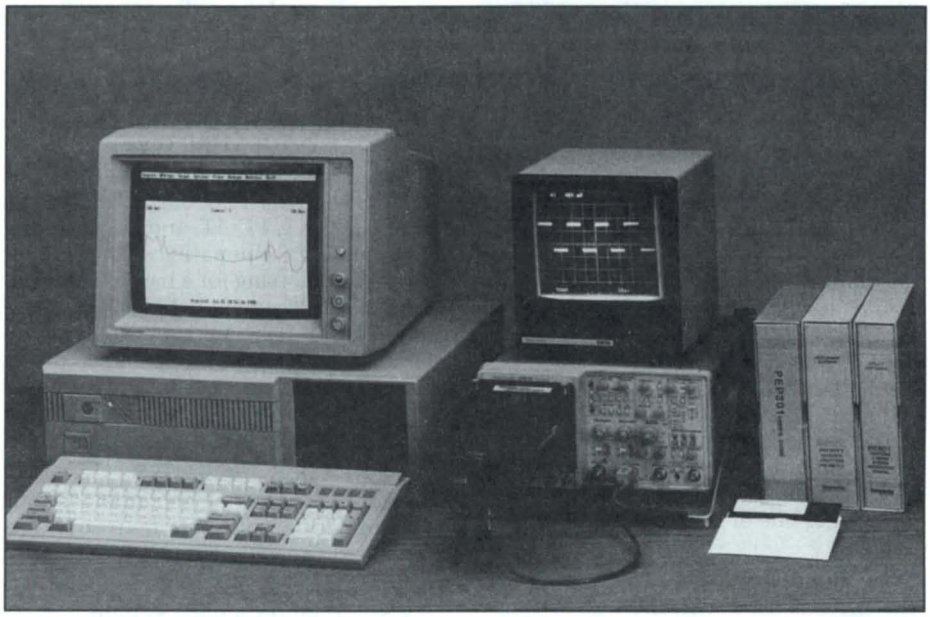
INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.

WARRANTY

On-site 90 days part and labor.

UNIX is a trademark of AT&T.



The Digitizing Camera System consists of the C1001 Camera, frame store board inside the PC, DCS software and cables. The system shown includes the DCS, Tek's 2467 scope and DX05 video monitor.

DCS01 Digitizing Camera System

TYPICAL APPLICATIONS

- **High-Energy Physics**
- **Telecommunications**
- **Laser Research**
- **Electrostatic Discharge Tests**
- **High-Speed Logic Testing**
- **ECM Research**
- **Imaging**
- **Surveillance**
- **Remote Monitoring**
- **Presentations/Training**
- **Documentation**

FEATURES

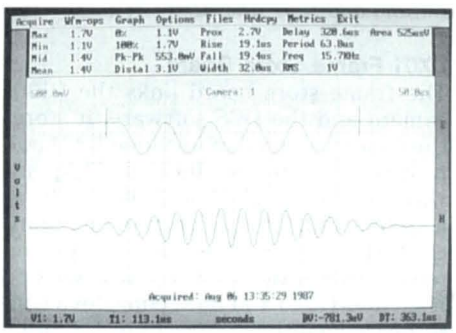
- **Upgrades Many Analog Scopes to Waveform Digitizer Systems**
- **Digitizes 1-GHz Single-Shot Waveforms with 7104 Scope**
- **Up to 12 Bits Nominal Digitizing Resolution (Repetitive)**
- **Simultaneously Digitizes 2 Non-crossing Waveforms**
- **Digitizes Up to 16 Channels (32 Waveforms) with TEK PEP301 Controller, IBM PC or Compatible or PC Expansion Chassis**
- **Menu-Driven, Mouse Compatible System Software**
- **Display Acquired Waveforms with CGA, EGA, VGA or Hercules MGA Resolution**
- **User-Friendly Waveform Analysis and Processing Functions**
- **Powerful Waveform Acquisition Tools Like SAVE-On-Delta™ and Trigger on Light**
- **Waveform Files Compatible with Tek Signal Processing (SPD) Software (S3FG130)**
- **User Programmable with S58DC01 Functional Library**

The Digitizing Camera System (DCS) integrates the analog oscilloscope and the personal computer into a leading-edge waveform digitization and analysis system. By combining significant advances in optics, signal-processing hardware and software with Tektronix long-standing leadership in high-performance analog oscilloscope technology, the DCS builds complete signal acquisition systems that capture repetitive and transient signals at the scope's full bandwidth. Systems with Tektronix scopes employing Micro Channel Plate (MCP) CRT technology like the 2467B, 11302A, and 7104/R7103 offer digitizing bandwidths of 350 MHz, 500 MHz and 1 GHz, respectively, with nominal digitizing resolution of up to 12 bits for repetitive signals and 9 bits for single-shot signals.

A Digital Camera System consists of the DX01 frame store board, the C1001 video camera and its high-resolution lens, DCS operating software interconnecting cables and an operators manual.

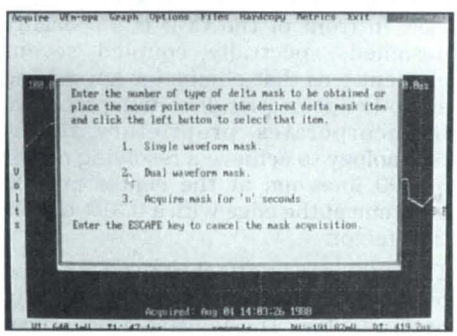
The *NEW* DCS V2.0 software adds dual-trace and multiple-channel capabilities to the highly functional feature set found in the previous DCS software.

DCS V2.0's mouse or key-operated menus let you quickly select commands that provide instant control of the software's many signal-analysis and processing functions. You can simultaneously acquire two noncrossing waveforms and display them with CGA, EGA or VGA resolution on the PC screen. And you can acquire waveforms from up to 16 C1001 cameras and DX01 frame store boards with a PC (with expansion chassis) and the multiple channel support feature of DCS V2.0.



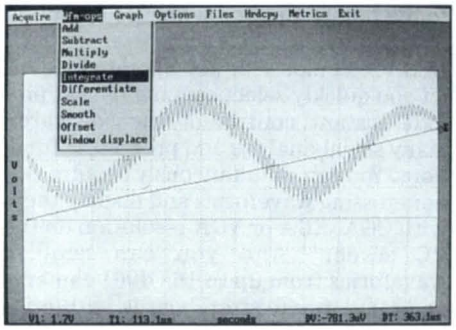
DCS V2.0 software can simultaneously acquire 2 noncrossing waveforms.

Other software provided functions enable you to easily control acquisition settings, scope settings, system focus and calibration, graphing waveforms and windowing parametric functions such as rise time, fall time, frequency and area under the curve. DCS V2.0 provides the Save-On-Delta™ feature as a menu choice to allow you to easily set comparative tolerances for capturing and analyzing transient waveforms.



Menu selected Save-On-Delta makes it easy to quickly find out-of-tolerance signals.

Other software features allow you to mathematically analyze acquired waveforms as well as manually or automatically save them to disk and print them on Tek's HC100 Color Plotter, HC02 Video Copier, or other non-Tek compatible printers like Epson or IBM.



Manipulate waveforms mathematically by using such procedures as integration, differentiation, addition, and subtraction.

DX01 Frame Store Board

The frame store board links the C1001 camera and the DCS software. It stores the camera's signal in its video RAM and processes it to produce a 512-point waveform array. The board also produces a system calibration signal and contains circuitry to provide camera power, remote triggering capability, single-sweep reset and video and hard copy device interfaces. Real-time direct-to-disk writing of event-triggered waveforms, disk writing or processed waveforms or raw video, and real-time comparison and summing of video data are other functions supported by the frame store board.

C1001 Video Camera

The C1001 is an optically coupled CCD video camera that uses 490 by 384 photosensitive elements to capture oscilloscope waveform images. Video CCD technology ensures images are captured undegraded by blooming, lagging, burning, geometric distortion or saturation recovery delay characteristics of other video technologies. In front of the CCD is a specially designed, spectrally coupled seven-element lens that eliminates keystoning and other geometric-distortion problems. It incorporates proprietary optics technology to achieve a resolving power of 100 lines/mm at the center and 20 lines/mm at the edge with a 0.31% distortion factor.

The C1001 can be attached to most analog oscilloscopes by optional, swing-away bezel adaptors. The adjustable magnification feature allows you to adjust the DCS for either 7.2×9.0 cm or 8.00×10.0 cm CRT dimensions. A special ruggedized adaptor is available for applications involving Tek's 7K scopes in an environment subject to physical shock or vibration. Contact your local Tektronix Sales office for details.

The C1001 can be used with the DX02 and an HC02 to easily document images.

The C1001 can be used without the frame store board and DCS software to capture and save or print scope or non-scope images. This is accomplished by using the DX02 camera power supply/video interface (C1001 Option 04) and a video recorder or one of Tek's HC01/HC02 Video Copiers.

DX05 Video Monitor

The DX05 is used with the DCS to speed system set-up/calibration. The DX05 shows you what the camera sees, allowing you to easily and quickly make scope and camera adjustments needed to capture the signal you want to analyze.

DCS Non-Scope Applications

The optional S58DC01 DCS Functional Library allows you to access the functionality of the frame store board with your programs. Source code written for Microsoft's "C" compiler V5.0 is included with each S58DC01 package as well as object modules, a library and a programmer's manual. A Knowledge of "C," Pascal, FORTRAN, or Quick Basic and a compiler are needed to take full advantage of this DCS user-programmable feature.

Optional Software

DCS applications involving Tek's 2467B (with Option 10) or 11302A oscilloscopes may be enhanced by optional software. S58DC02 and S58DC04 add GPIB scope control to the DCS software features for enhanced system performance with the 2467B and 11302A. While this special software is not mouse compatible and supports only CGA and Hercules MGA displays, it is menu driven and allows changing the scope settings from the PC. Also, it allows the DCS to read scope settings for use in making waveform parameter computations.

OSCILLOSCOPE COMPATIBILITY

The DCS may be used with scopes with 7.2×9.0 cm or 8.0×10.0 cm CRT image areas. Recommended MCP scopes include the 2467B 400 MHz four-channel portable oscilloscope, the 11302A 500 MHz programmable analog oscilloscope with an 11A71 plug-in, and the 7104 1 GHz real-time oscilloscope with a 7B10 time base and 7A29 dual-trace amplifier plug-in.

COMPUTER/CONTROLLER COMPATIBILITY

Tektronix has verified the operation of the DCS with the Tektronix PEP301, the IBM PC, PC XT, PC AT, and PC Portable, and Compaq PC compatibles. The DCS requires the following for a base PC system: IBM PC, XT, AT or compatible, 512K bytes memory, MS-DOS V2.1 or higher, one 360K or 1.2M byte floppy disk drive, numerical co-processor chip, color graphics adaptor, and a monochrome monitor.

DCS PACKAGES

To assist in configuring and ordering your complete DCS system, Tektronix has assembled the following DCS packages:

DCS P10—
DCS01 Digital Camera System
PEP301 System Controller
DX05 Video Monitor
Bezel Adaptor Options

DCS P11—
DCS01 Digital Camera System
PEP301 System Controller
DX05 Video Monitor
2467B Scope with GPIB
S58DC02 DCS/2467 Software
2467B Bezel Adaptor
2467B Rack Mounting Option

DCS P12—
DCS01 Digital Camera System
PEP301 System Controller
DX05 Video Monitor
7104 Scope
7A29 & 7B10 Scope Plug-ins
7K Bezel Adaptor
7104 to R7103 Replacement Option

DCS P13—
DCS01 Digital Camera System
PEP301 System Controller
DX05 Video Monitor
11302A Scope
11A71 Scope Plug-in
S58DC04 DCS/11302 Software
11302A Bezel Adaptor
11302A Rack Mounting Option

Contact your local Tektronix Sales office to order these packages or for further details.

CHARACTERISTICS

The following DCS specifications are valid when the camera system is operated at a temperature between 0 to 40 °C.

DCS01

Digitizing Technique—Scan Conversion.
System Writing Speed—MCP Scopes: To bandwidth of the scope (single shot and repetitive). Non-MCP scopes: Single shot, dependent on scope's photographic writing speed; repetitive, to bandwidth of scope. Note: an analog scope's writing speed varies depending on the age of the scope/CRT, phosphor, CRT filters, intensity settings, accelerating potential, etc. Usually, if you can see the entire waveform, the DCS can capture it.
Nominal Digitizing Resolution—12 bits repetitive, 8 to 9 bits single shot (baseline RMS is greater than 74 dB, S/N).
Record Length—512 points.
Number of Traces/Acquisition—1 or 2 for each DX01 present.
Number of Channels—Up to 16 with PC expansion chassis.
Signal Acquisition Rate—With IBM PC/AT: time to capture, digitize and display on screen is approximately 2 to 4 seconds.
Maximum Displayed Waveforms—6.
Number of Active Waveforms—26.
Calibration Output Signal—Into 50 ohms: 20 kHz ±0.1%. Square wave with software controlled amplitude range from 100 to 800 mV in eight 100 mV ±0.2% steps.
Video Output Signal—NTSC standard, RS170 from DX01 memory or live from C1001.
Scope Reset Signal Output—12 V Pulse.
Power Requirements—DX01 and C1001: +12 V: <300 mA; −5 V: <35 mA; +5 V: <2.5 A. Total is less than 16.5 W.
DX01 (Frame Store Board)—Requires full-length slot in IBM PC. (Approximately 13.25 in. or 336.6 mm long.)

C1001 CAMERA

Focal Length—10.746 mm at 5200 A.
F Number at Infinity—F/1.3.
Object-to-Image Distance—
1633.542 mm at 0.075X,
144.723 mm at 0.833S.
Field of View (Variable Mag.)—7.2×9.0 cm and 8.0×10.0 cm.
Spectral Range—400 to 600 nm within 3 dB.
Angular Range—23.45°.
Distortion—Within 0.3% at image plane.
Lens Resolution—Center: 100 lines/mm, Edge: 20 lines/mm.
Imaging Device—Solid State, Inter-line CCD.
Pixels—490 vertical by 384 horizontal.
Resolution—480 vertical lines by 285 horizontal lines.
S/N Ratio—Typical: 50 dB; minimum: 47 dB. Gamma=1.
Sensitivity—3 Lux.
Video Output—1 V p-p Composite video, 75 Ω.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	120	4.8
Height	104	4.1
Depth	241	9.5
Weight ≈	**kg**	**lb**
With scope mounting adaptor	1.4	3.0

DX02 CAMERA POWER SUPPLY AND VIDEO INTERFACE

Number of Cameras Supported—1 or 2.
Output per Camera—+12 V ±5% at 0 to 600 mA with 1 mV ripple or less at 500 mA load.
Video Out—75 Ω feedthrough from each camera.
Input Power Requirements—at 88 to 270 V ac, 40 to 440 Hz, 24 W maximum.
Safety Certifications—U.L., CSA, VDE.
EMI Compliance—Qualifies under test limits specified for VDE 0871, Class B, emissions limitations.
Environmental Considerations—Operating: 0 to 40 °C; up to 90% relative humidity at 40 °C; up to 15,000 feet or 4.5 km above sea level. Nonoperating: −55 to 75 °C; up to 90% relative humidity at 60 °C, up to 50,000 feet or 15 km above sea level.

ORDERING INFORMATION

DCS01

DCS01 Digitizing Camera System. **$6,500**
Includes: C1001 Camera, DX01 Frame Store Board, DCS V2 software on 5¼ in. floppy disk, DCS cable (174-0449-00), three BNC to SS cables (174-0430-00), and operator's manual (070-6175-00). Requires optional camera adaptor bezel(s).

OPTIONS

Option 1A—Adaptor Bezel for Tek 5K, 7K, 11301/11302 scopes (016-0248-01). **+$95**
Option 2A—Adaptor Bezel for Tek 2400 Series and scopes with 8×10 cm CRTs (016-0269-03). **+$105**
Option 3A—Adaptor Bezel for Tek 485 Series and scopes with 7×9 cm CRTs (016-0306-01). **+$105**

C1001 CAMERA

C1001 Video Camera. **$2,900**
Includes: Camera, cable (174-0449-00), instruction manual. Requires optional camera adaptor bezel(s) and external power (Option 04).

OPTIONS

Option 1A—Adaptor Bezel for Tek 5K, 7K, 11301/11302 scopes (016-0248-01). **+$95**
Option 2A—Adaptor Bezel for Tek 2400 Series and scopes with 8×10 cm CRTs (016-0269-03). **+$105**
Option 3A—Adaptor Bezel for Tek 485 Series and scopes with 7×9 cm CRTs (016-0306-01). **+$105**
Option 04—DX02 camera power supply and video interface. **+$285**

Note: When ordering the C1001 with Option 04, please select one of the A0 through A5 power plug options. For example, a C1001 with Option 04 and A0 includes a DX02 set for 120 V and a C1001 with Option 04 and A1 includes a DX02 set for 240 V with a universal European plug.

DX01 FRAME STORE BOARD

DX01 DCS Frame Store Board. **$2,800**
Includes: DCS frame store board, three BNC to SS cables (174-0430-00), operator's manual.

DX01 OPTIONS

Option 01—DCS V2 Software. **+$800**
(A C1001 and DX01 with Option 01 is equivalent to a DCS01).

DX02 CAMERA POWER SUPPLY AND VIDEO INTERFACE

DX02 C1001 Power Supply/Video Interface, 110 V version. **$285**
(A1 through A5 power plug options available.)

DX05 VIDEO MONITOR

DX05—9 inch Video Monitor. **$290**
Note: The DX05 is available with A0 and A1 power plug options only.

INTERNATIONAL POWER PLUG OPTIONS

Option A0—Standard North American 120 V, 60 Hz.
Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

RECOMMENDED SOFTWARE

S58DC01—DCS Functional library with source code. **$360**
S58DC02—DCS V1 with GPIB Interface for 2467B. **$295**
S58DC04—DCS V1 with GPIB Interface for 11302A. **$295**
DCS V2.0—Software and Manual. Order 062-9859-00. **$800**
S3FG130 Option 01—Signal Processing and Display (SPD) Software. **$995**

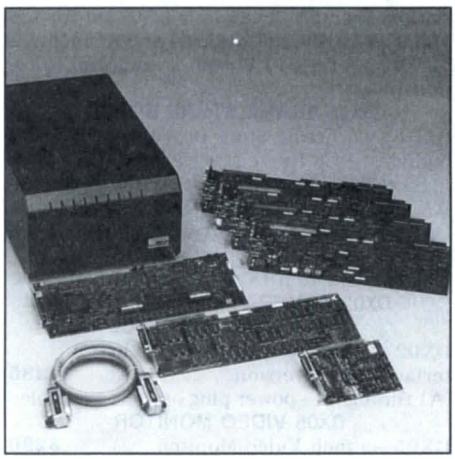
DCS PACKAGES

Note: Contact your local Tektronix Sales office for additional information.

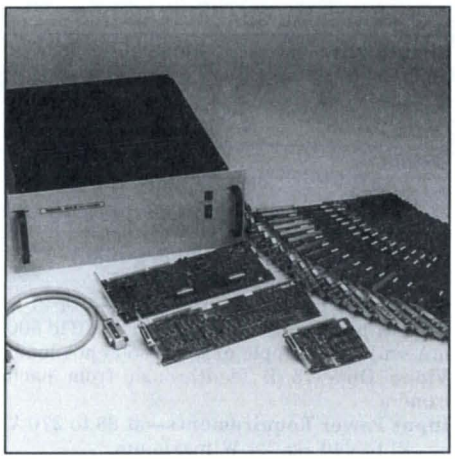
DCS P10—DCS01, DX05, and PEP 301. **$14,785**
DCS P11—DCS01, DX05, PEP 301 and 2467B. **$28,015**
DCS P12—DCS01, DX05, PEP 301, 7104, 7A29, and 7B10. **$48,035**
DCS P13—DCS01, DX05, PEP301, 11302A, 11A71. **$31,015**

OPTIONAL INSTRUMENTATION

2467B—400 MHz Portable Scope. See page 159. **$11,990**
7104—1 GHz Scope Mainframe. See page 203. **$26,695**
11302A—500 MHz Scope Mainframe. See page 195. **$12,950**
HC100—Four Color Plotter. See page 502. **$825**
HC01—4×5 inch Thermal Video Copier. See page 501. **$1,235**
HC02—8×10 inch Thermal Video Copier. See page 501. **$1,645**
Thermal Paper—4 rolls per box.
(For HC01) Order 016-0867-01. **$45**
(For HC02) Order 016-0868-01. **$85**



MUX04—Bench Top



MUX16—Rackmount

Mainframes shown with DX01 frame store boards, 80286 CPU board, GPIB PC III and PC-IIA boards, and GPIB cables.

MUX04, MUX16

Mainframes

GPIB IEEE-488 The MUX04 and MUX16 comply with IEEE 488.1-1987 and with Tektronix Standard Codes and Formats

- **One Host Can Control Up to 256 DCS (16 MUX16s)**
- **MUX04 Supports Up to 4 DCS**
- **MUX16 Supports Up to 16 DCS**
- **Fully Programmable Over GPIB**

The DCS, MUX04, MUX16, in conjunction with a host controller, is part of a programmable multiple-channel digitizer system. Users can control up to 256 DCSs with one host controller.

Operation

The MUX04 and MUX16 are designed to be used with a host controller and are not capable of standalone operation without additional hardware and software. The controller must have a compatible GPIB interface card capable of system controller/controller in charge operation. Controllers supported include: Tek PEP 301, IBM PC or compatible, VAX or MicroVAX.

The MUX mainframe is a talker-listener to the controller via the GPIB. The controller downloads the MUX operating software to the MUX. After the frame store boards acquire the waveforms, the stored video images are processed by the MUX CPU to produce waveform files. The waveform files then can be uploaded to the host controller for additional processing and/or storage.

GPIB-controlled scopes can be controlled by the host via the MUX by the use of a PC-IIA board to interface to the scopes. Faster processing speed of approximately three times can be obtained with the use of an optional 80386 CPU.

Benchtop/Rackmount Models

The MUX04 is the benchtop model with six slots to hold up to four DCS frame store boards. The MUX16 is the rackmount model with 19 slots and will hold up to 16 DCS frame store boards.

Software

One of the software packages, specifically compiled in the proper format, is required for operation of the MUX system. The acquired waveform data is presented as a graphic representation or as logging of data (no graphic representation or manipulation of data).

CHARACTERISTICS

POWER REQUIREMENTS

User configurable. Cooling is provided by fans.
Line Voltage Ranges—90 to 130 V ac or 180 to 264 V ac.
Line Frequency—47 to 83 Hz, single phase.
Power Consumption—MUX04: 150 W. MUX16: 400 W.

PHYSICAL CHARACTERISTICS

	MUX04		MUX16	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	270	10.6	483	19.0
Height	165	6.5	178	7.0
Depth	448	17.6	985	220
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	10.9	24	21.8	48
Shipping	10.4	23	21.3	47

ORDERING INFORMATION

MUX04 Benchtop Multi-Channel DCS Mainframe, 110 V. **$3,900**
Includes: 4 open slots; 80286 CPU; PC-III; Instruction manual; power cord; 1 m GPIB cable.

MUX16 Rackmount Multi-Channel DCS Mainframe, 110 V. **$5,900**
Includes: 16 open slots; 80286 CPU; Chassis slide; PC-III; Instruction manual; power cord; 2 m GPIB cable.

OPTIONS

Option 01*1—80286 board is deleted and 80386 CPU board is added. **+$950**
Option 02*2—2M memory card (used with 80386 option only). **+$1,800**
Option 03*2—4M memory (two 2M cards) used with 80386 only. **+$3,600**
Option 04—GPIB low-speed interface card (PCIIA) for MUX. **+$495**
Option 05—Extra GPIB high-speed interface card (PCIII) for use in the host controller PC. **+$795**

SOFTWARE OPTIONS

Option 10—MSDOS MUX Data Logging software for PC. **+$1,000**
Option 11—MSDOS DCS/MUX Remote software for a PC. **+$1,200**
Option 12—VAX/ULTRIX MUX Data Logging software. **+$2,500**
Option 13—VAX/VMS MUX Data Logging software. **+$2,500**
Option 14—MicroVAX/ULTRIX MUX Data Logging software. **+$2,500**
Option 15—MicroVAX/VMX MUX Data Logging software. **+$2,500**

MUX04 OPTIONS

Option 22*3—C1001/DCS Package for 11K/7K scopes. **+$23,400**
Option 23*3—C1001/DCS Package for 2400 Series scopes. **+$24,100**

*1 *Memory is required for the 80386.*
*2 *Only order either Option 02 or 03—one cannot use both options together to get 6MB of memory.*
*3 *Includes four C1001/DX01s with the appropriate cables and camera adapters (016-0248-01 with Option 22, and 016-0269-03 with Option 23).*

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

OPTIONAL ACCESSORIES

Extra length C1001 to DX01 cables—
(4 meter) Order 174-1368-00. **$150**
(6 meter) Order 174-1369-00. **$150**
GPIB Board Kits—GPIB driver software has been modified to operate with either MUX mainframe.
(PC-IIA GPIB board and driver)
Order 021-0452-00. **$495**
(PC-III GPIB board and driver)
Order 021-0453-00. **$795**
80386 CPU—(MUX04 only)
Order 672-0251-00. **$1,500**
80386—(MUX16 only)
Order 672-0256-00. **$1,500**
Memory Board—
(2 M for 80386)
Order 672-0252-00. **$2,000**
(4 M for 80386)
Order 672-0253-00. **$4,000**

TEST AND MEASUREMENT SOFTWARE

CONTENTS

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TekMAP 467
11000 Series Utility 469

TEKWARE PROGRAMS COMPLEMENT TEKTRONIX INSTRUMENTS AND CONTROLLERS

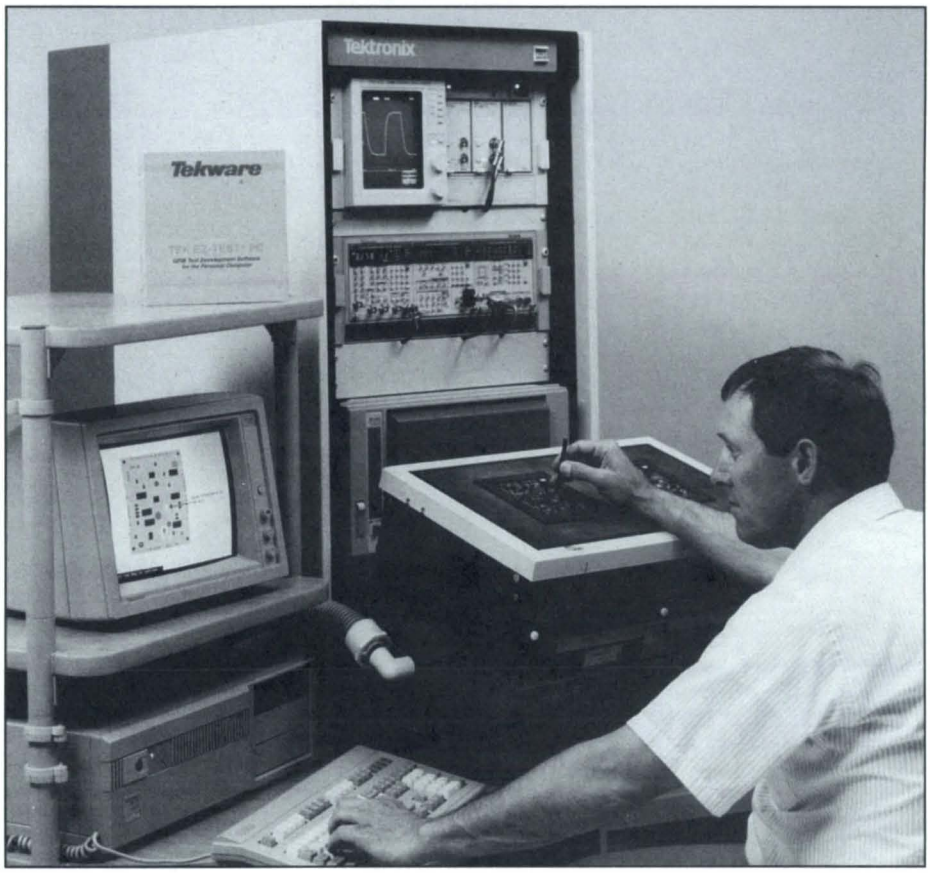
Tekware software is designed and tested to enhance the productivity of Tek instruments and controllers.

More and more, engineers involved in almost any measurement environment have to be part-time computer experts. In addition to writing programs in standard languages, you have to be adept at bringing up and running many different software programs. This means that software compatibility is a vital piece of your instrument control puzzle. Tektronix has performed extensive software testing to verify that all standard Tekware measurement, analysis, and utility packages run reliably with Tek instruments and controllers. MS-DOS Tekware programs have been tested for compatibility with 286/386 IBM compatible PC's and the PEP family of system controllers.

TEKWARE INSTRUMENTATION SOFTWARE LIBRARY

The Tekware Instrumentation Software Library is part of the Tektronix commitment to provide complete solutions for your test and measurement needs. The software product matrix on the following pages provides an easy way to match MS-DOS Tekware programs to Tek instruments and to your measurement needs.

The Tekware Software Library Catalog, literature number 49W-6829, has programs for MS-DOS compatible, and other instrument controllers. Call your local sales representative for more information.



DEVELOPMENT SOFTWARE

Tekware development software tools can be used to create new software or to modify existing software. Some Tekware development software products contain test program generators enabling you to create test procedures without writing a single line of code.

If your testing requirements call for development of a custom program or for customizing an existing program, a Tekware development software tool could be the key to the solution.

UTILITY SOFTWARE

Tekware utility software instrument drivers, peripheral drivers, processing modules, and display modules can be linked to other Tek or non-Tek software to produce custom programs. Using Tekware utility software whenever possible, rather than developing your own code, can substantially reduce software development time.

APPLICATIONS SOFTWARE

Tekware applications software provides a wide selection of ready-to-use general purpose control, measurement, and display capabilities. Simply load Tekware applications into your controller, and your system is ready to go to work for you. If your software requirements do not call for unique processing or specialized control functions, Tekware applications software could be the shortest path to a complete system solution.

TEKWARE SOFTWARE LIBRARY CATALOG

The Tekware catalog has programs for MS-DOS compatible PCs, Tek PEP301, 4041, and other instrument controllers. Call your Tektronix sales representative for a copy of the latest catalog, literature number 49W-6829.

SOFTWARE SUPPORT

To keep your software current and up-to-date, our software support is available at no charge during the warranty period. Post-warranty software support is available on a subscription basis.

TECHNICAL ASSISTANCE SERVICES

When your software development program calls for informed, on-site assistance, Tektronix can keep you in touch with some of the best in the world.

When you need assistance to supplement your own resources, Tek can arrange the consultive services of an Application Engineer skilled in meeting your needs. Not only are our AEs skilled professionals in their own right, they are backed by the resources and collective experience of Tektronix—itself an experienced user of automated test and measurement systems.

Tektronix AE consultation is intended specifically for optimizing the operation of Tek instruments and software.

We suggest that customers may first want to avail themselves of Tek's excellent documentation and regular customer training programs prior to requesting our Technical Assistance Services. Typical consulting services include:

Installation Assistance

This may include pre-installation counseling, assistance in installing software or hardware, and installation validation.

Familiarization Training

This usually takes the form of a brief introduction, to individuals or groups, about software utilization, hardware basics, and system interaction. Other training modules may present specific operational aspects of a product.

Interfacing Assistance

We can assist you with unusual interfacing challenges requiring intimate knowledge of Tek software and hardware.

Applications Assistance

You can obtain expert consultation in signal acquisition, in specific test and signal acquisition, in integrating Tek software and hardware within an existing process, and in other application-specific areas.

MS-DOS TEKWARE AT A GLANCE

The software product chart on the following pages provides an easy way to match MS-DOS Tekware programs to Tek instruments and to your measurement needs.

How to use the Tekware Chart:

By software package

Find the software package in the list on the left side of the chart. Follow across the row for the instruments supported, features provided, and languages supported.

By instrument

Find your instrument in the list at the top of the chart. Follow down the column to identify Tekware packages which support this instrument. Other instruments supported by a particular software package, features provided, and languages supported are given in the row for each software package.

By printer support

Follow down the column for the printer to identify Tekware packages that support this instrument. Other instruments and features supported by a particular software package are given in the row for each software package.

By features provided

Follow down the column for the feature of interest to identify Tekware packages with this feature. Instruments supported, other features, and languages supported are given in the row for this software package.

By language supported

Follow down the column for the programming language to identify Tekware packages that support this language. Instruments supported, features provided, and other languages supported are given in the row for this software package.

MS-DOS Tekware Chart

Here are definitions for some of the terms used in the Tekware chart:

ADIF format
—A Tektronix format for interchange of waveform data between instruments.

Data logging
—Data or results can be stored to disk or other peripherals.

Extended graphics
—Supports graphics cards with resolution higher than CGA (e.g., EGA, VGA).

Front panel control
—Front-panel settings of associated instruments can be read and/or set.

GPIB communication
—Data can be sent and received via GPIB.

Instruments from other vendors
—Supports instruments from other vendors that comply with the IEEE-488 Standard.

Programming language support
—Produces source code or object files which can be read by the specific languages.

Pulse parameters
—Can perform pulse measurement functions such as risetime, falltime, width, etc.

RS-232 communication
—Data can be sent and received via RS-232

COMMUNICATIONS, TEST AND MEASUREMENT

Instruments Supported

Software Package	2220/21/30 DSO—GPIB	2220/21/30 DSO—RS-232	2430/A/32A DSO	2445A/B/65A/B/67B Scope	336/A DSO	370 Pgm. Curve Tracer	371 High-Power Pgm. Curve Tracer	390AD Waveform Digitizer	468 DSO	490P-/2750P-Series Pgm. Spectrum Analyzers	5223 DSO	7D20 Programmable Digitizer	7250 Transient Digitizer	7612D Pgm. Waveform Digitizer	7854 Waveform Processing Scope	7912 AD/HB Pgm. Digitizer	11301/A/302/A Pgm. Analog Scope	11401/402 Pgm. Digitizing Scope	AA 5001/SG 5010 Pgm. Analyzer/Oscillator	CG 5001 Pgm. Scope Cal. Gen.	DCS01 Digital Camera System	MI 5010 Pgm. Multifunc. Interface	RTD/A 710 Digitizer	TM 5000 Pgm. Test Instr.	TSI 8150 Test System Interface	Instruments From Other Vendors
EZ-TEST PC S45F030	•		•	•		•	•	•		•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•
GURU II S3FG100/110	•		•	•	•	•	•	•	•	•	•	•		•	•	•		•	•	•		•	•	•	•	•
GPIB Interface Software S3FG120/121/122																										
Signal Processing & Display (SPD) Software S3FG130	•	•	•								•	•			•	•		•					•			
ASYST Ver 2.0 S42P301																										
Digitizer Drivers for ASYST S42P302	•		•									•	•		•	•							•			
7854 Communications and Control Software S42P101															•											
7D20 Time and Amplitude Software S42P201												•														
7854 Time and Amplitude Software S42P202															•											
11400 Utility Software S47P102																		•								
11300 Utility Software S47P103																	•									
11400 Driver for ASYST S47P303																		•								
EMI Prequalification Software S26EM00										•																
General RF Applications Software (GRASP) S26RF00										•																
Remote Site Monitoring Software (RSM) S26RM00/01										•																
EZ-TEK 2400 S38A101			•	•																•		•		•		
307 Utility Software S48P104						•																				
370 Device Test Software S48P401						•																				
2220/2221/2230 Instrument Utilities S49Z201		•																								
2220/2230 Instrument Utilities S49Z202	•																									
2220/2221/2230 Instrument Utilities S49Z203	•																									
DCS Menu Software (Available only with DCS01 System)				•												•	•				•					
DCS01 Functional Library S58DC01				•													•				•					
DCS/GPIB Driver for 2467 S58DC02				•																	•					•
DCS/GPIB Driver for 11302 S59DC04																	•				•					•
24x5/2467/IBM PC Tutorial S49Z204				•																						
RTD 710 Digitizer S45D010																								•		

COMMUNICATIONS, TEST AND MEASUREMENT

Software Package	Printer Support										Features										Programming Language Support					
	IBM/EPSON	HC100	4693D	4695	4696						Front Panel Control	GPIB Communication	RS-232 Communication	Pulse Parameters	Waveform Analysis	Extended GRaphics	Test Procedure Generator	Test Program Generator	Data Logging	ADIF Format	Interpretive BASIC	IBM BASIC Compiler	Microsoft QuickBASIC	C Language	Borland Turbo Pascal	Fortran
EZ-TEST PC S45F030	•										•	•		•		•	•	•	•				•			
GURU II S3FG100/110	•										•	•		•			•		•	•	•	•	•			
GPIB Interface Software S3FG120/121/122												•									•	•	•	•		
Signal Processing & Display (SPD) Software S3FG130	•	•	•	•	•							•	•	•	•	•			•	•			•	•		
ASYST Ver 2.0 S42P301	•										•	•	•	•	•	•			•							
Digitizer Drivers for ASYST S42P302	•										•	•		•	•	•										
7854 Communications and Control Software S42P101	•											•										•				
7D20 Time and Amplitude Software S42P201	•										•	•		•	•	•										
7854 Time and Amplitude Software S42P202	•											•		•	•	•			•							
11400 Utility Software S47P102	•										•	•	•	•	•					•				•		
11300 Utility Software S47P103	•										•	•	•	•	•				•				•			
11400 Driver for ASYST S47P303	•										•	•	•	•	•	•			•							
EMI Prequalification Software S26EM00	•											•							•			•				
General RF Applications Software (GRASP) S26RF00	•										•	•			•				•		•	•				
Remote Site Monitoring Software (RSM) S26RM00/01	•										•	•			•				•		•					
EZ-TEK 2400 S38A101	•										•	•		•			•		•							
307 Utility Software S48P104	•										•	•				•	•		•				•			
370 Device Test Software S48P401											•	•				•			•							
2220/2221/2230 Instrument Utilities S49Z201													•			•					•		•			
2220/2230 Instrument Utilities S49Z202																									•	
2220/2221/2230 Instrument Utilities S49Z203												•				•					•		•			
DCS Menu Software (Available only with DCS01 System)														•			•		•							
DCS01 Functional Library S58DC01																							•	•	•	•
DCS/GPIB Driver for 2467 S58DC02	•	•									•	•		•			•		•							
DCS/GPIB Driver for 11302 S59DC04	•	•									•	•		•			•		•							
24x5/2467/IBM PC Tutorial S49Z204												•			•						•				•	
RTD 710 Digitizer S45D010											•	•		•	•	•			•	•						

TEK EZ-TEST PC

Test Development Software

- **Develops and Runs Automated Tests with GPIB Instruments**
- **Generates Application Test Code in Microsoft QuickBASIC**
- **Reduces Test Development Time by a Factor of 3**
- **Executes Compiled Test Programs**
- **Runs on TEK PEP Instrument Controllers and IBM XT or PC AT Compatible with Tek GPIB Interface Boards**

A Complete Development and Test Runtime System

EZ-TEST is a software productivity tool used to create and run test software for manufacturing, service repair and rework, metrology, and prototype evaluation.

EZ-TEST is for non-programmers or programmers who prefer to concentrate on testing rather than software coding chores. EZ-TEST will reduce software development time by a factor of three over conventional coding practices.

EZ-TEST creates fully functional test procedures which direct the system operator and control instruments for Unit Under Test (UUT) stimulus, switching, and measurement acquisition.

EZ-TEST controls instruments from Tektronix and other GPIB instrument vendors.

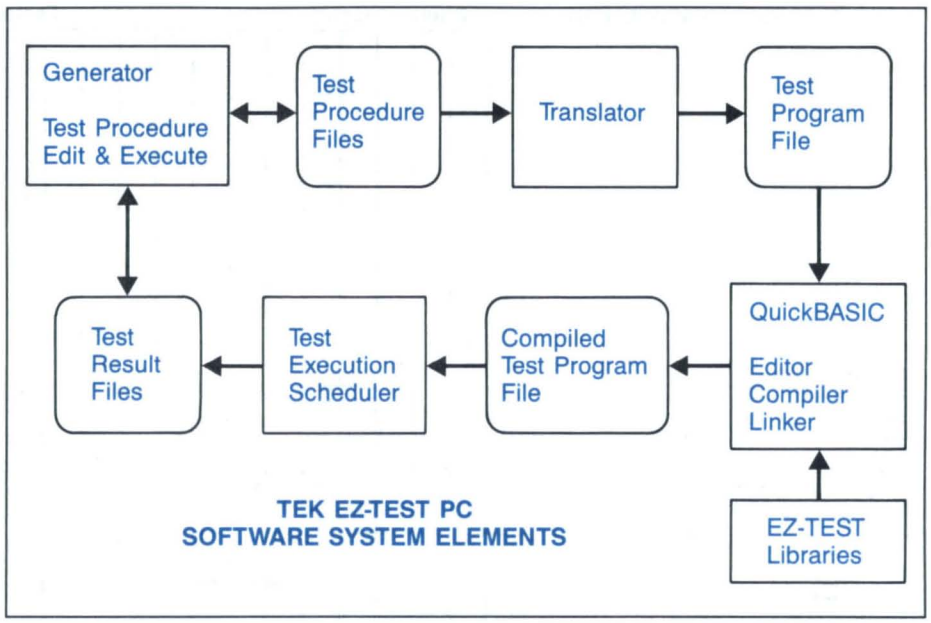


Figure 1. TEK EZ-TEST PC Software System

The EZ-TEST software system provides all the software necessary to develop and run test system programs. Figure 1 shows the major elements of EZ-TEST:

- Generator program to create, debug, and execute the test procedure
- Translator program to convert the procedure to Microsoft QuickBASIC code and then compile and link it, resulting in a complete standalone test program
- Test Execution Scheduler to run sequences of compiled tests and gather test data
- Microsoft QuickBASIC software package (Tek S3FG500—QuickBASIC editor, compiler, linker and manuals)
- GPIB interface software for QuickBASIC (Tek S3FG121)

Test Functions

EZ-TEST provides a simple means to specify high-level test functions using instruments on-line. Create test procedures with these functions:

- Instrument control commands
- Instrument measurements
- PASS/FAIL limits for measurements, controls procedure process flow
- UUT adjustment steps (see fig 2), measurements shown on screen with cursor moving relative to nominal and limits values for easy operator adjustments
- Waveform acquisition and pulse parameter analysis with PASS/FAIL limits
- Disk file transfers to and from instruments
- Procedure WAIT states for instrument or UUT settling
- Automatic Stimulus/Response testing
- Graphical Screens for operator instructions created with PC Paintbrush software from Microsoft
- SRQ Interrupt handlers
- Status Byte acquisition.

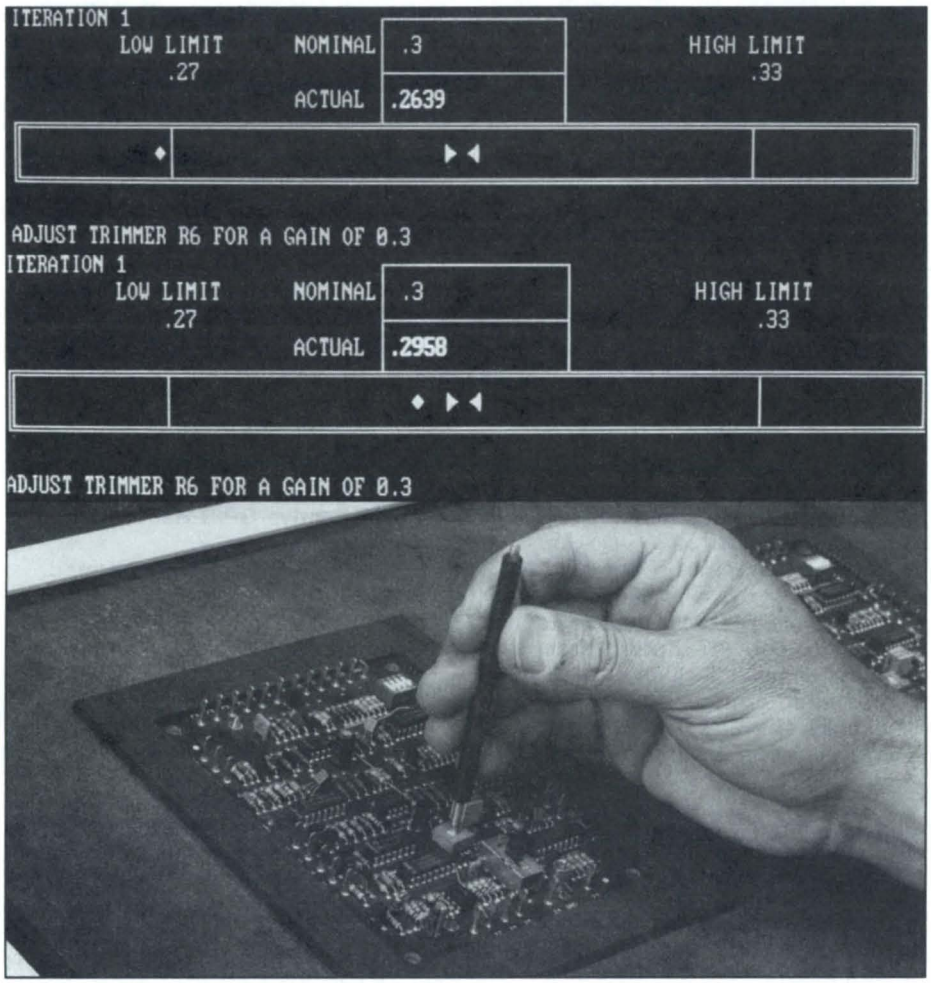


Figure 2. The adjustment step acquires measurements and displays them on screen relative to nominal and upper and lower test limits, simplifying UUT adjustment procedures.

Instrument Support

EZ-TEST supports Tektronix instruments with high-level functions for instrument setup and special measurement acquisitions.

- TM5000 family of general purpose test instruments
- Waveform acquisition and pulse parameter measurements for digitizers and digital oscilloscopes (7000, 11000, 2400, and RTD series).
- TSI 8150 Test System Interface configuration utility for fixture switch matrix programming.

Instrument settings queries and standard measurements are supported for the full line of Tektronix GPIB instruments which feature the Tek Codes and Formats Standard for Programmable Instruments, including spectrum analyzers and logic analyzers.

EZ-TEST also supports generic setup and measurement capabilities for IEEE-488.1 compatible instruments with any combination of talker and listener capabilities.

Instrument driver software modules may be written in QuickBASIC and installed into EZ-TEST to provide additional instrument support.

Required Hardware and Software

EZ-TEST runs on the Tektronix PEP 300 series instrument controllers and on any IBM PC XT, PC AT, or compatible configured with the Tektronix GPIB interface card (either GURU II package S3FG100 or GPIB Interface S3FG120).

Minimum requirements are 640K memory, DSDD 5¼ inch disk drive, hard disk, MS-DOS version 3.0 or higher. A CGA (or better) graphics monitor and adapter is recommended if waveforms and test data must be graphed.

Optional Hardware and Software

EZ-TEST optionally supports a math coprocessor, EGA display adapter and monitor, Hercules display adapter and monochrome display. A hard disk in excess of 10 Mbytes is recommended for large automated test system software development.

Warranty Plus Service

Tektronix Warranty Plus Service provides software updates to registered EZ-TEST owners during the first year of coverage.

ORDERING INFORMATION

S45F030 TEK EZ-TEST PC **$1,795**
Provided on 5¼ in. 360K and 3½ in. 720K diskettes.

OPTIONS

Option 06—Delete Microsoft QuickBASIC (required for International orders). **$100**

Option 07—QuickBASIC source code for the EZ-TEST Libraries and the Test Execution Scheduler.*[1]

Option S9—US Warranty Plus Service (US Domestic orders only). **NC**

Option 1S—International Software Update Service (International orders only). **NC**

*[1] *Contact your local sales office.*

GURU II

- **Store/Recall Waveforms**
- **Calculate Waveform Parameters**
- **Library of Commonly Used Subroutines**
- **Source Code Provided for Most Programs**
- **Graphics Capability**
- **Flexible Peripheral Handling**
- **Tutorial Manual**
- **Instructional GPIB Programming Examples**

Tektronix GURU II (GPIB User's Resource Utility) is a low-cost hardware and software package for instrument control, waveform acquisition, and display. GURU II supplies the important communication link between an IBM PC (or compatible) and GPIB instrumentation.

The GURU II software is written in IBM's Advanced BASIC (Microsoft's BASICA) language. BASICA source code is provided for maximum flexibility to customize for a specific application. Languages supported include BASICA/GW-BASIC, IBM BASIC Compiler 1.0/2.0, and Microsoft QuickBASIC 1.0/2.0/3.0/4.0. GURU II saves data to disk in a format compatible with many popular programs (LOTUS 1-2-3, Framework II, etc.).

The software includes a TEST PROCEDURE GENERATOR (TPG), a useful tool for users who want fast results but do not want to learn to write their own test software. The TPG is a self-explanatory menu-driven program.

GURU II also includes a waveform-acquisition and pulse-analysis program that supports most Tek digitizers. This program allows waveform segmenting, graphics, and storage. The pulse parameters include rise time, fall time, pulse width, max and min voltages, and others.

Library of Commonly Used Subroutines

This library contains subroutines to do low-level communications with GPIB devices, store/recall waveforms on a disk, calculate waveform parameters, and graph the waveform. The subroutines are written in assembly language to facilitate maximum performance when sending or receiving commands or data. Waveform-acquisition performance is further enhanced by the DMA transfer of waveforms to the controller's memory.

Tutorial Manual

The User's Manual is a valuable GPIB reference. It includes many GPIB program examples, which are useful when interfacing to various types of new GPIB instrumentation.

Required Hardware

GURU runs on an IBM PC, PC XT, Portable PC, PC AT, Tektronix PEP controllers, or compatible. Minimum requirements: 256K memory and either 2 floppy-disk drives or 1 floppy and 1 hard disk.

GURU also requires one of the following graphics-display card combinations:

1. IBM Color/Graphics Adapter (or compatible card) and the IBM Color Display, Model 5153 (or equivalent), or a composite video monitor (color or monochrome), or EGA or VGA.
2. Hercules Graphics Card and IBM Monochrome Display Model 5151 (or equivalent). For the Hercules Graphics card, the GRAPH X utility from Hercules Computer Technology is required to obtain printer copies of screen graphics. Hercules HBASIC runs GURU graphics programs interpretively, but only on a true IBM PC with IBM DOS/BASICA 2.0 to 3.1.
3. Tektronix PEP display monitor and graphics card.

Optional Hardware

Multifunction card with clock/calendar, serial/parallel ports, and up to 384K bytes of RAM.

Additional Hardware Requirements

If the S3FG110 GURU II Software and Documentation only package is ordered (see below), one of the following National Instruments interfaces is needed: GPIB-PC, GPIB-PC2, GPIB-PC2A, or IBM PC GPIB adapter or S3FG120.

Required Software

IBM PC DOS 2.0 to 3.3 or higher with Advanced BASIC (BASICA), or MS-DOS 2.02 to 3.2 or higher with BASICA.

Optional Software

Microsoft QuickBASIC 1.0/2.0/3.0/4.0 or IBM BASIC Compiler 1.0/2.0 (requires S3FG121 GPIB compiled BASIC Interface Software).

Printers Supported

IBM Graphics Printer or equivalent (e.g., Epson RX/FX family, Toshiba P1340/P1350 Series); for Toshiba P1340/P1350, the Paper Screen utility from MAP Systems, Inc. is needed to get printer copies of screen graphics.

ORDERING INFORMATION

S3FG100 GURU II + Package. **$995**
Includes: Software/manual plus PC2A board; cable; software on 5¼ inch 360K floppy diskette.
S3FG110 GURU II Software and documentation only. **$495**
For users with existing PC2/PC2A board and cable.
Includes: Software and manual.
Upgrade Kit—GURU II
V2.0 to 3.0. Order 020-1459-01. **$250**
Includes: Software and manual.

GPIB Interface Hardware and Software

- **Cost-Effective GPIB Hardware and Software**
- **Example Programs in Interpreted BASICA**
- **Interface Orderable Separately for Compiled BASIC and C Languages**

The GPIB Interface (S3FG120) provides the minimum software and hardware to convert an IBM PC/XT, PC/AT or compatible into an instrument controller. Included are diagnostic utlities, an interactive control program and language interface for BASICA (BASIC interpreter) and manual.

The Compiled BASIC Interface (S3FG121) includes software for both IBM BASIC Compiler 1.0/2.0 and Microsoft QuickBASIC 1.0/2.0/3.0/4.0. The software link provided permits users of the GPIB interface to program their applications in compiled BASIC.

The C Compiler Interface (3FG122) links programs compiled in Lattice C (version 2.0/3.0) and Microsoft C compiler (version 3.0/4.0/5.0) with the GPIB interface.

ORDERING INFORMATION

S3FG120 GPIB Interface. **$650**
Includes: Manual, GPIB interface card, and software on a 5¼" diskette.
S3FG121 GPIB Compiled BASIC Interface. **$150**
Includes: Manual, 5¼", and 3½" diskettes.
S3FG122 GPIB C Compiler Interface. **$150**
Includes: Manual, and 5¼" diskette.

ASYST Scientific Software

- **Automatic Graphics With Modifiable Defaults**
- **High Resolution and Color-Graphics Support**
- **Comprehensive Data Analysis**
- **Integrated GPIB/IEEE-488 Hardware Support**
- **Built-in Functions Plus Full Programmability**

ASYST is a fully integrated software tool that provides the user with the most commonly used data acquisition, statistical, graphing, and analysis capabilities required in engineering and scientific applications. Operating on the IBM PC/XT/AT, ASYST is designed so novice users can start carrying out complicated operations with a minimum of introduction, while allowing the advanced user to take full advantage of a powerful programming language that supports all of the features of the IBM PC.

Most mathematical or graphics operations can be performed by using a single predefined word describing that operation; e.g., MATRIX.INV, FFT, INTEGRATE.DATA, 2WAY.ANOVA or Y.AUTO.PLOT. New words can be defined to perform any sequence of actions.

```
: PLOT.IT!
PRESSURE
TEMPERATURE
XY.AUTO.PLOT;
```

PLOT.IT! now automatically plots two data arrays when invoked: PRESSURE and TEMPERATURE.

The Analysis module contains most of the common operations used to treat experimental data. These include integration, differentiation, base-line correction, peak finding, digital smoothing, FFT, IFT, matrix manipulation, Eigen system analysis. . .

Instrument-specific application programs such as the 7000-Series Driver Software for ASYST are also available. Written in the ASYST language, this driver provides the user with a function-key-driven program that allows for the acquisition and storage of waveforms, storage and retrieval of settings or programs, zoned pulse-parametric analysis (max, min, mid, p-p, rise time, fall time, overshoot, undershoot, pulsewidth, period, crossing levels) and frequency-domain analysis. Data may be acquired from the Tek 7D20, 7854, 7912AD, 7912HB, RTD-710, 7250, 2230, or 2430A. There is a similar driver for the 11400-Series Digitizing Oscilloscopes.

MODULE 1

SYSTEM/GRAPHICS/STATISTICS

Data Types—Single or double precision, real, integer, or complex values (80-bit double precision); strings; named scalars or arrays. Automatic or user-controlled conversions in mixed expressions between integers, reals, and complex data types. Arrays may have up to 16 dimensions and be as large as 64K bytes apiece.
Arithmetic Operations and Special Functions—+, −, *, /, **, min, max, neg, abs, inv, sqrt, ln, exp, conj, sin, cos, tan, sec, csc, cot, sinh, cosh, tanh, sech, csch, coth, asin, acos, atan, asec, acsc, acot, asinh, acosh, atanh, asech, acsch, acoth. All arithmetic operators work directly (without loops) on all elements of an array. Mixed expressions of arrays and scalars, or arrays of differing dimensionality, are permitted.
Statistical Functions—Mean; variance; mode; median; moments; standard deviation; cumulative distributions; Gaussian, Chi-square, Student-T distributions; random number generation; sort, sort and index.
Array Handling Functions—Subarrays, reversal of indices, transposition of dimension, lesser dimension subsets, individual elements, catenation, lamination, auto entry of array data, scrolling, format control of array data display, generalized inner and outer product, matrix multiplication.

BUILT-IN FULL-SCREEN TEXT EDITOR AND ARRAY EDITOR

Graphics—Automatic line graphs, scatter plots, bar and pie charts, plotting with error bars. Options include: color graphics superposition of plots, multiple graphics windows, polar plots, autoscaling and data fitting, linear or logarithmic display along either axis, strip chart recorder emulation, replotting data subsets with a single keystroke, and support for digital plotters and high-resolution graphics.
Graphics Readout and Cursors—On-screen graphics cursors controlled by arrow keys, labeling at any location within the graphics area.
Control Structures—If. . .else. . .then, Begin. . .until, Begin. . .while. . .repeat, Case. . .of. . .endcase, Do. . .loop; Comparisons: =, <, >, ≤, ≥, not, and, or, xor.
Input/Output—Loading from standard text or arbitrary user-defined files, saving and loading workspace images to disk, direct array I/O to packed-binary disk files, ASCII, BASIC, and DIF format files.
String Handling—String-to-number conversion, number-to-string conversion, string arrays.

GAMMA, BESSEL, AND ERROR FUNCTIONS

RS-232 Support.

MODULE 2

ANALYSIS

Polynomial Mathematics and Evaluation—Polynomial multiplication, synthetic division, integration, differentiation, shifting, root extraction.
Advanced-Graphics—Axonometric and contour plots. Plotting with hidden lines removed.
Vectors and Matrices—Matrix inversion, determinants, QR factorization, and Gram-Schmidt orthogonalization.

SOLUTIONS TO SIMULTANEOUS EQUATIONS

Eigenvalues and Eigenvectors—Eigen systems of Hermitian matrices, spectral slicing, reduction of a general matrix to Hessenberg and triangular form.
Curve Fitting—Least squares polynomials, multilinear regressions, parametric and nonlinear curve fitting, weighted least squares, exponential and logarithmic fits, orthogonal polynomials, R^2 (cross-correlation).

NONLINEAR REGRESSION

Advanced Statistics—One- and two-way analysis of variance (ANOVA), F-tests.
Data Manipulation—Data smoothing, differentiation and integration, peak detection, convolutions and filtering.
Fast Fourier Transform, 2D FFT, and Inverse FFT

MODULE 4

GPIB/IEEE-488

Interface Boards Supported—National Instruments GPIB-PC, GPIB-PC2, GPIB-PC2A; Tektronix GURU II; IBM Capital Equipment PC-488 model 01000-003000; MetraByte IEEE-488.
Complete IEEE-488 Protocol—Device-dependent and device-independent commands, parallel and serial polling, synchronous and asynchronous operation, DMA acquisition.
Buffering—Array buffering of data. Buffering of device-dependent commands.
Real-Time Synchronization—Triggering, clock-initiated acquisition, software synchronization.

Required Hardware

IBM PC/XT/AT; Tektronix PEP controllers, or DOS 2.0/2.1/3.0/3.1 compatible; two or more drives (including one double-sided floppy drive); 512K memory (640K recommended); 8087 or 80287 coprocessor; IBM Color Graphics Board; IBM Enhanced Color Graphics Card (with 64K to 256K graphics memory); or Hercules Graphics Card.

Optional Hardware

IBM graphics printer; Hewlett-Packard 7470, 7475, or Gould Colorwriter plotters, Interface board(s) required for GPIB interface.

ORDERING INFORMATION

S42P301 Option 01 ASYST Scientific Software. **$2,095**
Includes: Software (Modules 1, 2, and 4) on 5¼'' DS/DD disk, manuals, and license agreement.
S42P302 Option 01 7000-Series Driver Software for ASYST (Requires S42P301 or equivalent software). **$395**
Includes: Software source on 5¼'' DS/DD disk, hardware driver for Tek 7D20, 7854, 7912AD, 7912HB, RTD-710, 7250, 2230, and 2430A; manual; and license agreement.
S47P303 Option 01 11400-Series Driver for ASYST (Requires S42P301 or equivalent). **$395**
Includes: Software source on 5¼'' DS/DD disk, hardware driver for Tek 11401/11402, manual, and license agreement.

SPD

Signal-Processing and Display Software

- **Convenient Interactive Menu Interface**
- **Software Libraries for Application Software Development**
- **Comprehensive Set of Functions for Acquisition, Processing, Measurement, Storage, and Display of Waveforms from Tektronix Digitizers**

SPD simplifies the acquisition, processing, measurement, storage, and display of waveforms from Tektronix digitizers for scientific and engineering applications.

The SPDMENU program provides an easy to use interactive menu to perform SPD functions without writing programs. Getting started is easy with extensive on-line help.

The SPD Function Libraries provide software modules for programmers who are writing applications with Microsoft C or QuickBASIC.

Acquisition Library

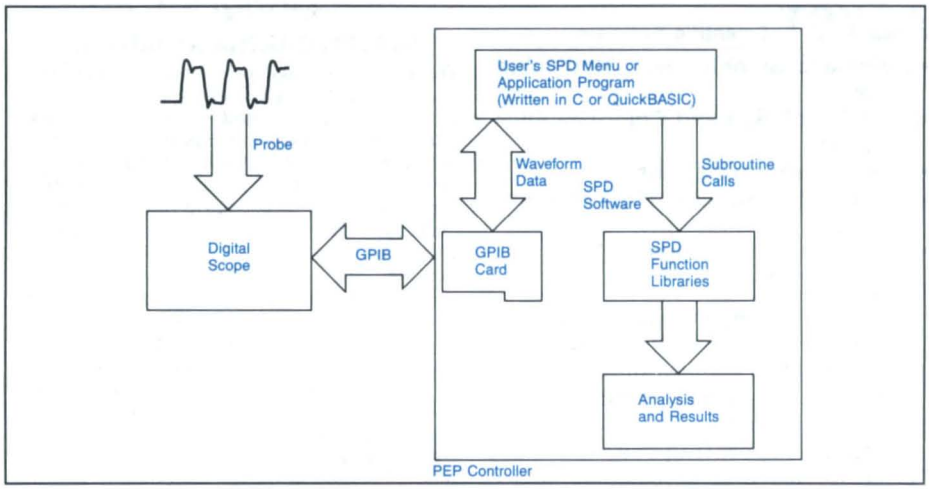
The Acquisition Library acquires waveforms from Tektronix digitizers and formats them for use by other SPD functions. Waveform acquisitions from digitizers can be achieved with a single menu selection or function call. The library supports these Tektronix digitizer products:

2220	7D20
2221	7854
2230	7912AD/HB
2430	11401
2430A	11402
2432	RTD 710
2440	RTD 710A
5223	

Signal Processing Library

The Signal Processing Library provides time and frequency domain signal processing functions for arbitrary length waveforms. These functions include:

Arithmetic
Integration and Differentiation
Pulse Measurements
Statistics
Convolution and Correlation
Forward and Inverse Fast Fourier Transforms (FFT)
Interpolation and Decimation
Standard Waveform Generation (SINE/SQUARE)
Finite Impulse Response (FIR) Filter Generation
Waveform File Input and Output



SPD MAKES DATA ANALYSIS EASY

1. *A probe acquires real-time data from a device under test and sends it to a digital-storage scope like the Tek 2430A.*
2. *The oscilloscope digitizes the waveform and stores it at a 1024×8 bit record, then transfers that record via GPIB to the PEP controller.*
3. *The GPIB IEEE-488 bus transfers data values, scale factors, offsets, and units to and from the PC/AT and the oscilloscope.*
4. *SPD processes, analyzes, and displays the waveform. SPD may be invoked via menu for ease or C or BASIC for speed and programmability. SPD is aided by optionally available 2430A Driver Utility Software, which acquires the data record.*

Waveform Graphics Library

The Waveform Graphics Library provides device independent waveform graphics using the GSS*CGI device drivers from Graphic Software Systems. These drivers support a wide range of printers and plotters, and supports high resolution display up to 800×600 pixels. The Waveform Graphics Library allows the user to create waveform displays and control these attributes:

Log or Linear Axes
Auto or Manual Scaling
Titles and Axes Labels
Multiple Curves per Graph
Multiple Line Styles
Full Color Control

SPDMENU Program Process Menu

The SPDMENU program functions can be extended with the Process Menu option. This feature makes it possible to access user written programs from the SPDMENU program. Writing these custom programs is simplified with the example programs provided in SPD.

SPD C and QuickBASIC Language Support

The SPD libraries are intended for software professionals who must develop comprehensive applications written in the Microsoft C 5.0 or QuickBASIC 4.0 languages.

Software debugging is simplified with SPD functional prototype INCLUDE files to catch errors at compile time rather than at runtime. The SPD software functions maximize use of memory by accessing all available standard memory for waveform data.

Required Hardware and Software

The Tektronix PEP Controller is recommended, or IBM PC/AT or compatible computers with a graphics display monitor and adapter, 640K bytes memory, a 5¼ or 3½ inch diskette drive and a hard disk drive, and Tektronix GPIB interface (GURU II or equivalent).

DOS 2.1 or later version is required.

Optional Hardware and Software

A wide variety of graphics displays, printers, and plotters are supported by the GSS*CGI (Graphics Software Systems, Inc.) drivers supplied with the SPD package.

SPD supports the Tektronix HC100 plotter and the 4693D or 4696 printers.

Math co-processors are supported, and will improve the execution speed of SPD.

ORDERING INFORMATION

S3FG130 SPD Signal Processing and Display Software **$995**
Includes: Software on 5¼ and 3½ inch diskettes, SPDMENU function key overlay, and manuals.

TekMAP

- **Graphics**
- **Archival Storage**
- **Pulse Parametrics**
- **Delay-Time Measurements**
- **Hard-Copy Dump**
- **Menu Driven**

The TekMAP (Tektronix Measurement Application Programs) library of software products supports the Tektronix 7854 and 7D20 GPIB programmable digitizers in automated engineering or research environments.

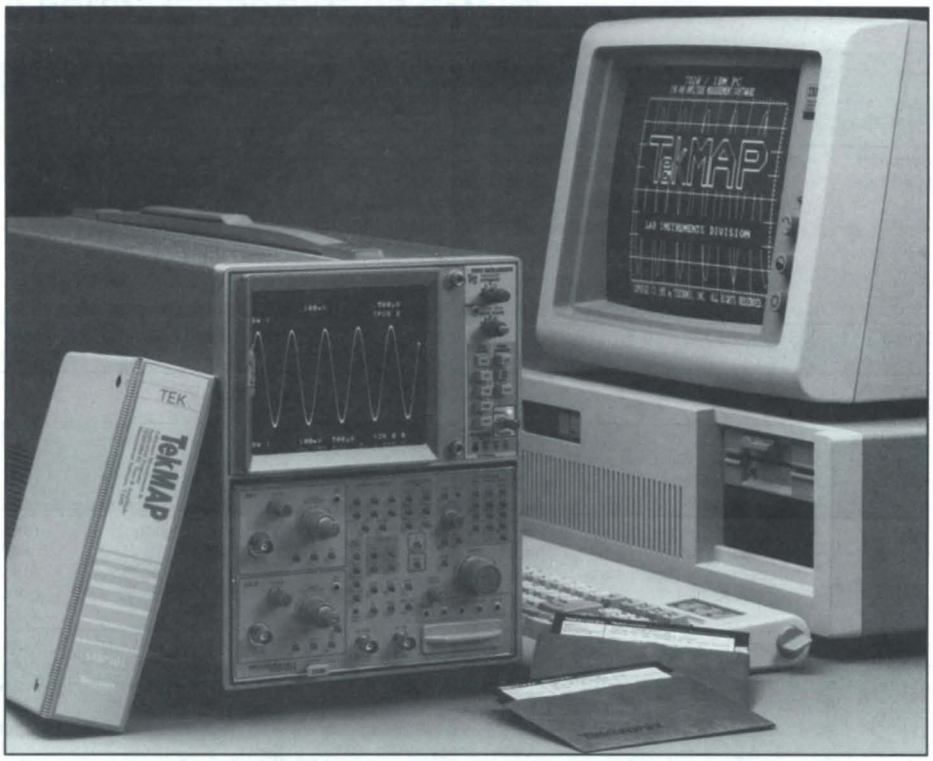
TekMAP software extends the versatility of Tektronix digitizers by integrating them with Tektronix PEP controllers, IBM personal computers, or HP-Series 200 technical computers.

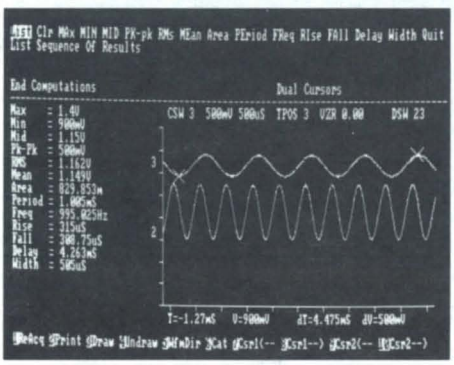
Basic communication utilities, accessible through friendly, menu-driven user interfaces, are available through Communication and Control Utility Software.

Extended measurement capabilities, such as automated pulse-parameter analysis, Fast Fourier transformation, and propagation-delay measurements, are provided by the Time and Amplitude Measurement Software products.

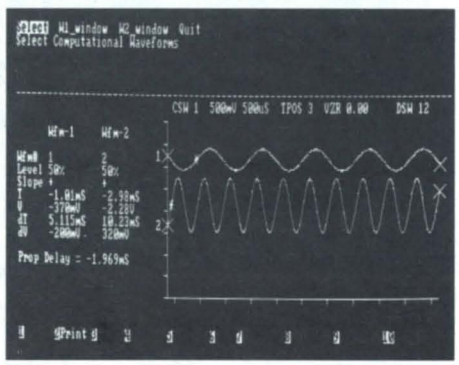
The TekMAP software is a continuing series of applications programs developed and supported by Tektronix applications engineering.

Please contact your local Tektronix Sales Engineer or representative regarding hardware configuration requirements and current software offerings.

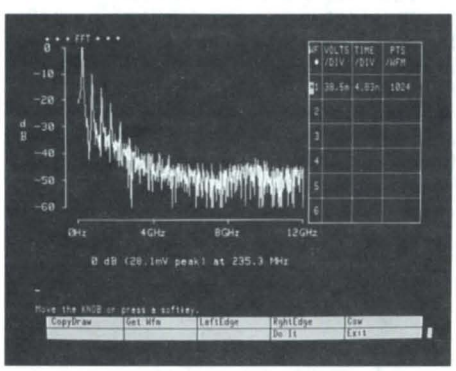




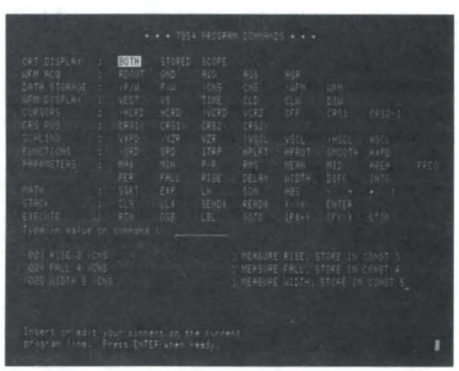
Automatic Pulse-Parameter Analysis using the 7D20/IBM PC Time and Amplitude Measurement Software.



Delay-Time Measurement using an IBM PC/XT/AT as controller with Tek's Time and Amplitude Measurement Software, plus 7D20 Programmable Digitizer and Tek 2603 oscilloscope.



Computing and displaying frequency-to-main data using an HP Series 200 Controller and Tek 7854 or 7D20 digitizing oscilloscope.



Editing a Tek 7854 RPN program, including downloading to the 7854 or archiving to disk available in S42H202.

TekMAP SOFTWARE SELECTION GUIDE

	S42P101 7854/IBM PC Communications and Control Software	S42P201 7D20/IBM PC Time and Amplitude Measurement Software	S42P202 7854/IBM PC Time and Amplitude Measurement Software	S42H201 7D20/HP Series 200 Time and Amplitude Measurement Software	S42H202 7854/HP Series 200 Time and Amplitude Measurement Software
Required Hardware	IBM PC, XT, or AT 128K memory Dual floppy or hard drive IBM color graphics board Nat'l Instruments PC-2, PC-2A GPIB board*1 (Rev C Drivers)	IBM PC, XT, or AT 640K memory Dual floppy or hard drive IBM color graphics board Nat'l Instruments PC-2, PC-2A GPIB board*1 (Rev C Drivers) 8087 or 80287 coprocessor	IBM PC, XT, or AT 640K memory Dual floppy or hard drive IBM CG board or EGA Nat'l Instruments PC-2, PC-2A GPIB board*1 (Rev C Drivers) 8087 or 80287 coprocessor	HP 216, 226, 236, or 236C 640K memory 5¼-in. or 3½-in. disk	HP 216, 226, 236, or 236C 640K memory 5¼-in. or 3½-in. disk
Media	5¼-in. DS/DD	5¼-in. DS/DD	5¼-in. DS/DD	5¼-in. or 3½-in. disk (9121, 9122 compatible)	5¼-in. or 3½-in. disk (9121, 9122 compatible)
Operating System	DOS 2.0/2.1/3.0/3.1/3.2	DOS 2.0/2.1/3.0/3.1/3.2	DOS 2.0/2.1/3.0/3.1/3.2	BASIC 3.0	BASIC 3.0
Language	Source code for IBM compiled BASIC (for program modification and recompilation)	Executable code only supplied	Executable code only supplied	AUTOST, plus fully commented source code BASIC 3.0	AUTOST, plus fully commented source code BASIC 3.0
Data Acquisition	Waveform transfer Manual/Automatic measurement results data logging to disk	Remote acquisition (multichannel) Autoranging for rise, fall, period measurements Acquire from stored settings	Remote acquisition (multichannel) 7854 Program register acquisition	Remote acquisition (multichannel) Autoranging for rise, fall, period measurements Acquire from stored settings	Remote acquisition (multichannel)
Measurements	Provided by 7854	Pulse Parametrics Automatic Histogram: Max, Min, Mid, P-P, 100%, Distal, Center, Prox, 0%, +0S, −0S, Rise, Fall, Width, Delay, Period, Freq, RMS List Mode: Mean, Area, Max, Min, Mid, P-P, Rise, Fall, Width, Delay, Period, Freq, RMS Prop Delay Waveform Operations: +, −, *, ÷, Scale, Offset, Diff, Integ, Smooth Cursor (V, T, ΔV, ΔT) Selectable measurement region and crossing levels	Pulse Parametrics Automatic Histogram: Max, Min, Mid, P-P, 100%, Distal, Center, Prox, 0%, +0S, −0S, Rise, Fall, Width, Delay, Period, Freq, RMS List Mode: Mean, Area, Max, Min, Mid, P-P, Rise, Fall, Width, Delay, Period, Freq, RMS Prop Delay Waveform Operations: +, −, *, ÷, Scale, Offset, Diff, Integ, Smooth Cursor (V, T, ΔV, ΔT) Selectable measurement region and crossing levels FFT (Freq. and mag.)*2	Pulse Parametrics Automatic Histogram: Max, Min, Mid, P-P, 0%, 100%, RMS, Rise, Fall, Width, Freq, % Overshoot, Period, % Undershoot Prop Delay FFT Cursor (V, T, ΔV, ΔT) Selectable measurement region and crossing levels	Pulse Parametrics Automatic Histogram: Max, Min, Mid, P-P, 0%, 100%, RMS, Rise, Fall, Width, Freq, % Overshoot, Period, % Undershoot Prop Delay FFT Cursor (V, T, ΔV, ΔT) Selectable measurement region and crossing levels
Hard Copy	Graphics dump	Graphics dump	Graphics dump	ThinkJet (Text and Graphics)	ThinkJet (Text and Graphics)
Disk Storage	Waveforms; Programs (7854); Logged Data	Waveforms; Settings	Waveforms; Programs (7854); Logged Data	Waveforms; Settings	Waveforms; Programs (7854); Logged Data
Utilities	File (Catalog, Delete, Drive)	File (Catalog, Delete, Drive)	File (Catalog, Delete, Drive); 7854 Program Listing and Editor	Copy; File (Catalog, Delete)	Copy; File (Catalog, Delete); 7854 Program Editor

*1 *Available in Tek GURU II package.* *2 *Measurements may be logged to a disk file in ASCII format.*

ORDERING INFORMATION

S42P101 7854/IBM PC Communication and Control Software. **$450**
Includes: Software, operator manual, and license agreement.

S42P201 7D20/IBM PC Time and Amplitude Measurement Software. **$450**
Includes: Software, operator manual, and license agreement.

S42P202 7854/IBM PC Time and Amplitude Measurement Software. **$495**
Includes: Software, operator manual, and license agreement.

S42H201 7D20/HP Series 200 Time and Amplitude Measurement Software. **$950**
Includes: Software, operator manual, and license agreement.

S42H202 7854/HP Series 200 Time and Amplitude Measurement Software. **$950**
Includes: Software, operator manual, and license agreement.

OPTIONS

Option 01—5¼-in. flexible disk. **NC**

Option 02—(S42H201/S42H202) 3½-in. single-side micro disk. **NC**

11000 Series Utility Software

GPIB IEEE-488

The 11000-Series complies with IEEE Standard 488.1-1987, and with Tektronix *Standard Codes and Formats.*

- **Archival Storage of Waveforms and Settings**
- **Automated and Manual Logging of Measurement Data**
- **Measurement Data Graphing and Histograms**
- **GPIB and RS-232 Instrument Control**
- **Waveform Acquisition and Display or Template Waveform Creation**
- **Hard-Copy (Printer or Plotter)**
- **BASIC Source Code Included**

The 11000-Series Utility Software packages provide complete GPIB or RS-232 control of the Tektronix 11300-Series Programmable Oscilloscopes, or the 11400-Series Digitizing Oscilloscopes from your IBM PC.

These utility software packages allow you to use the full GPIB or RS-232 programmability of the 11000-Series oscilloscopes without ever having to write a single line of code.

You get the simplest possible access to the measurement system power through each menu-driven package.

All of the major commands and functions are directly executed from the PC's function keys. You choose what you want to do from the first-level main menu—acquire measurement data, copy settings, send GPIB interface commands, etc. Then a second-level menu appears, allowing you to select the specific functions or options for the operation or to enter controlling parameters or file names. Required entries from the keyboard are always prompted and are in a simple "fill-in-the-blanks" format.

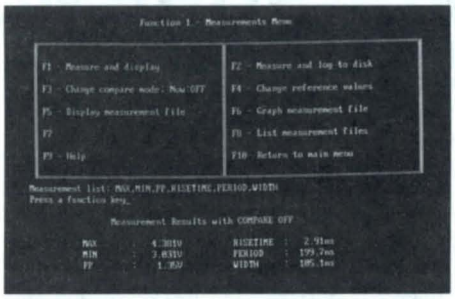
No matter what you select or enter, the Utility Software packages do thorough error checking to help ensure the job is done correctly. Also, if there is any ambiguity or error in entries, the packages provide automatic prompting for immediate on-line correction.

If there is ever any question about program operation, simply press F9. This provides complete on-screen help from any menu.

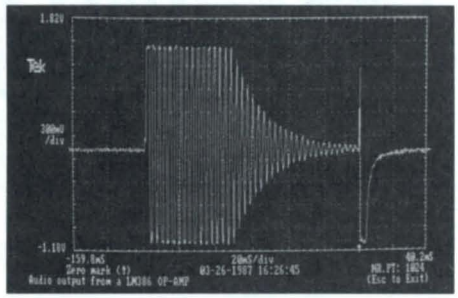
Hardware Configuration

Tektronix PEP Controller, IBM PC, XT, or AT or DOS 2.0/2.1/3.0/3.1/3.2 compatible with 640K memory; dual floppy drive or 1 floppy and 1 hard disk; IBM color graphics card (or compatible); National Instruments PC-2 or PC-2A GPIB card (for GPIB operation); GPIB cable or a 9-wire RS-232 cable.

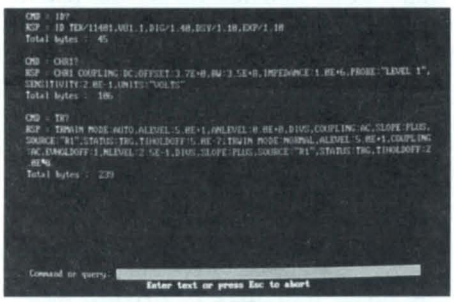
11401/11401 DIGITIZING OSCILLOSCOPE UTILITY SOFTWARE



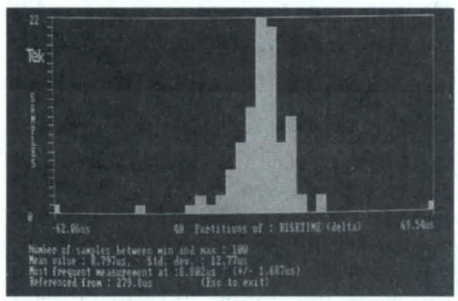
Interaction with the software is simplified through the use of function-key-driven menus as shown above in the Measurement menu.



Waveforms can be acquired and displayed on the PC screen and output to a plotter or dot-matrix printer.

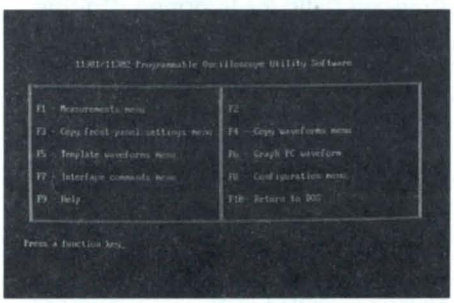


Direct entry of instrument commands is supported with control over GPIB or RS-232 interfaces and screen listing of command responses.

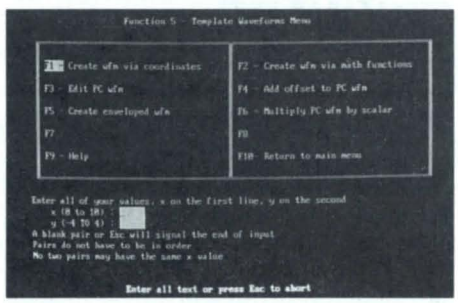


All of the measurement features of the 11400-Series scopes are available through the menus and are supported by measurement logging, statistics, and screen graphics.

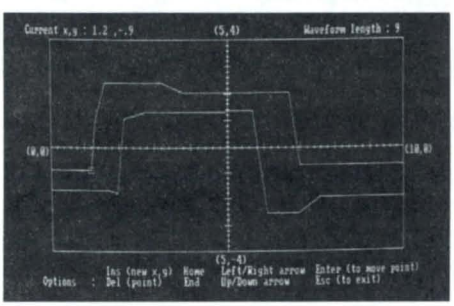
11301/11302 PROGRAMMABLE OSCILLOSCOPE UTILITY SOFTWARE



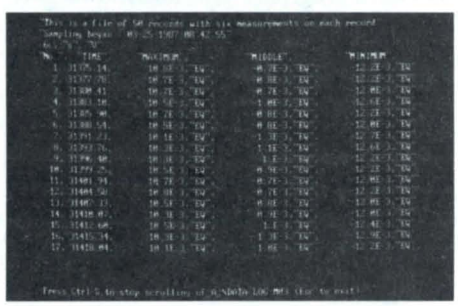
The Main Menu provides submenu access to 7 major operating areas as well as on-screen help.



Template waveforms for limit of comparison testing can be created in the PC and transferred to the 11300 scope.



The use of a graphics editor simplifies the modification of template waveforms.



Measurements acquired with the data-logging function can be listed on-screen or plotted in a graph.

ORDERING INFORMATION

S47P102 Option 01 11401/11402 IBM PC Utility Software. **$450**
Includes: Software on 5¼ DS/DD disk, manual, and license agreement.

S47P103 Option 01 11301/11302 IBM PC Utility Software. **$450**
Includes: Software on 5¼ DS/DD disk, manual, and license agreement.

TEST AND MEASUREMENT SYSTEMS/PACKAGE

CONTENTS

Semiconductor Test Systems 471
Measurement Instrument Systems 474
Manufacturing Test Systems 476
A/D Converter Test System 480
VXIbus Instrument and Test Systems 482
Measurement Package 486

Tektronix Provides Systems Solutions
Tektronix provides a full range of products and services to ensure total system solutions to test and measurement problems.

Tek's systems are not just hardware packages. With each system, Tek provides complete design services, a fully documented system proposal, manufacturing and integration, software development, on-site installation, maintenance and repair services, and technical support.

TEKWARE

Software designed and tested to enhance the productivity of Tek instruments and controllers.

TEKWARE Programs Complement Tektronix Instruments and Controllers

More and more, engineers involved in almost any measurement environment have to be part-time computer experts. In addition to writing programs in standard languages, you have to be adept at bringing up and running many different software programs. This means that software compatibility is a vital piece of your instrument control puzzle. Tektronix has performed extensive software testing to verify that all standard TEKWARE measurement, analysis, and utility packages run reliably with Tek instruments and controllers. MS-DOS TEKWARE programs have been tested for compatibility with 286/386 IBM compatible PCs.

TEKWARE Instrument Software Library
The TEKWARE Instrument Software Library is part of the Tektronix commitment to provide complete solutions for your test and measurement needs. The Tekware Software Library Catalog has programs for MS-DOS compatible PCs, Tek PEP 301, 4041, and other instrument controllers. Call your Tektronix Sales Rep for a copy of the latest catalog, literature number 49W-6829.

Technical Assistance Services

- **Installation Assistance**
- **Familiarization Training**
- **Custom Training**
- **Problem Definition and Debugging Assistance**
- **Interfacing Assistance**
- **Applications Assistance**

When Your Systems Development Program Calls for Informed, On-Site Assistance, Tektronix Can Keep You in Touch with Some of the Best in the World.
With Tek Application Engineers, you enjoy a resource that you can draw on to help you derive maximum benefit from Tektronix system components.

When you need assistance to supplement your own resources, Tek can arrange the consultive services of an Application Engineer skilled in meeting your needs.

Not only are our AEs skilled professionals in their own right, they are backed by the resources and collective experience of Tektronix—itself an experienced user of automated test and measurement systems.

Tektronix AE Consultation is Intended Specifically for Optimizing the Operation of Tek Instruments and Software.
We suggest that customers may first want to avail themselves of Tek's excellent documentation and regular customer training programs prior to requesting our Technical Assistance Services. Typical consulting services include:

Installation Assistance
This may include pre-installation counseling, assistance in installing hardware or software, and installation validation.

Familiarization Training
This usually takes the form of a brief introduction to hardware basics, system interaction, and software utilization to individuals or groups. Other training modules may present specific operational aspects of a product.

Custom Training
You may require that unique training modules be designed and presented to meet an unusual application, environmental or personnel need.

Problem Definition and Debugging Assistance
Application Engineers can help you trace and debug problems within a hardware/software system.

Interfacing Assistance
We can assist you with unusual interfacing challenges requiring intimate knowledge of Tek hardware and software.

Applications Assistance
You can obtain expert consultation in signal acquisition, in specific test and measurement tasks, in integrating Tek hardware and software within an existing process, and in other application-specific areas.

ORDERING INFORMATION

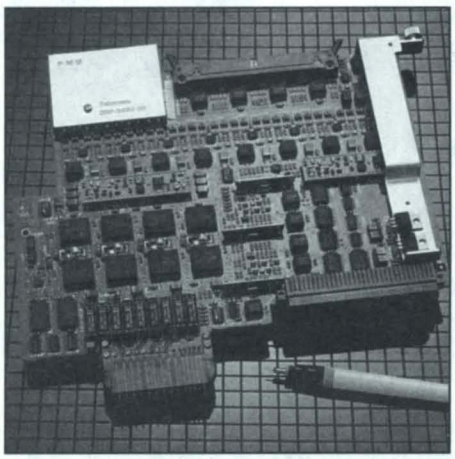
Technical Assistance Services—
1 hour increments.
Order 068-9080-00 **$125**

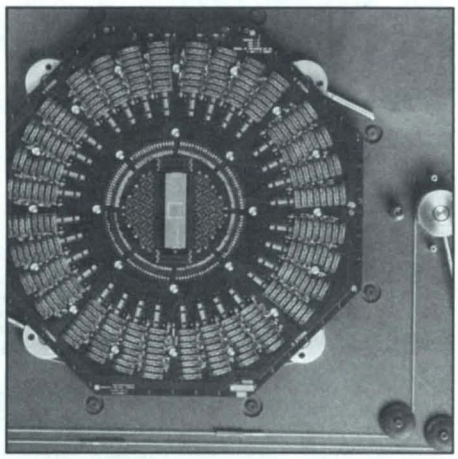
If you'd like to know more about these Tek consulting services, please call your Tektronix Sales Engineer.

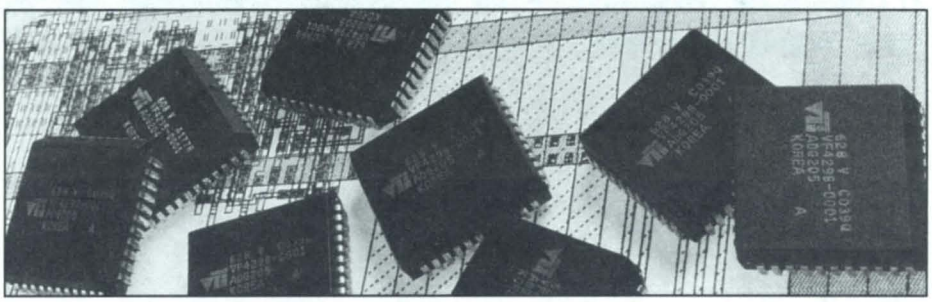
Semiconductor Test Systems—Vista Series

CONTENTS

LT-1000 VLSI Logic Test System 472
LT-1000+ VLSI Logic Test System 473
LT-1100 VLSI Logic Test System 473







The Vista Series Test Systems are designed to meet the stringent testing requirements of today's complex, high-speed devices—with the system modularity and flexibility to adapt to future needs. And they deliver superior performance at a cost that can offer a competitive edge in today's VLSI device marketplace.

To deliver value and performance without sacrificing flexibility, Vista Series systems are built around a consistent modular architecture. Each system component, hardware and software, is designed for maximum efficiency and is aimed at reducing cost-per-test.

A Vista Series Test System consists of four major components—the Test Station, which performs device testing and data logging; the LT-PDS or Program Development Station, a standalone, UNIX-based workstation for test program generation without programming; a mobile LT-ACS or Auto-Calibration Station for fully automatic system calibration; and LT-HOST, software which provides access to CAE and manufacturing databases, analyzes and manages test data, and archives test programs.

For any number of Test Stations on a site, only one LT-ACS and one LT-HOST are needed. The number of LT-PDSs is determined by programming workload—a single unit suffices for smaller installations, while larger users may elect to place an LT-PDS in each test engineer's office. This "distributed" approach eliminates unnecessary duplication of system programming and calibration resources.

The Vista Series Test Station architecture combines the best features of tester-per-pin and shared-resource architectures to offer the performance benefits without the cost and reliability penalties often associated with tester-per-pin architecture.

To test complex devices, critical timing facilities are needed at each pin. The Vista Series testers reproduce these resources—drivers, comparators, expect voltage references, timing generators, etc.—for each I/O channel and place them in the test head, close to the DUT. Each DUT pin also has its own independent test pattern memory.

Resources such as DUT power supplies and drive voltage references are shared. And some resources are shared by groups of DUT pins—a Parametric Measurement Unit (PMU) for every eight pins, for example, allowing parametric measurements in parallel.

The test head is organized into 64-pin quadrants, with independent resources in each. Each quadrant has its own cycle clock with 16 unique cycle time sets that can be switched on the fly. Each quadrant is also backed by its own error detection circuitry and pattern memory, providing an avenue for simultaneous multi-device testing.

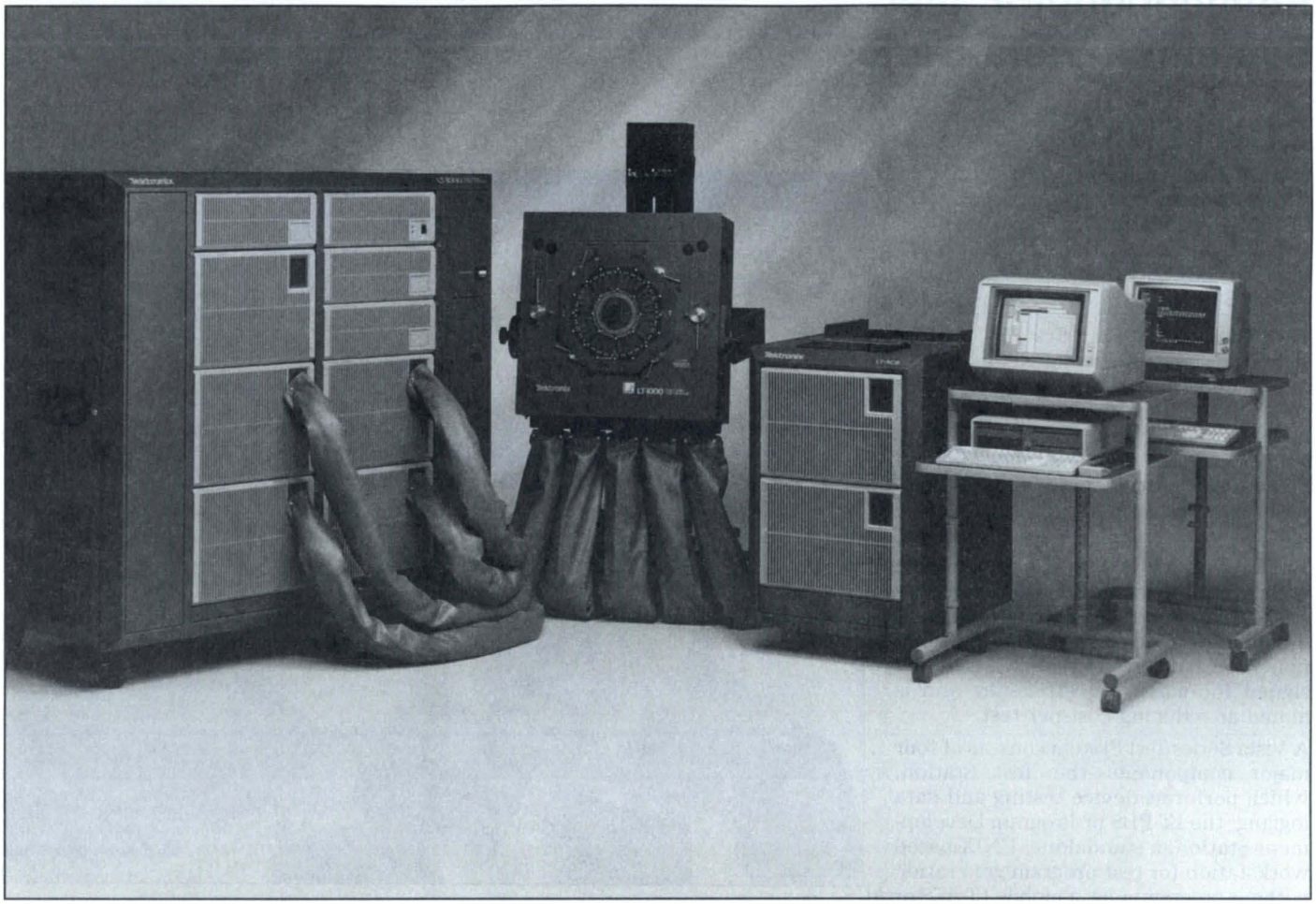
That means unprecedented flexibility and economy in configuring test hardware.

The system can test multiple subsystems within a device by selecting as many as four separate clocks operating at different periods. Or, to test smaller LSI devices, the system can be configured without pin electronics, pattern memory and support circuitry that aren't needed.

Still, the test head is small and maneuverable, making it easy to interface with handlers and probers, for maximum throughput in the production environment.

The modular structure of the Vista Series Test Systems delivers true economy of scale. It allows for future growth in testing capacity, device complexity, and new device families—with the addition of test head quadrants, test heads, test stations and LT-PDSs—while preserving the structure of the original system.

The systems' modular structure results in a lower capital investment and the independent Auto-Calibration Station and Program Development Station save time and money on the job, creating a more cost-efficient operation.



LT-1000 VLSI Logic Test System

FEATURES

- **Up to 256 I/O Channels, in 64-Pin Increments**
- **50 MHz Uncompromised I/O Data Rates**
- **100 MHz I or O data rate with No Reduction in Pin Count**
- **±500 ps Overall Timing Skew**
- **256K x 4 Vectors/Pin**
- **Monolithic Pin Electronics**
- **MC68020, UNIX-Based 32-Bit Program Development Workstation**
- **Extensive On-Line Debugging Tools**
- **Mobile, Automatic Calibration**

The LT-1000 VLSI Logic Test System is a high-performance, high-throughput system optimized for cost-efficient testing of ASICs and other complex VLSI devices.

In this system, as in all Vista Series Test Systems, one or more MicroVAX II-controlled Test Stations is supported by an LT-ACS or Auto-Calibration Station, which provides full-automatic calibration, LT-HOST software, which provides access to CAE and manufacturing databases, analyzes and manages test data, and archives test programs; and one or more LT-PDSs, which allow rapid test program development with minimal programming.

The LT-1000 provides up to 256 I/O test channels with a 50 MHz base test rate and a double-pulse test rate of 100 MHz. With 39 ps resolution and absolute accuracy of ±500 ps, the LT-1000 has the performance required for today's most demanding devices and tomorrow's smaller geometries. Up to 32 parallel parametric measurement units accelerate DC testing. The LT-1000 supports two test heads, each with 256 pins, for high throughput that reduces the test time and cost per device.

LT-1000+ VLSI Logic Test System

FEATURES

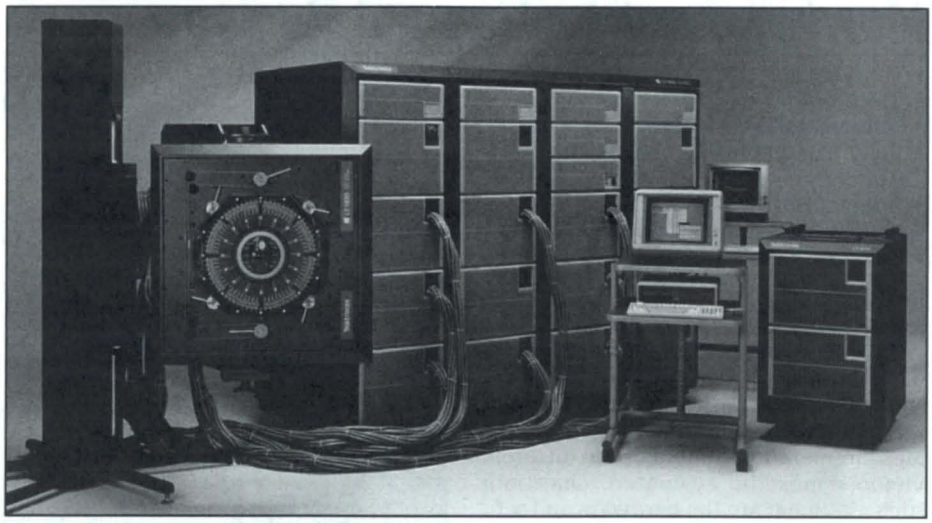
- **Up to 256 I/O Channels, in 64-Pin Increments**
- **100 MHz Stimulus Rate, Without Multiplexing**
- **200 Mbit/s Pattern Data Rate, Without Multiplexing**
- **±275 ps Timing Accuracy**
- **256K 4-Bit Test Vectors Per Pin**
- **Monolithic Pin Electronics**
- **35 mA Driver Current Capability**
- **Extensive On-Line Debugging Tools**
- **Mobile, Automatic Calibration**

The LT-1000+ is designed to offer a cost-effective high-performance solution for testing complex VLSI devices.

The tester's pin electronics are concentrated in two custom ICs per pin, providing exceptional accuracy and speed. The system can test devices of up to 256 pins at speeds of up to 100 MHz, with special formatting options available to provide edge placements at effective rates of up to 200 MBits/s. These formats allow the LT-1000+ to offer functional test performance equivalent to the most costly characterization systems.

In the LT-1000+, as in all Vista Series Test Systems, one or more MicroVAX II-controlled test stations is supported by an LT-ACS Auto-Calibration Station, which provides fully automatic calibration; LT-HOST software, which provides access to CAE and manufacturing databases, analyzes and manages test data, and archives test programs; and one or more LT-PDSs for test program development.

Each LT-1000+ Test Station provides a test head, a computer-controlled support rack, and a Tester Control Terminal (TCT). The test head provides up to 256 I/O channels in 64-pin increments, with each 64-pin Pin Module backed by a Support Module containing clock support circuitry and pattern memory. The result is unprecedented variety and economy in configuring test hardware to DUTs, including double-pulse and 200 MBit/s timing modes. The tester can be configured to test up to four devices at a time, and an optional second test head can be added for increased throughput. Up to 32 Parametric Measurement Units, one for every 8 pins, expedite DC testing.



LT-1100 VLSI Logic Test System

FEATURES

- **Up to 512 I/O Channels, in 64-Pin Increments**
- **50 MHz Uncompromised I/O Data Rates**
- **100 MHz I or O Data Rate With no Loss in Pin Count**
- **±500 ps Overall Timing Skew**
- **256K Vectors/Pin**
- **Compatible with LT-1000 and LT-1000+ Installations**
- **Mobile External Automatic Calibration System**

The LT-1100 VLSI Logic Test System extends the Vista Series into the realm of the largest VLSI devices. The LT-1100 is a high-performance, high-throughput system designed to test a wide range of VLSI including CMOS, ECL and GaAs devices that require very high pin counts and pattern rates.

The LT-1100 sets a new standard of value among VLSI ATE products. The unique Vista architecture provides unsurpassed performance in a compact, cost-effective package—the system rack is the smallest of its kind in the industry, while the 512-pin test head is only 4 inches larger than the 256-pin LT-1000 version. The test head's low heat dissipation results in high reliability and repeatability, and allows air cooling to suffice where others require cumbersome liquid-cooling schemes. The LT-1100 is compatible with the LT-PDS, LT-ACS, and host units used throughout the Vista Series.

The LT-1100 Test Station features the Vista Series fully scalable architecture, which combines tester-per-pin and shared-resource technologies. The tester's 512 I/O channels are partitioned in 64-pin modules, each of which is backed by a support module containing clock support circuitry and pattern memory. This unique incremental approach makes it possible to configure systems for 64-to 512-pin devices without upgrade barriers or cost penalties.

The LT-1100 is also available in a "+" configuration (nomenclated as the LT-1100+) that provides ±275 ps timing accuracy, 200 MBits/s pattern rate, additional functional test data formats, and 35 mA driver current capability.

Measurement Instrument Systems

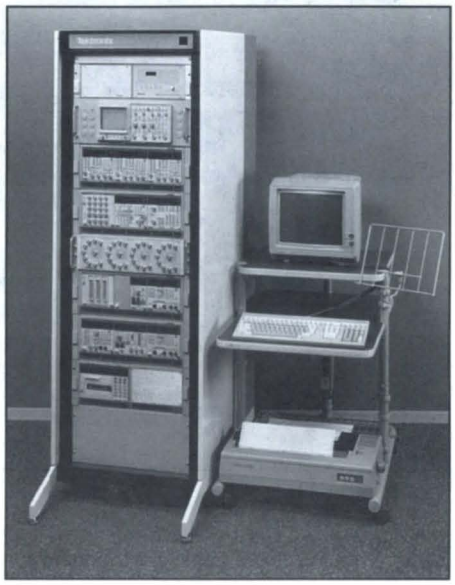
- **Total Measurement Systems Solutions**
- **Tailored to User's Needs**
- **Fully Integrated Hardware and Software**
- **Specialized Designs**
- **Modified System Products**
- **System Installation**

Researchers, engineers, and manufacturing test system designers are often faced with the task of adapting, reconfiguring, or rebuilding test systems to meet specialized testing requirements. New test specifications must be written. Measurement instruments from different vendors must be evaluated. Questions such as, "what are the hardware and software requirements," and "how easily can the test system be reconfigured or upgraded?" must be considered. It's often a tedious and time consuming process—time that could be better spent in the lab or adding value to products.

Tektronix Has The Solution

The Tek Measurement Instrument Systems team is a group of hardware, software, and systems specialists whose sole purpose is to provide total, integrated measurement solutions.

We specialize in measurement systems solutions requiring high-speed, multiple channel data acquisition, data logging, and diagnostic testing; time domain measurement systems; and automated test systems for low-run manufacturing environments. In fact, our high-performance, specialized systems are currently utilized in such diverse fields as fusion research, high-energy physics, radar, lidar, communications, component radiation hardness testing, and nuclear magnetic resonance, to name just a few.



Typical Measurement Instrument System

In the manufacturing environment our high-performance systems feature fully automated functional testing of PCBs and hybrids, as well as simultaneous analog and digital testing.

Our modular instrument approach ensures system flexibility for easy reconfiguring or expansion to meet a variety of test situations.

Systems Tailored to the User's Needs

From complete integration and installation of one-of-a-kind turnkey systems to simple modifications of selected products, Tek's Measurement Instrument Systems team can tailor a complete high-performance measurement system based upon your present and future needs, your budget, and your required degree of continuity with existing hardware and software components.

You provide your unique measurement requirements; Tektronix will provide the professional expertise in instrument systems integration.

Together we'll evaluate your hardware and software requirements (including refined application and diagnostic programs and the drivers to run them), custom cabinetry or racks, and even non-Tek components if Tek does not have the instrument to fit a particular application.

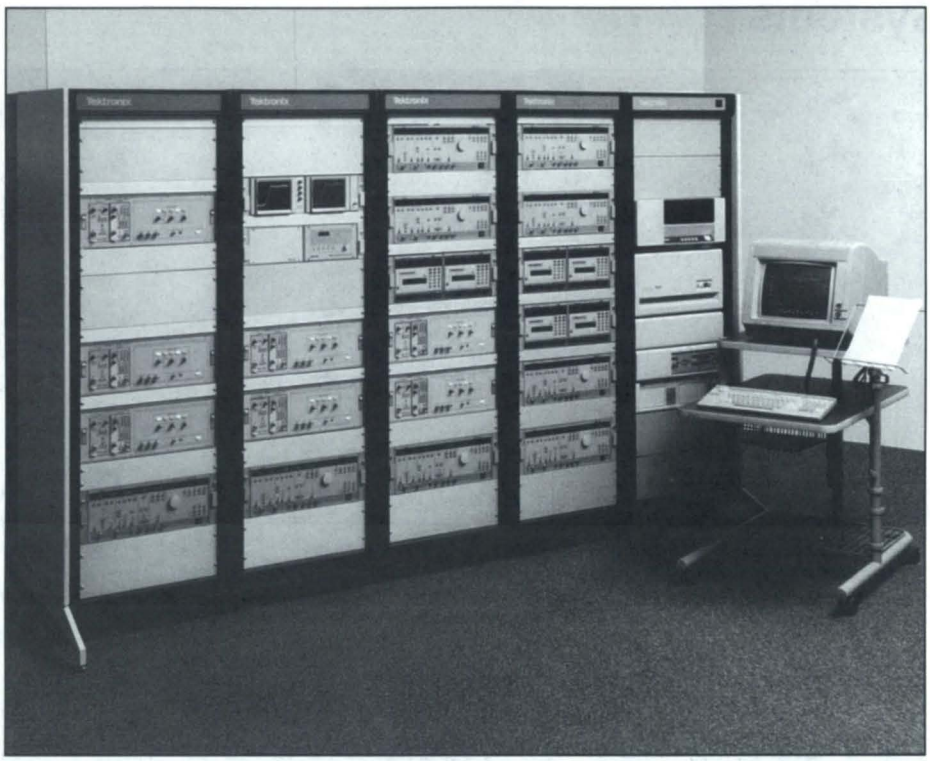
We'll define your exact requirements, and settle contract terms and conditions. The result will be the total solution required, whether you need just an off-the-shelf modified product, or a multi-instrument, multi-channel custom system.

Here's How We Work

During the design phase, the Measurement Systems team will help define measurement requirements, and then follow up with a comprehensive system design, which includes hardware and software configurations as well as electrical and mechanical specifications for specialized requirements.

After full agreement is reached on the design parameters, Tek will provide a complete proposal including a system description, rack drawing, block diagram, system price, and warranty information.

Upon acceptance, your system will be engineered, manufactured, and fully checked out before on-site installation. Our doors are open for a full factory inspection before delivery. The on-site installation will be considered complete only after start-up, testing and acceptance.



Typical specialized system.

Modified System Products

Selected products can be modified with off-the-shelf plug-ins, options, and other modifications to meet specialized requirements. The 7854 Waveform Processing Oscilloscope, for example, when integrated with the 7S12 plug-in, an S-6 Sampling Head, and an S-52 Pulse-Generator Head, becomes a TDR measurement system.

Other off-the-shelf modified system products of interest include:

- A GPIB program decoder plug-in that enhances the 7854 oscilloscope by interfacing to programmable vertical and time-base front-panel settings with selected plug-ins.
- High-speed buffer memories for DMA collection of long record data streams.
- A GPIB-controlled, medium-speed signal multiplexer with 4 each, one-to-nine 300 MHz bandwidth switch units, expandable in units of 4 each switches.
- Modification to the 7912AD and the 7912HB Programmable Digitizers to provide non-volatile memory for storage of panel settings.
- A GPIB-controlled signal routing and auto-characterization system with greater than 3 GHz bandwidth multiplexing with dc level and time references built in.
- High-speed data output modification for customer-owned 390AD digitizers.
- The RTD 710 and other digitizers can be equipped with FDC1 and FDC2 long buffer memories to enable reading of 16-bit data words, allow digitizing speeds of up to 100 MS/s, and expand storage to 32M words.

For ordering information on any of these items, contact your local Tektronix Sales Representative.

Specialized Systems

Any number of standard and modified products can be integrated into large, multichannel test and research systems incorporating a wide variety of Tek digitizers and high-bandwidth acquisition instruments, both for major military installations and defense contractors, and for a variety of commercial test applications, such as fiber optics research and testing.

Post Installation Support

Product warranties, stipulated for each system instrument, cover all hardware and software. In addition, the System Warranty covers installation and service at your site for 90 days from the date of acceptance, or 120 days from shipment. Maintenance contracts are available through Tektronix for extended support periods.

Pre-installation consultation or training for operators, technicians, engineers, or maintenance staff may also be arranged at the Tek home office, at regional sales offices, or on-site. And when you need additional support down the road, Tek's applications engineering and product service staffs can help keep your systems tuned and your people informed.

In the Tektronix tradition, documentation is thorough, clear and complete. Regular updates and a user's exchange program are only two of the many ways Tek stays in touch with its system owners.

A Totally Integrated Measurement Solution

By blending the best of technologies, we can build systems that do in minutes tasks that may now take days.

By providing a team of experienced systems integration specialists that will work with you from the initial system definition through installation and support, Tek offers the highest level of service and support available anywhere.

By combining superior products and services from a single source, we reduce to a minimum the task of defining, configuring and ordering the system that will do your job.

In short, Tektronix provides fully integrated specialty system solutions by combining the best waveform acquisition instruments on the market with automated stimulus and acquisition capability, and the world's most respected technical support.

ORDERING INFORMATION

Call your local Tektronix Sales Representative for total measurement systems solutions today.

Engineering Support Services—
1 hour increments.

(Support Services) Order 068-9161-00.	**$95**
(Technical Services) Order 068-9162-00.	**$125**
(Engineering Services) Order 068-9163-00.	**$175**

Manufacturing Test Systems

THE MANUFACTURER'S TESTING DILEMMA

Tektronix realizes that surviving in today's competitive market depends more and more on product differentiation and cost reduction. Automated testing can provide cost reduction, but equipment has traditionally been suited to high-volume applications with a uniform product. Where a high level of product differentiation led to small production runs, manufacturers made automated testing work by maintaining a large staff of test engineers to build IEEE-488 based rack and stack test systems that adapted to multiple applications.

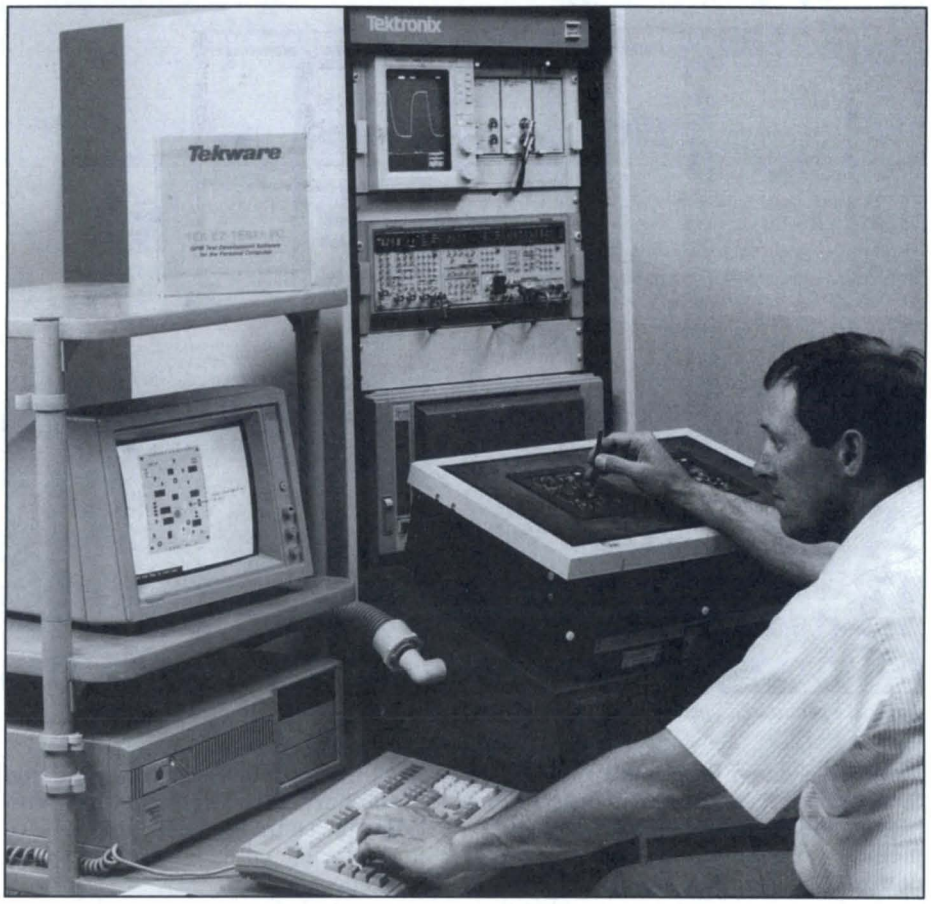
This approach, however, incurs many hidden costs and unforeseen hardships. Most project timelines, for example, are not met, and either costly interim test procedures must be set up, or new product introductions must be delayed. Also, companies rarely know the true cost of their test systems because variables such as meeting time, purchasing costs, etc. are not captured in their accounting system. Consequently, future decisions are based on distorted values of past projects. Finally, companies expose themselves to a great deal of risk, since usually only one person is familiar enough with the system to repair and maintain it.

Why Tektronix for Flexible Automated Test Solutions?

Tektronix now offers relief to manufacturers facing this testing dilemma by providing *Total Test Systems Solutions.* Tek's line of GPIB-compatible system components make it possible to build a unique automated test system (at a reasonable price) that can easily be adapted to other applications.

Each system is built on a highly reconfigurable test platform consisting of a PEP 301 System Controller, an instrument rack, EZ-TEST PC Test Procedure Generator, the TSI 8150 Switch Controller, and high-performance Tektronix instrumentation.

But Tektronix provides more than just hardware. With each system, Tek offers system design services, a full system proposal, project management, documentation, software development services, on-site installation, maintenance and repair services, and technical support.



The result is a totally integrated system solution built to fit *your* test application—a test system built with the same care and quality standards that have made Tek a leader in test equipment manufacturing for over 40 years.

THE TOTAL SOLUTIONS APPROACH

Tektronix can free your staff from the burdensome task of system development with a full line of support services. From the first visit to final installation, you can select whatever level of Tektronix services that you require. Initially, Tek specialists can help define the major constraints and problems associated with your testing needs. Then, Tek can provide a goal-directed development program that integrates the efforts of everyone involved to produce your system on time, with the capabilities you need, and with the required maintenance and system support firmly in place. The basic elements of the program are as follows:

Requirements Analysis: After the main constraints are identified, detailing the specific requirements of a system is often tedious, and always time consuming. Tek's systems specialists can reduce both the tedium and the time required by working closely with your staff in an interactive process. Combining your unique knowledge with Tek's systems experience and expertise results in a cost-effective, thorough analysis.

Proposal: Based on the requirements analysis, you are provided a written proposal including a system description, price, and warranty information. You know up front exactly what you are paying for, but without being locked into a rigid proposal. Additional system features can always be negotiated into the project.

Design: Upon acceptance of the proposal, Tek can design every facet of the system. Over 40 years of designing test and measurement equipment assures you of clean signals and reliable results from your test system. Nevertheless, if your application requires a special purpose instrument from another manufacturer, Tek will purchase it and integrate it into the system. Throughout the design phase, Tek will maintain close contact with you in order to ensure that no surprises are designed into your system.

Manufacture: For some test system builders, the physical integration of a system is trying because of the variety of miscellaneous and customized parts needed for assembly. Tektronix avoids needless production delays by maintaining a shop with all of the miscellaneous parts on hand. Next door is a model shop to build the parts needed to adapt special equipment to the system. Tek's experienced and innovative technicians use the same materials and care used to make the highly reliable Tektronix test instruments.

Customization: All systems require customization beyond instrument configuration. Tek can provide customization of software, switching, fixturing, and user interfaces.

Software: Tek's test program professionals can develop a unique software package for your specialized applications. Using EZ-TEST PC, or a variety of high-level languages, the Tek specialist can build test procedure software that is easy to learn and to use. All software is documented, and application source code is provided.

Switching: Tek's TSI 8150 Switch Controller is an extremely flexible card-modular switching system that provides low-noise, power, and general purpose switching from DC to 18 GHz. It can be configured to meet almost any system switching requirement. For customized switching, Tek has developed a prototype card that fits into the TSI 8150 architecture to allow either you or Tek to build a custom switch module.

Fixturing: Tek's TSA 8140 Test System Adapter mates directly to the Virginia Panel line of fixturing hardware. This feature almost makes building fixtures as easy as assembling off-the-shelf hardware. Still, DUT's must be analyzed and fixtures must be designed. In many cases, Tek can provide these services.

User Interfaces: Tek has a custom modification team with both the electronic and mechanical expertise to design and manufacture special user interfaces such as patch panels, keypads, touch screens, etc.

Documentation: Because good documentation is a time-consuming, grueling task, custom systems typically come with sketchy documentation. Tektronix provides complete documentation including safety practices, operating instructions, system drawings and a functional description of the system.

Installation: Often the purchaser of new equipment is left with the responsibility of set-up and start-up. If it does not run, the user often does not know if the equipment is defective or merely hooked up wrong. This generally leads to extended telephone calls to the vendor (if anyone is available) while the buyer learns how to bring the equipment up. On-site installation is always available with Tek's test systems.

Support After the Sale: Regular maintenance and periodic servicing are essential to maximizing the return on your test system investment. Test systems will sometimes require modifications as new test procedures are implemented. And spare parts must be available for the life of the system.

Service: All of Tek's manufacturing test systems include a standard 90-day limited on-site warranty in addition to standard warranties on the individual instruments. Extended warranties are also available. Service can be provided on-site or at the nearest service depot by Tek's top-flight service technicians. And Tektronix maintains service facilities around the globe for overseas customers.

Long-term Support: Tek's experience with military contracts, where products are kept in use longer than in commercial applications, assures you of replacement instruments and parts for extended periods. When a product *is* phased out, Tek maintains support for most spare parts for nine years.

Application Support: Tektronix maintains a staff of experts in each field office to answer questions about hardware or software, to write new test procedures, or to provide start-up training for new technicians and operators.

THE NUCLEUS OF MANUFACTURING TEST SYSTEMS

- **PEP 301 System Controller.** The PEP 301 is a 16-MHz, 80386/80387-based, PC-compatible system controller. It is equipped with 1 MByte RAM, a 40 MByte hard drive, a 1.2 MByte floppy disk drive, a high resolution EGA graphics board and monitor, two RS-232 serial interface ports, and a GPIB port. Software includes MS DOS 3.2, GW-BASIC, and GURU II. GURU II is the GPIB User's Resource Utility software that allows the PEP 301 to communicate with the bus instruments easily.
- **TEK EZ-TEST PC Test Procedure Generator.** This high-level software package provides the tools for generating complex test procedures on the PEP 301 or IBM PC® -compatibles. Test procedures can be generated in as little as one-third the time required with high-level language coding methods. It even guides technicians with little programming experience through test procedure development with multi-level menus. Test procedures can be translated into easily modified QuickBASIC source code. This code can then be compiled for faster test execution.
- **TSI 8150 Switch Controller.** This programmable, card-modular control assembly supports a full line of scanner and switch modules to provide high-quality switching from DC to 18 GHz. Multiple test requirements are supported within a single hardware configuration. With options, scanner and switch modules can be mounted directly below the DUT to minimize transmission loss and noise. The TSA 8140 Test System Adapter and a test head receiver allow rapid change-over to other test fixtures.
- **TM 5000 Modular System Instruments.** Stimulus, acquisition, and power functions are offered in this line of modular instruments. The simple plug-in design makes physical reconfiguration a simple matter of sliding out one instrument and replacing it with another. GPIB compatibility and adherence to Tek's *Standard Codes and Formats* assure full use of instrument capabilities over the bus.

EXAMPLE TESTING SYSTEMS

Four test systems are outlined below to illustrate Tektronix's Manufacturing Test System capabilities. The first two are combined analog and digital functional testers that demonstrate how Tek solves the test engineer's dilemma of how to functionally test PCBs containing both analog and digital circuitry. The third system is an automated bareboard Tester that utilizes time domain reflectometry for quality and process control during bareboard manufacture. The final system highlights Tek's capability for low-impedance probing of high-impedance test points at high frequencies in a bed-of-nails testing application.

BASIC ANALOG AND DIGITAL FUNCTIONAL TEST SYSTEM

System Platform

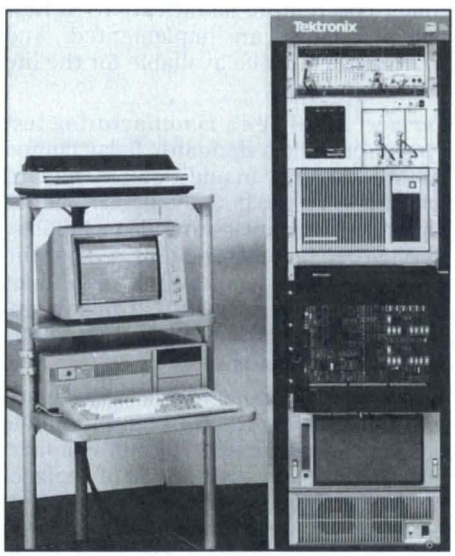
PEP 301 System Controller
EZ-TEST PC Test Procedure Generator
TSI 8150 Switch Controller
TSA 8140 Test System Adapter
- TSD20 Digital I/O Card
- TST20 Timer Counter Card
- TSM20 Memory Card

2432 300 MHz Digital Oscilloscope
TM 5000 Modular Stimulus and Measurement Instruments

The Basic Analog and Digital Functional Test System is designed to provide fully integrated analog and digital functional testing of circuit boards and sub-assemblies. The TM 5000 Series provides a wide range of analog stimulus and measurement instruments. Digital I/O to 2 MHz and timing are provided on cards in a compact format that plugs into the TSI 8150 Switch Controller. The TSI 8150 also provides signal routing for the system. These switching cards can also be mounted remotely directly under the DUT to shorten signal path lengths and reduce system noise. Its steel construction shields the test circuits from low-frequency magnetic fields.

The TSD20 Digital I/O card provides two 16-bit digital interface ports that can be accessed either by the GPIB or by a high speed bus built into the TSI 8150. This high speed bus is used for communication between other devices in the TSI 8150 subsystem. Both ports are bidirectional, and interface with standard TTL logic levels.

The TST20 Timer Counter Card contains five independent timing generators which allow system pacing, delay generation, and clock generation for use throughout the system. Each generator provides fully programmable control of period, pulse width, delay, burst count, source and destination triggers. The measurement section of the card provides frequency, period, pulse width, time A to B, and totalize measurements to 6-digits resolution. A 24-bit up-down totalizer provides memory record length control and other counting functions.



Typical High-Speed A/D Functional Test System

200-MHz COMBINED ANALOG AND DIGITAL FUNCTIONAL TEST SYSTEM

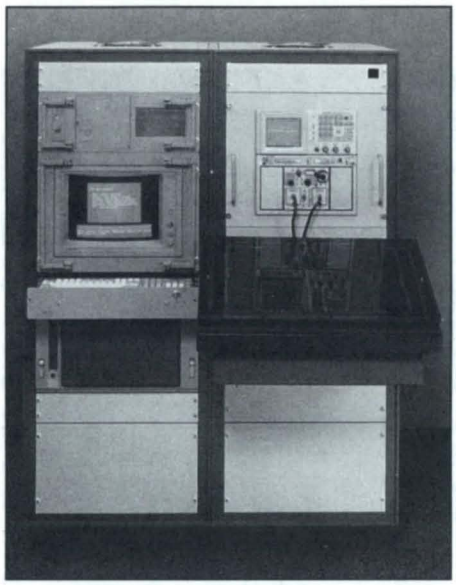
System Platform

PEP 301 System Controller
EZ-TEST PC Test Procedure Generator
DAS 9229 Digital Analysis System
TSI 8150 Switch Controller
92BTARM Board Test Adapter
High-Performance Digitizing Oscilloscope
TM 5000 Modular Stimulus and Measurement Instruments

As clock rates increase, variations in component characteristics and trace impedances become much more critical. At-speed testing is the only way these circuits can be tested with any confidence.

The 200-MHz Combined Analog and Digital Test System is designed for fully integrated digital and analog at-speed functional testing of circuit boards and sub-assemblies containing high-speed digital circuitry. It provides digital acquisition to 200 MHz, digital stimulus to 50 MHz and analog acquisition to 600 MHz.

It lets the user identify faults that would not show up at slower speeds. Defects are identified in a two-step process. First, digital faults are identified, at-speed, using the high-performance digital analysis subsystem. Then, an analog analysis is performed on the faulty area to determine the analog cause of the problem. This allows the user to make quick decisions about whether to repair or scrap a board and to correct defective manufacturing processes. It also allows the use of lower-skilled labor to perform board repair.



Typical TDR System.

The key ingredient of this system, aside from the high-performance instrumentation is the 92BTARM. The 92BTARM provides a means of mounting up to 540 digital acquisition channels and up to 640 digital stimulus channels in very close proximity to the device under test. It can also accommodate the TSI 8150 Auxiliary Card Rack, which can place up to 12 TSI family switching cards in a position to minimize the cable length between the DUT and the test instrumentation. This minimizes the exposure of signals to uncontrolled environments and allows such high-speed testing.

AUTOMATED TDR BARE BOARD TEST SYSTEM

System Platform

PEP 301 System Controller
TDR Application Software
TSI 8150 System Controller
TSA 8140 Test System Adapter
Waveform Processing Oscilloscope equipped with TDR Sampler and Pulse Generator Heads

System Description

Time Domain Reflectometry (TDR) was originally developed to test the uniformity of transmission lines. A fast pulse introduced to one end of a line will reflect back a portion of its energy as it encounters local changes in impedance. Given the dielectric properties of the medium, the location of impedance changes can be determined from the time it takes a reflection to be detected.

At higher frequencies, circuit board traces behave like transmission lines. The Automated TDR Bare Board Test System uses TDR to identify unacceptable variations in board lamination thickness, dielectric properties, or damaged photomasks.

Using the Automated Bare Board Tester, the circuit designer can verify propagation delays and impedance mismatches in the design. The bare board manufacturer can detect and correct variations in the bare board materials or manufacturing process. And the bare board customer can verify critical propagation delays and trace impedances on incoming boards. All with the test repeatability and reduced test time that automation offers.

Due to the very high frequency components of the TDR pulse, the system performance is totally dependent on the ability to maintain a uniform impedance throughout the system. Variations in fixture design and test coupon design affect the ability to preserve a 50-ohm environment. Tek maintains a 50-ohm environment in the TDR Test System by using high-quality microwave switches and connectors from the pulse generation head to the fixture. Tek-built systems have provided impedance resolution as good as ±2 ohms and propagation delay resolution of 300 ps.

BED-OF-NAILS FUNCTIONAL TEST SYSTEM

System Platform

PEP 301 System Controller
EZ-TEST PC
TSI 8150 Switch Controller
TSA 8140 Test System Adapter
P6513 High Impedance, DC to 300 MHz Probe
2432 Digital Oscilloscope
TM 5000 Modular Stimulus and Measurement Instruments

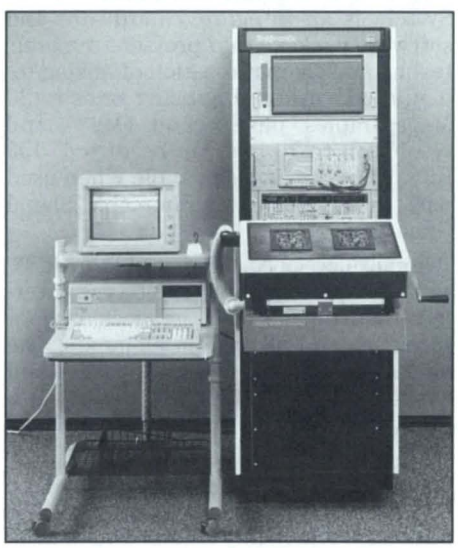
System Description

For some applications, such as precise fault isolation, probing points not accessible to the card edge is the only feasible testing solution. Often, this requires low-impedance probing of high-impedance test points. Low-impedance probing is also needed for functional testing where loading is critical due to a high proportion of timing related errors in the fault spectrum. The Bed-of-Nails Functional Test System is equipped to solve both of these testing problems.

The Bed-of-Nails Functional Test System combines standard Tektronix instrumentation, multiple P6513 high-impedance probes, and custom fixturing to provide automated parametric testing in applications requiring waveform acquisition from high-impedance test points without loading the circuit.

The P6513 is a high-impedance, dc to 300 MHz probe in a spring contact form designed for placement in a bed-of-nails where high-impedance probing is required. The probe receptacles' size permits mounting on 0.1 inch centers, the standard for most circuit board tests, and allows use of interchangeable spring contacts for a variety of tip configurations.

The TSA 8140 Test System Adapter can be fitted with special connectors for easy fixture changing.



Bed-of-Nails Functional Test System.

ORDERING INFORMATION

For complete ordering and pricing information, contact your local Tektronix Sales Representative.

PERSONAL TEST SYSTEM

NEW PTS101

A-D Converter Test System

GPIB IEEE-488

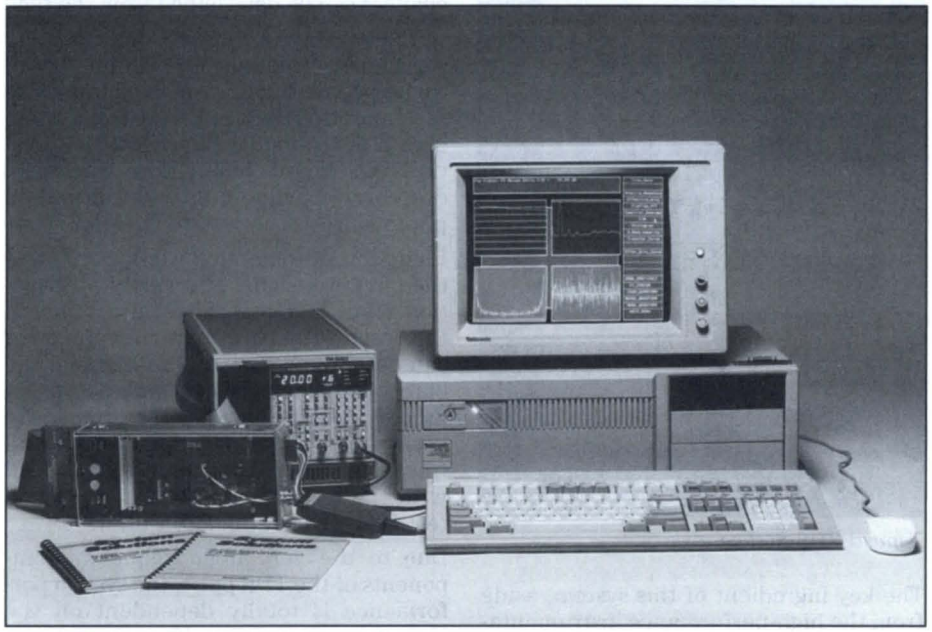
The PTS101 complies with IEEE Standard 488.1-1987 and with Tektronix *Standard Codes and Formats.*

TYPICAL APPLICATIONS

- **Evaluate A-D Converter Design**
- **Evaluate DSO Performance**
- **Production Test of A-Ds**
- **Incoming Inspection of A-Ds**
- **Simulate Ideal A/D Converters**

FEATURES

- **Fast A-D Converter Test Results**
- **Built-In Functions Library of Common Operations Speeds Testing**
- **Easy for New and Occasional Users to Learn and Operate**
- **Highly Interactive Software for Easy Parameter Changes**
- **Open Software Architecture for Easy Expansion**



PTS101 Personal Test System with optional TM 5000 test equipment.

The *NEW* Tektronix PTS101 Personal Test System is an integrated hardware and software package that provides dynamic testing and characterization of analog-to-digital converters. Digitizing rates to 20 Megasamples per second (MS/s) and resolution to 10 bits can be tested. 400 KS/s, 12-bit testing is possible when used with an SG 5010 Programmable Signal Generator.

Tektronix-developed, windowed POLARIS® software provides an easy-to-use interface that controls both the measurement sequence and all system elements. The mouse-based, menu-driven operation and concise documentation are designed to have new users operating their systems within an hour.

Design and test engineers will find the PTS101 system software ideal for their purposes. The highly interactive mouse-based interface allows fast parameter changes, and instantly displays results in color graphics on a windowed display. A library of built-in functions makes common operations easy and flexible. When more functions are needed, the system is easily expanded by adding procedures.

The software user interface uses five waveform windows, with one large window behind or in front of the other four. Once a waveform is displayed in any window, the operator can zoom in for a closer look, add an XY cursor for readout at a given point, overlay it on another waveform, and perform a wide variety of analytical tasks. A menu window is used to offer menu selections, while a conversational menu prompts the operator for input and provides numerical results.

The software features a proprietary high-performance effective-bit measurement algorithm for dynamic A-D Converter testing. Tests available include

- Effective Bits
- Flattop FFT
- Spectral Averaging
- Histogram/Code Density
- Signal-to-Noise Ratio
- Differential Nonlinearity
- Transfer Curve
- Effective Bits Curve

High-Performance Hardware

At the heart of the system are two PC instrumentation cards, a high-performance *Arbitrary Waveform Generator* (AWG) and an *Acquisition Memory Card* (ACQM). The AWG provides a high-performance sine wave, required for testing A-D converters. The output is 1 volt peak-to-peak into 50 ohms, and the sine wave signal range is 1 Hz to 6.7 MHz with 1.25 Hz resolution. A major feature of this AWG, and a key element for successful A-D converter testing, is the extremely low harmonic distortion; at least 60 dB down for signals up to 5 MHz, and at least 57 dB down for signals to 6.7 MHz.

The ACQM card and Acquisition Probes (two are included) acquire up to 16 data channels plus clock at a sample rate of up to 20 million megasamples per second (MS/s). The card has a 4K-deep memory. When the clock line is active, data acquisition takes place in a First In, First Out (FIFO) fashion. When Acquire Signal is selected in the menu window, acquisition stops and the data are copied from Acquisition Memory into the controller memory and made available for processing.

System control is provided by a Tektronix PEP 301 Instrument Controller. Based on the 32-bit Intel 80386 Microprocessor running at 16 MHz, the PEP 301 includes an 80387 Coprocessor, 1 MByte of RAM expandable to 16 MBytes, a 40-MByte hard disk drive, a 1.2 MByte floppy disk drive, a high-resolution 640×480 color graphics board and monitor, and a 101-key detachable keyboard.

The controller also features Microsoft MS-DOS 3.3 and GW-BASIC interpreter software. It executes IBM PC/AT-compatible software and has full power-on boot/test diagnostics. A GPIB interface is built in.

TM 5000 series and other auxiliary instruments can extend the usefulness of the system. These include: PS 5010 Programmable Triple Power Supply, SG 5010 Programmable Oscillator, TM 5006 Power Module Mainframe, FG 5010 Programmable Function Generator, 2465A 350 MHz Oscilloscope, and 4696 Color Ink-Jet Printer.

CHARACTERISTICS

ARBITRARY WAVEFORM GENERATOR

Peak Output Signal—1 V peak-to-peak.
DC Performance—Resolution: 12 bits.
Memory Depth—16K.
Sine Wave Performance—1 Hz to 6.7 MHz.
Timebase—Internal 20 MHz clock.
Harmonic Distortion—−60 dB for signals ≤5 MHz; −57 dB for signals 5 to 6.7 MHz.
Spurious Distortion—<60 dB.
Step Performance—75 ns risetime.

ACQUISITION MEMORY CARD

Maximum Memory Word Width—16 bits.
Maximum Acquisition Rate—20 MS/s.
Threshold Level Range—−5 V to +5 V.
On-Board Memory—4K.
Clock Required—External.

P6451 DATA ACQUISITION PROBES

Input Resistance—1 MΩ ±15 KΩ.
Input Capacitance—5 pF ±1 pF (without leads).
Maximum Dynamic Input Voltage—−40 V to a maximum of 10 V above input threshold.
Maximum Nondestructive Voltage—40 V (dc + peak ac).
Delay Time—17 ns.

ELECTRICAL

Power Requirements—All operating power supplied by PEP 301 Controller (115/230 V, 50/60 Hz, 230 W ac switching power supply).
Safety Certification—UL 478, CSA C22.2 (No. 154-M).

ENVIRONMENTAL

Operating Temperature—+10 to +32 °C.
Nonoperating Temperature—−10 to +60 °C.

PHYSICAL

Mainframe—21.0 in. (533 mm) W, 6.5 in. (165 mm) H, 17.0 in. (432 mm) D; 41.9 lb (19 kg).
Keyboard—19.1 in. (485 mm) W, 0.75 in. (19 mm) H, 8.2 in. (208 mm) D; 6.0 lb (2.72 kg).
Display Monitor—15.6 in. (395 mm) W, 11.5 in. (291 mm) H, 15.75 in. (400 mm) D; 30.8 lb (14.0 kg).

DISK STORAGE

Floppy Disk Drive—1.2 MByte high-density, 5.25-inch, half-height; 94 ms average access time; read-compatible with 360 KByte media.
Hard Disk Drive—40 MByte, 5.25-inch, full-height; 28 ms average access time.
Add-On Capability—Standard adapters support up to two hard disk drives and two floppy disk drives.

PRINTER SUPPORT

The PTS101 supports Epson-compatible graphics dot matrix printers that use the Centronic printer interface.

LICENSING AND WARRANTY

Licensing for the software is "break the seal." The warranty period extends to the product's media and encoding only.

ORDERING INFORMATION

PTS101 A-D Converter Test System. **$18,950**
Includes: PEP 301 Instrument Controller, POLARIS Application Software (installed on hard disk with backup copy on 5.25-inch floppy disk); Turbo PASCAL Version 4.0 Development Software; Arbitrary Waveform Generator (AWG); Two P6451 Data Acquisition Probes with 5-inch Flying Lead Set; Serial Optical Mouse, User's Manual; a Diagnostic Aid (067-0180-00).

PTSF01 PEP 301 Upgrade Kit. **$11,335**
(Upgrades an existing PEP 301 to a full PTS101 configuration).

NEW VXIbus Instrumentation and Test Systems

What Is VXIbus

The VXIbus standard establishes the basis for the next generation of automated test systems, and is the most important new standard since IEEE-488. VXIbus (VMEbus Extensions for Instrumentation) is a completely open, nonproprietary architecture for modular electronic test instruments that fully incorporates the open VMEbus standard, and is completely compatible with Eurocard standards.

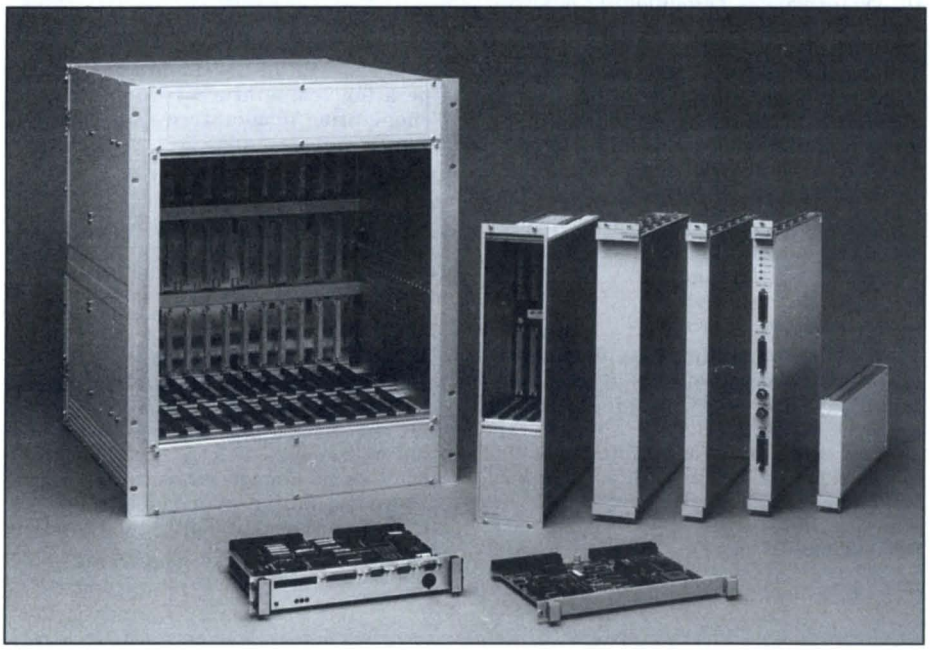
Developed by a consortium of major test equipment manufacturers, of which Tektronix is a founding member, VXIbus allows a wide range of instruments, interfaces, and computers from different manufacturers to coexist as fully compatible modules within the same card chassis. It provides the foundation for downsized, interchangeable, and standardized electronic test equipment.

VXIbus is the long-awaited standard that makes possible the evolution of ATE to instruments-on-a-card.

A True Systems Approach

This broad based standard allows integration of up to 256 devices under one resource manager. It allows multi-device card modules and multi-card modules per device. It allows linking a VXIbus chassis into a layered hierachical network. And it allows for interfacing to virtually any external system. There are few limitations to the level of integration achievable within the VXIbus definition.

The VXIbus Specification addresses not only electrical and mechanical interfacing, but also provides the lower level communications protocols necessary to ensure interdevice communication along the VXIbus backplane. Devices designed within the VXIbus specification must support a standard set of register definitions, as well as configuration and communication protocols.



VXI Offers Extended Performance Features

Built upon VMEbus, the VXIbus standard defines a 13-slot card chassis with P1, P2, and P3 card connectors for each slot. The connectors are mounted to a high-performance backplane and accept A, B, C, or D Eurocard sizes (Figure 1).

The VXIbus standard retains the VMEbus pin configuration on P1 and the center row of P2, but adds optional higher performance features via the outer rows of P2 and all of P3 (Figure 2).

The outer rows of P2 provide a 10 MHz ECL clock, ECL and analog supply voltages, ECL and TTL trigger lines, an analog summing bus, a module identification line (MODID), and a flexible local bus.

P3 offers a 100 MHz clock and sync signal, additional power pins, six additional parallel ECL trigger lines, precision trigger routing with two STAR lines, and additional LOCALbus high-speed lines.

Autoconfiguration

The system automatically identifies each device, its type, model, manufacturer, and any memory requirements upon powerup. You no longer need to physically configure an instrument's address (as with GPIB instrumentation). Identical modules can be plugged into the same chassis and the system will automatically configure the modules correctly because each module has a distinctive ID.

MODID

The module identification line, MODID, on P2 allows a Slot 0 Resource Manager to detect the presence of a module, and to identify each module's geographical location (slot number). The resource manager detects a module when the MODID line is pulled to ground. This allows any module, even if failed and unpowered, to be detected. The slot number of a device is identified when the Slot 0 module asserts a particular MODID line, and polls the MODID bit in each module's A16 autoconfiguration space to detect the selected device.

Precision Timing With STARbus

The STARbus, available through the P3 connector, provides two local bi-directional channels between each instrument module and Slot 0. Each module connected to the STARbus appears equidistant from the Slot 0 Resource Manager. This allows very precisely matched trigger timing between modules regardless of their location in the VXIbus chassis.

Both analog and digital multiple channel acquisition and stimulus instruments can be tightly time coordinated to a single reference point, either with the VXI defined 10 or 100 MHz clocks, or any compatible user clock input. These time coupled measurements greatly enhance data analysis capabilities.

Signals exceeding 250 MHz can be routed through the ECL terminated backplane connections, allowing high frequency clock distribution without the need for multiple clock drivers.

STARbus routing can be programmed to provide a network of connections between system components. This eliminates cable clutter and coax switching components.

LOCALbus

Extended high-speed data transfer, control, and analysis is possible over the VXI P3 LOCALbus lines. Short, well matched propagation delays and very tight time coordination allows internal data transfer rates of up to 1 Gbyte/s, 4 times faster than on P2. This high-speed data transfer can occur between several modules simultaneously, allowing private communications between modules, without occupying the global resources of the system. The VMEbus, the trigger bus, and the analog bus can then be utilized for other tasks.

SYNC100

The 100 MHz clock and SYNC100 signal line available on P3 allow increased timing accuracy between modules within a VXI chassis. This virtually eliminates inter-instrument aliasing.

VXI to IEEE-488 Interfacing

Most instrumentation systems today use the IEEE-488 bus for instrument control. VXIbus instrumentation can be controlled with an external computer using the IEEE-488 bus or any other standard communication interface—RS 232, LAN, MAP. This permits additional capacity though the addition of systems based on existing standards.

VXI Reduces Software Requirements

Because the VXIbus standard ensures multivendor interoperability of all VXI modules, users will have access to generic software packages such as Tek's EZ-TEST. Standardized software will improve the quality of testing by reducing development errors and making troubleshooting easier.

Virtual software can be used to select front panel settings. Programmable operator interfacing lets you establish the degree of operator involvement that fits your application.

TEK/VXI MEANS HIGH PERFORMANCE

As a founding member of the VXI consortium, Tektronix is an industry leader in the development of high-performance VXIbus instrumentation. All Tek VXIbus equipment is designed to take full advantage of the performance-extending features of the VXI-defined D-size cards and P3 connector.

The Tektronix VX1500 D-size Mainframe will accommodate any VXI card size. This means that standard VMEbus computer cards can be integrated into Tek VXIbus instrument systems. Tek VXI users will have access to a world of VME interfaces, single board computers, memory boards, and I/O devices that are already established and on the market.

Tek's D-size modules offer the benefits of reduced noise, reduced interboard connectors, and reduced crosstalk between components—all because there is more space available on D-size cards.

Reliability is increased because component packing is less dense, and more power is available to the instrument.

Tektronix VXI Solutions

Utilizing the high-performance advantages offered on P3, Tek's VXI solutions have been designed from the ground up to fit the high-performance test system environment. Our new line of VXI equipment is ideally suited for high-speed functional testing of circuit boards, hybrids and subassemblies; for providing test and measurement links to CAE/CAD workstations; for testing of mixed function—analog and digital—devices; and for constructing unique test configurations for specialized requirements. ATE systems integrators, experienced in systems engineering, configuration and checkout, will find that Tek VXI instrumentation can be easily integrated into existing test environments.

Tektronix Higher Level Protocols

The VXIbus specification defines the Word Serial and Shared Memory Protocols for device communications within the VXIbus context. However, these protocols demand extensive knowledge of VXIbus specifications.

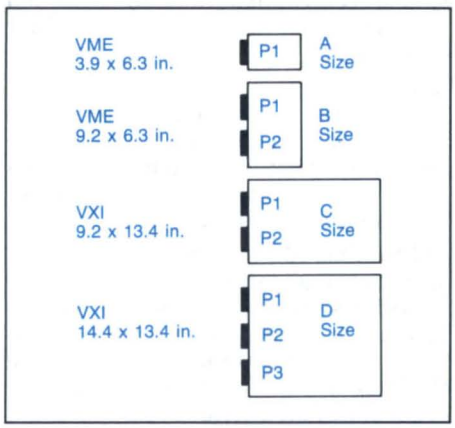
All Tektronix devices have a core set of common communications routines with which device applications can communicate across the VXIbus. These routines provide a standard method for device communication that encompasses the VXIbus lower level protocols, making the details of the VXIbus registers and signal handling operations transparent to the device-specific application.

DUT Interfacing

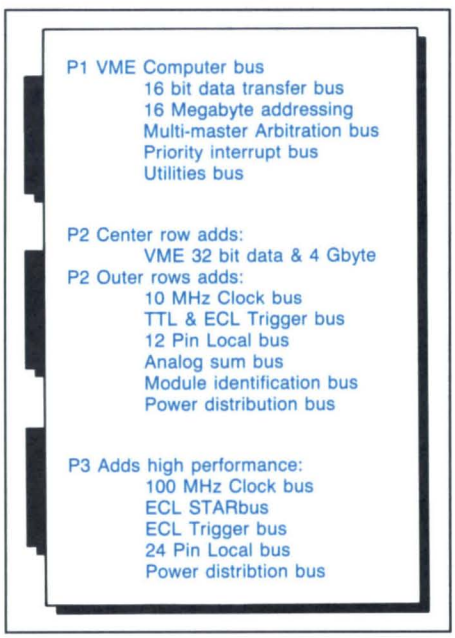
The VXI's card modular approach allows the physical distance between instruments and a DUT interface to be greatly reduced. The Tektronix TSA 8140 Test System Adapter can be mounted in very close proximity to the instrument modules, permitting very low transmission losses. Noise, power, grounding and shielding problems are all minimized, because you don't have to deal with multiple grounds from several racks, or high currents.

Tek's Flexible System Design

All of your Tektronix VXI assets are easily reconfigurable or replaceable. This reduces your capitalization costs, as well as the operator training required. Downtime can be dramatically reduced by keeping spare modules, or complete VXI systems, on the production floor. Spare modules may even be designed into the VXI chassis in order to allow automatic switching to a functional backup module if one fails.



Four card sizes are defined by the VXIbus specification.



Each 96-pin connector increases the capabilities of VXIbus modules. Tektronix utilizes the full capabilities of P3.

What Does All This Mean For You?

Tektronix VXI instrument modules and fully integrated test systems let you downsize floorspace requirements, enhance timing coordination between instruments, increase system flexibility, increase asset life, and reduce both hardware and development costs.

With Tektronix VXIbus instrumentation, high performance instruments-on-a-card become a reality.

VX7501 D-size Development System

GPIB instruments have inherent speed limitations and other problems in applications requiring large data transfers. For these applications, the computer bus is the only way to communicate between mass storage and the actual instrument memory. As a result, many systems developers have to design their own systems, instruments and interfaces for these high-end applications. Developing a computer bus system from scratch can be a time-consuming, costly process.

Tektronix provides the solution with the VX7501 D-size VXIbus Development System. VX7501 is a VXI platform upon which you can build a specialized VXI test system. It includes:

- VX1500 High-Performance, D-size Mainframe
- VX5520 D-size Slot 0 Resource Manager
- Two, VX1521 D-size Development Cards
- VX1521 Opt 01 Software Development Tool Kit
- VX1510 VME Conversion Module

NEW VX1500

VXI D-Size Mainframe

- D-Size VXIbus Mainframe Supporting:
  - Medium Performance: 10 MHz Precision Clock, TTL & ECL Trigger Lines, Localbus, MODID, and SUMbus
  - High Performance: 100 MHz Clock, ECL Trigger Lines, System Sync Signal SYNC100, LOCALbus, and Deskewed STAR Triggers
- Accommodates A, B, and C VXIbus Modules with Adapters
- Supports Full 32-Bit VMEbus
- 900 Watt Power Supply
- Up to 100 Watts of Cooling Per Slot

NEW VX5520

VXI Slot 0 Resource Manager

- Single-Wide D-Size, Slot 0 VXIbus Module
- Supports VXI Slot 0 Functions: Clocks, Triggers, SYNC100, Extended Start/Stop Protocol, and MODID
- Supports VXI Resource Manager Functions: Configuration Control, VXIbus Device Identification, and System Self Test and Start Up
- D-Size VXIbus Module Supporting:
  - Medium Performance: 10 MHz Precision Clock, TTL and ECL Trigger Lines, Localbus, MODID, and SUMbus
  - High Performance: 100 MHz Clock, ECL Trigger Lines, System Sync Signal SYNC100, and LOCALbus
- VXIbus Commander and Servant, VMEbus Master and Slave
- Supports Full 32-Bit VMEbus
- IEEE-488 Talker/Listener Interface
- Three External Input Channels
  - Two Serial RS-232 Ports
  - One GPIB Interface

NEW VX1321/ 1421/1521

VXI Development Modules

- Single-Wide B, C and D-Size VXIbus Modules
- Intelligent 68010 VXIbus Message Based Interface Devices
- VXIbus Message Protocols
  - Word Serial
  - Shared Memory
- VXIbus Configuration Registers
- Software Development Tool Kit Option
- pSOS and pROBE Single-Copy License Option

NEW VX1520

VXI Prototype Module

- Double-Wide D-Size VXIbus Module
- Perforated Board for Mounting Discrete Mechanical or Electrical Components and Installing Wire-Wrap Pins
- Accommodates all Three VXI Connectors with Separate Pin Hole Access to Each Signal or Power Line
- Module Shielding
- Blank Front Panel
- Pre-Drilled and Plated Holes for Easy Mounting of Daughter Cards

NEW VX1510 VME Module (VCM)

- Converts 3 VXIbus Slots into 4 VMEbus Slots
- VMEbus P2 Outer Rows Are User Definable
- Fully Compatible with VME Specification C.1
- Triple-Wide D-Size VXIbus Module
- Two 3.5 Inch Floppies and/or Hard Disk Drives Option

ORDERING INFORMATION

VX1500 VXI D-Size Mainframe	$9,995
VX5520 VXI Slot 0 Resource Manager	$3,995
VX1321 VXI Development Module	$1,950
VX1421 VXI Development Module	$2,150
VX1521 VXI Development Module	$2,250
VX1520 VXI Prototype Module	$1,395
VX1510 VME Module (VCM)	$2,995

Measurement Package

CONTENTS

MP 1101 Programmable Digitizer . 489

Precise automatic waveform measurements for demanding applications in research, design, manufacturing, and quality assurance

Automatically Saves Time

The MP 1101 measurement package is specially designed to handle the increasingly complex, expensive, and time-consuming task of waveform characterization.

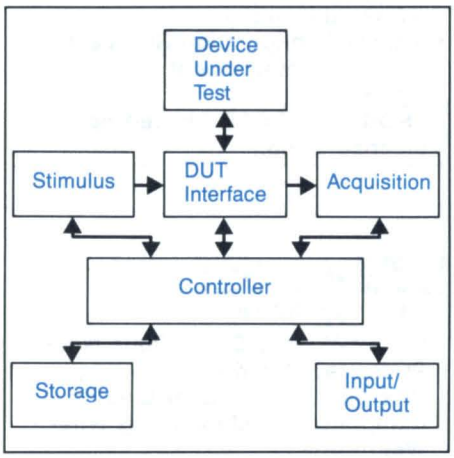
It offers all of the power and flexibility of oscilloscope signal acquisition, which can be coupled with programmable stimulus sources for fully automatic analysis. The package features signal-processing software with extensive control over instrumentation, waveform manipulations, and graphic display.

Compatibility

The MP 1101 provides system compatibility to allow configuration for many types of test and measurement applications. This flexibility of specialized instrument selection and easy integration allows the application potential of your automated testing unit to increase with your requirements.

System Building Blocks

Whether your application is in scientific research, engineering design, or automated manufacturing and quality control, Tektronix provides for each of the functions that comprise virtually every measurement system.



Increase Productivity

The MP 1101 combines state-of-the-art waveform-acquisition capabilities with computer processing and software control. It automatically capture signals, make measurements, then display, store, and document the results. Projects can be completed on time and within budget.

Systems That Put You in Charge

From today's research-and-development tasks to tomorrow's production testing, Tek's package gives you all the capabilities needed to characterize your waveforms quickly, efficiently, and accurately.

Device Under Test (DUT)

The system provides stimulus to the DUT and acquires the results from the test.

Stimulus

Stimulus units, including function generators, signal generators, and other sources, provide known control signals to drive the DUT through normal operation patterns or into boundary conditions for performance-limits testing.

DUT Interface

The DUT Interface provides a path from the stimulus and acquisition equipment and the DUT. Tektronix provides a number of GPIB-compatible products for DUT interfacing.

INDIVIDUAL PACKAGE CONFIGURATION

Application	Fastest single-shot transient digitizer, highest bandwidth	Multi-record, dual-channel digitizer for single & repetitive signals, high bandwidth	Excellent signal acquisition for repetitive signals, high bandwidth	Extensive signal acquisition capabilities w/ signal analysis	Long record length, dual-channel, versatile digitizer for both single and repetitive signals, high bandwidth	Versatile, compact signal stimulus & acquisition for medium & low speed signals	Makes critical audio measurements consistently, accurately, and quickly
Acquisition Instrument	7912HB	7612D	7854	2432	RTD 710	MI 5010/ MX 5010	SG 50101/ AA 5001
Your own controller	MP 1101	Available					

MP 1101

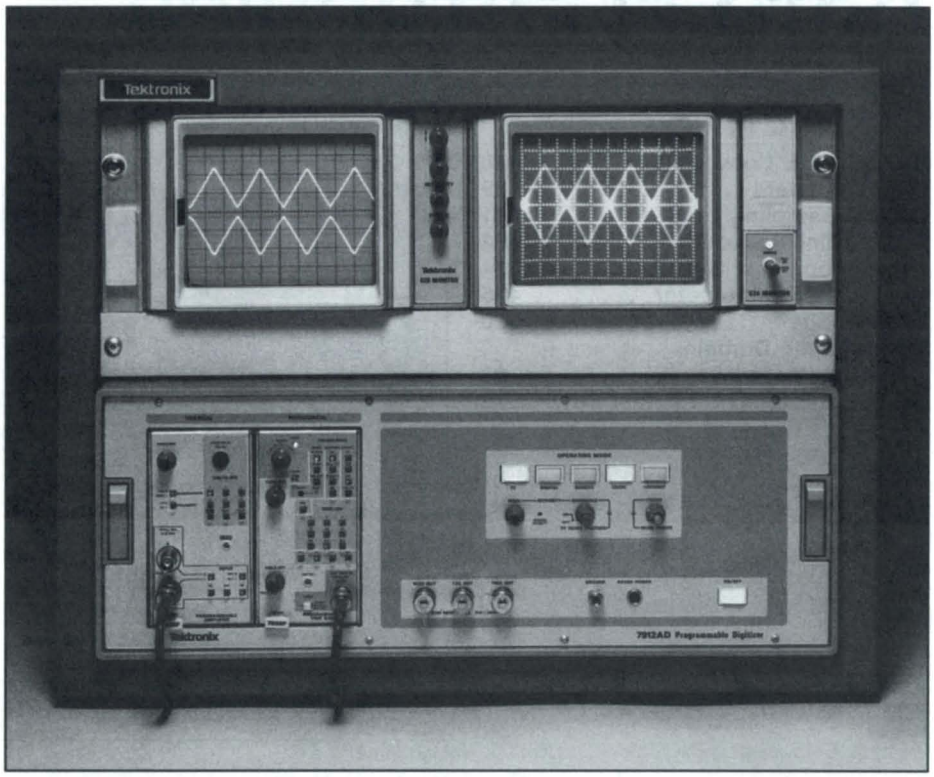
GPIB IEEE-488

The MP 1101 complies with IEEE Standard 488-1975 and with Tektronix *Standard Codes and Formats.*

FEATURES

- **Highest Bandwidth Single-Shot Acquisition (750 MHz at 10 mV/Div)**
- **Fully Programmable up to Maximum Bandwidth**
- **Codes and Formats Compliance**

The MP 1101 is based on the high-bandwidth 7912HB Programmable Transient Digitizer. It is excellent for any signal-measurement requirement needing single-shot acquisition (either for computer or operator interpretation of extremely fast signals such as laser research and high-energy physics phenomena). Without a controller, the MP 1101 can be used as a high-bandwidth storage oscilloscope.



MP 1101 (shown above) consists of a 7912HB, 7A29P, 7B90P, 620, and 634.

CHARACTERISTICS

ENVIRONMENTAL

Operating Temperature—0 to +40°C (+32 to +104°F).

Thermal Output—Approximately 1550 BTU/hr.

Operating Altitude—4600 m maximum (15,000 ft).

POWER REQUIREMENTS

Standard Operating Voltage—115 V (nominal).

Line Frequency—60 Hz.

Maximum Power Consumption—450 W (nominal).

PHYSICAL CHARACTERISTICS

See individual component pages for dimensions.

ORDERING INFORMATION

MP 1101 Programmable Digitizer Measurement Package. **$26,000**
Includes: 7912HB; 7A29P; 7B90P; 620; 634 Option 01; mounting hardware; cables; accessories; cabinet.

OPTIONS

Option 01—Delete 7A29P and 7B90P Plug-ins. **−$2,500**
Option 1D—Delete cabinet. **−$750**
Option 3D—Delete 7A29P only. **−$1,000**
Option 13—Change TV scan rate to 625 lines at 50 Hz. **NC**
Option 25—Add PEP301 Instrument Controller. **+$7,995**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

OPTO-ELECTRONICS

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Laser Diode 500
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Fiber Optic Bandwidth Test Set .. 70

OT501/OT502/ OT503 Transmitters OR501/OR502 Receivers

Electrical-to-Optical and Optical-to-Electrical Converters

The OT501/502/503 Transmitters and OR501/502 Receivers are designed to transmit and receive signals through optical fiber. The receivers can be used to convert most instruments to optical instruments (e.g., the optical scope). The transmitters and receivers are designed as a TM 500 plug-in to be used in any TM 500 or TM 5000 mainframe. Diamond 3.5 mm connector is standard.

OT501/502/503 TRANSMITTERS

	OT501	OT502	OT503
Wavelength	825±15 nm	850±10 nm	1300±25 nm
FWHM*	<2 nm		<4 nm
Output Power, DC	+3 dBm		0 dBm
Mod Input	50 Ω		
Mod Input Level: Max	+20 dBm		
Mod Input Level: w/100% Mod	<0 dBm		
Mod Freq Response	0.03 to 1700 MHz		0.03 to 1500 MHz
Mod Flatness	±1 dB (0.05 to 1000 MHz)		
	±2 dB (0.03 to 1700 MHz)		±5dB (0.03 to 1500 MHz)

OR501/502 RECEIVERS

	OR501	OR502
Wavelength	700 to 1500 nm	
Photo Element	Ge-APD	
Max Linear Input	−20 dBm	+10 dBm
Frequency Response	0.03 to 1500 MHz±2 dB 0.05 to 1000 MHz±1 dB	
Noise Floor	≤−110 dBm/Hz	
Output 50 Ω	−15 dBm typical for −20 dBm optical input	−12 dBm typical −20 dBm optical input
Optical Attenuator	N/A	2.5 dB/step (Norm) 37.5 dB (Max)

* *Full width half maximum.*

ORDERING INFORMATION

OT501 825 nm E/O Converter	$5,900	**OPTIONS**	
OT502 850 nm E/O Converter	$5,900	**Option 01**—Diamond-to-SMA Cable	NC
OT503 1300 nm E/O Converter	$9,500	**Option 20**—AT&T Biconic Connector	NC
OR501 O/E Converter	$4,300		
OR502 O/E Converter	$6,500	**Option 22**—FC Connector	NC

OPTICAL-TO-ELECTRICAL CONVERTERS

P6701
450 to 1050 nm, DC to 700 MHz

P6702
1000 to 1700 nm, DC to 500 MHz

P6751
Spatial Input Head

- **Optical Oscilloscope**
- **Average and Pulse Power Meter**
- **Calibrated Output**

The Tektronix P6701/P6702 are optical probes that allow the user to receive optical signals and convert them to electrical signals for convenient analysis on Tektronix oscilloscopes equipped with the TEKPROBE™*1 interface or any other oscilloscope when used in conjunction with the Tektronix 1103 TEKPROBE™ interface power supply. The conversion is linear, DC coupled, calibrated, and of high bandwidth.

Use of the 11000-Series Oscilloscopes TEKPROBE™ interface allows the oscilloscope to supply power to the probe, automatically determine and display the proper scale factor (in milliwatts of optical power) and set the input termination to the required 50 ohms. An oscilloscope-controlled calibrated offset of 0 to 1 mW is also available through this interface.

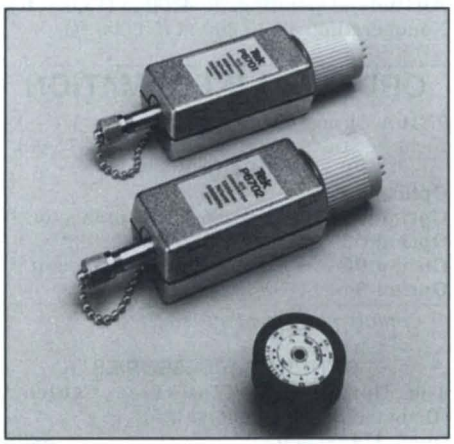
The P6701/P6702 provides a calibrated means of analog analysis of optical signals in the wavelength range 450 to 1050 nm (P6701) and 1000 to 1700 nm (P6702) thus combining the functions of an optical power meter with the high-speed analog waveform analysis capability of an oscilloscope in one instrument. The user has the capability of acquiring, displaying and analyzing mixed analog and digital, optical and electrical signals simultaneously.

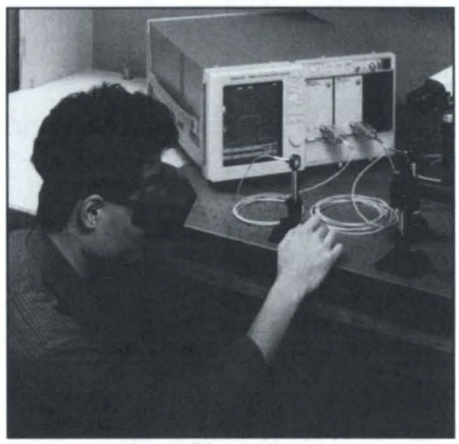
Each probe is contained in an oscilloscope probe-size compensation box and mounts directly to an 11000 series oscilloscope plug-in, thus requiring no bench space. Optical signal input is through a standard SMA or optional FC or ST fiber optic cable connector mounted on the front of the converter.

The P6751 Spatial Input Head is a turnable lens system for sampling optical energy from any source and delivering it via a fiber optic cable to the P6701/P6702 optical to electrical converter. The P6751 is easily mounted using standard optical bench fixtures. The Spatial Input Head can be adjusted (500 to 1500 nm) by the user to optimize the amount of optical energy sampled and delivered to the P6701/P6702. The P6751 has a standard SMA fiber optic cable connector. Also available are a series of fiber optic jumper cables for interfacing the P6701, P6702, and P6751 with other industry standard optical fiber connectors.

*1 *Tektronix 11000-Series Oscilloscopes.*

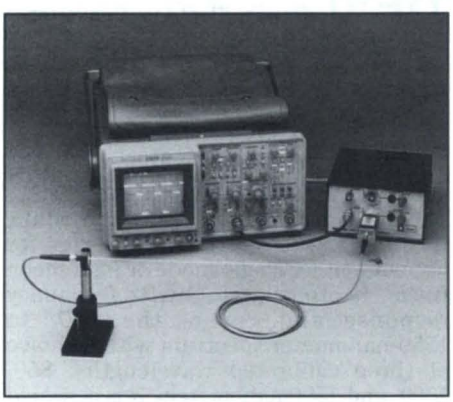
TEKPROBE is a trademark of Tektronix, Inc.





TYPICAL APPLICATIONS

Applications range from measuring the transient optical properties of lasers, LEDs, electro-optic modulators, flashlamps, etc., to the development, manufacturing, and maintenance of fiber optic control networks, local area networks (LANs), optical disk devices, and high-speed fiber optic communications systems. As an example, eight P6701s/P6702s coupled with two 11A34 amplifier plug-ins and an 11000-series oscilloscope can be configured as an 8-channel optical oscilloscope!



P6701 with 1103 power supply and a 2440 Portable Oscilloscope.

CHARACTERISTICS

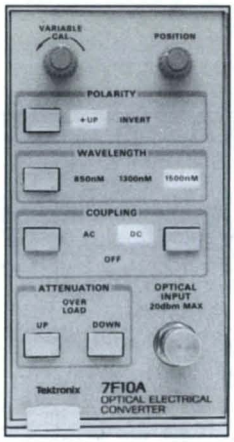
	P6701	P6702
Wavelength response	450 to 1050 nm	1000 to 1700 nm
Bandwidth	DC to 700 MHz	DC to 500 MHz
Risetime	≤0.7 ns	≤1.0 ns
Conversion Gain	1 V/mW at 850 nm	1 V/mW at 1300 nm
Calibrated Offset	0-1 mW	0-1 mW
Max Input Optical Power	2 mW	2 mW
Noise Equivalent Power	≤1μW	≤1μW

ORDERING INFORMATION

P6701 Optical-to-Electrical Converter **$1,900**
Includes: Standard SMA input connector; carrying case (016-0156-03); and instruction manual (070-6465-00).
Option 01—FC input connector. **NC**
Option 02—ST input connector. **NC**
P6702 Optical-to-Electrical Converter **$2,095**
Includes: Standard SMA iinput connector; carrying case (016-0156-03); and instruction manual (070-6465-00).
Option 01—FC input connector. **NC**
Option 02—ST input connector. **NC**
P6751 Spatial Input Head **$310**
Includes: Adjustment tool and instruction sheet.

OPTIONAL ACCESSORIES

Cables—(2 meters) 100/140 micron
(SMA to SMA) Order 174-0879-00 **$280**
(SMA to Diamond 3.5) Order 174-0877-00 **$330**
(SMA to FC) Order 174-0878-00 **$250**
(SMA to Biconic) Order 174-0880-00 **$250**
(SMA to ST) Order 174-0876-00 **$250**
(SMA to Diamond 2.5) Order 174-1303-00. **$280**
1103 TEKPROBE™—Interface Power Supply. Refer to page 528 for additional information.



7F10A Optical-Electrical Converter

- **Single-Mode/Multimode Fiber Optical Input**
- **700- to 1550-Nanometer Wavelength**
- **DC to 1 GHz Frequency Response**
- **Built-in Optical Attenuator**
- **CRT Readout of Deflection Factor**

The 7F10A single-wide plug-in module is an optical-to-electrical converter for use with either single-mode or multimode fibers. It offers dc to 1 GHz frequency response and covers the 700- to 1550-nanometer spectrum with a choice of three calibrated wavelengths: 850, 1300, and 1500 nanometers. It is designed for use in the vertical compartments of 7000-Series Oscilloscopes.

The optically coupled 7F10A input goes through a built-in attenuator that provides sixteen calibrated settings for controlling the input-signal level. On the front panel there is an optical overload indicator and pushbuttons to vary the attenuation level. Readout for deflection factor, uncalibrated indication, and polarity invert appears on the CRT.

CHARACTERISTICS

CONVERTER-AMPLIFIER

Wavelength—Operates from 700 to 1550 nm continuously with selectable calibrated settings at 850, 1300, and 1500 nm.
Photo Element—Ge-APD.
Maximum Linear Input—+10 mW optical carrier, 70% modulation.
Deflection Factor—9 selectable 5-dB steps. Calibrated 1500-nm Wavelength; 2.5 μW/div ±30% at 0-dB attenuation setting. Calibrated 1300-nm Wavelength; 2 μW/div ±30% at 0-dB attenuation setting. Calibrated 850-nm Wavelength: 4 μW/div ±30% at 0-dB attenuation setting.
Variable Range—At least 4 dB.

Frequency Response

7104/R7103	dc to 1 GHz, ±3 dB
7900 Series	dc to 400 MHz, ±3 dB
7800 Series	dc to 300 MHz, ±3 dB

Position Range—9 divisions each direction from graticule center, within 1 division.

ENVIRONMENTAL

Temperature—Calibration: 20 to 30°C. Operating: 0 to 50°C, to 95%. Nonoperating: −55 to +°C to 95% humidity.
Altitude—Operating: To 4500 m (15,000 ft). Nonoperating: To 15,000 m (50,000 ft).

ORDERING INFORMATION

7F10A Optical-Electrical Converter.*1
Includes: Instruction manual (070-6277-00).

OPTIONS

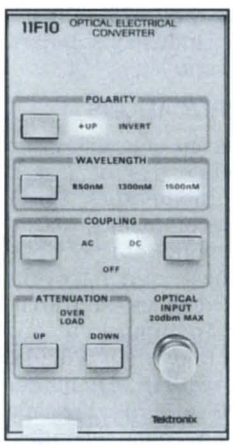
Optical Input
Option 01—Diamond 85μ/125μ connector.*1
Option 02—SMA 85μ/125μ connector.*1
Option 03—BICONIC 85μ/125μ connector.*1
Option 04—FC 85μ/125μ connector.*1

*1 *Contact your local sales office.*

OPTIONAL ACCESSORIES

1-m Optical-Fiber Interface Cables*1
(Diamond 3.5 to Diamond 3.5)
Order 174-0045-01. **$235**
(Optical Input Diamond 3.5 to SMA)
Order 174-0524-01. **$180**
(Diamond 3.5 to FC)
Order 174-0527-01. **$200**
(Diamond 3.5 to D4)
Order 174-0528-01. **$235**
(Diamond 3.5 to AT&T Biconic)
Order 174-0530-01. **$215**

*1 *3-m cables are also available. To order contact your local Tektronix Sales Office.*



11F10 Optical-Electrical Converter

- **Single-Mode/Multimode Fiber Optical Input**
- **700- to 1550-Nanometer Wavelength**
- **DC to 1 GHz Frequency Response**
- **Built-in Optical Attenuator**
- **CRT Readout of Deflection Factor**

The 11F10, a single-wide plug-in module, is an optical-to-electrical converter for use with either single-mode or multimode fibers. It offers dc to 1 GHz frequency response and covers the 700- to 1550-nanometer spectrum with a choice of three calibrated wavelengths: 850, 1300, and 1500 nanometers. It is designed for use in the vertical compartments of 11000-Series Oscilloscopes.

The optically coupled 11F10 input goes through a built-in attenuator that provides sixteen calibrated settings for controlling the input-signal level. On the front panel there is an optical overload indicator and pushbuttons to vary the attenuation level. Readout for deflection factor, uncalibrated indication and polarity invert appears on the CRT.

CHARACTERISTICS

CONVERTER-AMPLIFIER

Wavelength—Operates from 700 to 1550 nm continuously with selectable calibrated settings at 850, 1300, and 1500 nm.
Photo Element—Ge-APD.
Maximum Linear Input—+10 mW optical carrier, 70% modulation.
Deflection Factor—9 selectable 5-dB steps. Calibrated 1500-nm Wavelength; 2.5 μW/div ±30% at 0-dB attenuation setting. Calibrated 1300-nm Wavelength; 2 μW/div ±30% at 0-dB attenuation setting. Calibrated 850-nm Wavelength: 4 μW/div ±30% at 0-dB attenuation setting.
Variable Range—At least 4 dB.

Frequency Response

11402	dc to 1 GHz, ±3 dB
11401	dc to 500 MHz, ±3 dB
11302	dc to 400 MHz, ±3 dB
11301	dc to 300 MHz, ±3 dB

Position Range—9 divisions each direction from graticule center, within 1 division.

ENVIRONMENTAL

Temperature—Calibration: 20 to 30°C. Operating: 0 to 50°C, to 95%. Nonoperating: −55 to +°C to 95% humidity.
Altitude—Operating: To 4500 m (15,000 ft). Nonoperating: To 15,000 m (50,000 ft).

ORDERING INFORMATION

11F10 Optical-Electrical Converter.*1
Includes: Instruction manual.

OPTIONS

Optical Input
Option 01—Diamond 85μ/125μ connector.*1
Option 02—SMA 85μ/125μ connector.*1
Option 03—BICONIC 85μ/125μ connector.*1
Option 04—FC 85μ/125μ connector.*1

*1 *Contact your local sales office.*

OPTIONAL ACCESSORIES

1-m Optical-Fiber Interface Cables*1
(Diamond 3.5 to Diamond 3.5)
Order 174-0045-01. **$235**
(Diamond 3.5 to SMA)
Order 174-0524-01. **$180**
(Diamond 3.5 to FC)
Order 174-0527-01. **$200**
(Diamond 3.5 to D4)
Order 0528-01. **$235**
(Diamond 3.5 to AT&T Biconic)
Order 174-0530-01. **$215**

*1 *3-m cables are also available. To order, contact your local Tektronix Sales Office.*

NEW S-42 Optical Sampling Head

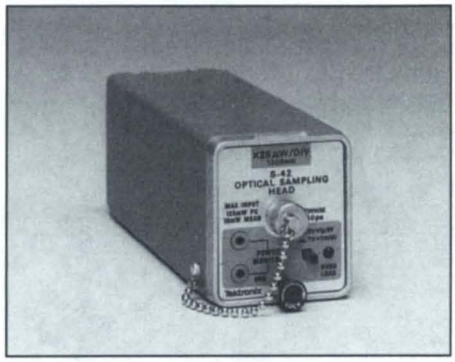
- **55-ps Optical Pulse Response (max. FWHM)**
- **DC-6.4 GHz Equivalent Bandwidth (0.35/55ps)**
- **1000 nm — 1700 nm Spectral Response**
- **Mean Optical Power Monitor Function**

The S-42 is an optical to electrical sampling head for use with Tektronix 7000 series oscilloscopes equipped with 7S11 or 7S12 sampling plug-ins. The optical to electrical conversion is linear up to 25 mW peak input with a calibrated deflection factor from 50 μW/Div to 5 mW/Div at 1300 nm.

The S-42 also has a Mean Power Meter Function with selectable 1 V/nW and 1 V/μW ranges.

The S-42 can be plugged into the sampling unit or attached by a sampling head extender for remote use.

Optical signal input is through a standard FC fiber optic connector, other connector types can be accommodated by use of fiber optic jumper cables.



Response of the S-42 to a 1300 nm laser pulse with a 50 ps (FWIM). The calculated pulse response of the S-42 is approximately 42 ps.

Optical Waveform Analysis

Characterization of optoelectronic devices such as laser diodes, light emitting diodes, optical waveguides, optical detectors and electro-optic modulators is becoming more important as applications for fiber optics in telecommunications and data communications expand. The S-42 optical sampling head allows researchers to display and measure optical waveforms from DC to 6.4 GHz in the 1000 nm to 1700 nm wavelength range. Measurements such as risetime, aberration, optical power vs drive current and voltage, modulation bandwidth, and sensitivity can now be made at high bandwidth accurately and easily.

CHARACTERISTICS

PULSE CHARACTERISTICS

Pulse Response—55 ps Max. (FWHM)
Bandwidth (Equivalent)—DC-6.4 GHz (0.35/55 ps).
Spectral Response—1000 to 1700 nm.
Noise Equivalent Power—≤125 μW
Aberrations—≤30% peak to peak in the first 400 ps following a pulse input.
Linear Response Range—≤25 mW peak power, ≤5 mW average power.

POWER METER

Spectral Response—1000 nm to 1700 nm.
Dynamic Range—5 nW to 5 mW (60 dB).
Sensitivity—1 V/mW ±10% (Range 1), 1 V/μW ±10% (Range 2).
Bandwidth—DC to 100 Hz.

ENVIRONMENTAL

Operating Temperature Range—0 to 50 °C.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	46	1.8
Height	51	2.0
Depth	152	6.0
Weight ≈	**kg**	**lb**
Net	0.4	0.9
Net (with options)	0.9	2.0

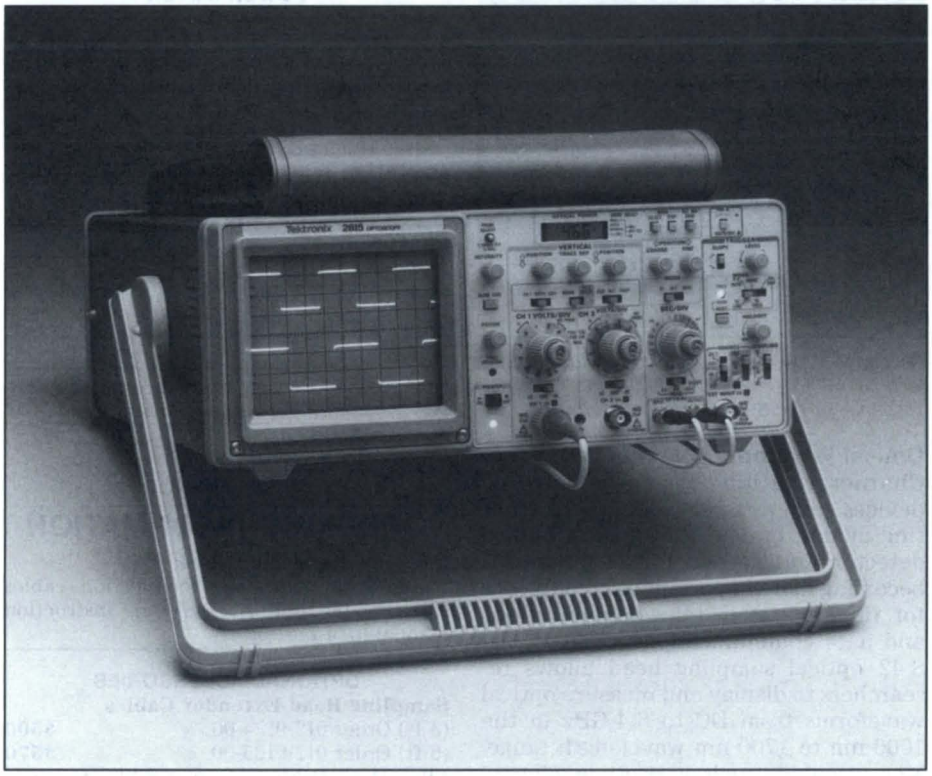
ORDERING INFORMATION

S-42 Optical Sampling Head.*1
Includes: 2 multimeter connection cables (012-1286-00 and 012-1287-00); instruction manual (070-7191-00).

OPTIONAL ACCESSORIES

Sampling Head Extender Cables
(3 ft) Order 012-0124-00 **$500**
(6 ft) Order 012-0125-00 **$570**
Fiber Optic Cables—2 meter, 8/125 μm, single mode.
(FC to Diamond 3.5) Order 174-1385-00.*1
(FC to Diamond 2.5) Order 174-1497-00.*1
(FC to ST) Order 174-1386-00.*1
(FC to FC) Order 174-1387-00.*1
(FC to Biconic) Order 174-1388-00.*1

*1 *Contact your local sales office.*



2815 OPTO-Scope™

NEW

2815 OPTO-Scope™

TYPICAL APPLICATIONS

- **Optical Data Communications**
- **Optical Video Testing**
- **Education**
- **Remote Control Testing**
- **850 nm Optical System Design**

FEATURES

- **DC to 50 MHz Electrical Bandwidth**
- **DC to 35 MHz Optical Bandwidth**
- **Operational from 450 to 1050 nm**
- **Integrated Optical Power Meter**
- **Externally Modulatable 850 nm LED**
- **500 μV/Div Electrical Sensitivity**
- **200 nW/Div Optical Sensitivity**
- **−60 dBm Power Meter Sensitivity**
- **5 ns/Div maximum Sweep Rate**
- **Three-Year Warranty, Five-Year Option**

The 2815 OPTO-Scope™ offers unprecedented capability for testing and maintaining optical communication systems. The OPTO-Scope is a portable, self contained, monolithic instrument which has the capability to view both electrical and optical signals. The OPTO-Scope also adds a fully featured optical power meter for applications requiring precise and sensitive measurement capability. An optical output is included as a stimulus signal for testing of optical systems. No other instrument gives you this flexibility.

A push button allows conversion from two electrical channels to one electrical and one optical channel for simultaneous real time display of both electrical and optical waveforms. This function makes it possible to compare the optical and electrical response of a receiver with just one instrument.

The optical power meter offers dBm, dB, manual, and auto-ranging Watts modes. The dynamic range extends from −60 dBm to +3 dBm. In dBm mode one can take relative (dB) measurements to test loss in optical fibers or other transmission media. The auto-ranging mode covers the dynamic range from 0.1 nW to 1.999 mW. Manual ranging is provided for those special measurements where a wide dynamic range and fast time response are needed. The power meter is functional at all times; even when the optical display channel is not selected.

An optical source is provided for internally testing the optical channel or for stimulating an optical system. This source will provide 10 μW of mean power (850 nm) at 10 kHz, or may be externally modulated with a TTL level signal up to 10 MBits/sec.

The capability to provide a known stimulus and observe the electrical and optical response of a system will make troubleshooting optical systems easy. All of these features are integrated into one portable lightweight package that is easy to use and handle. In addition, the 2815 is a fully functional 50 MHz dual channel oscilloscope, thus making the 2815 a complete opto-electronics field service tool. Pertinent details of the oscilloscope characteristics may be found under the description of the 2225 Oscilloscope on page 185 of this catalog.

As with all of the 2000 series oscilloscopes the 2815 is UL listed, CSA certified and comes with a three-year instrument warranty that includes all parts and labor including the CRT. Beyond the "basic three years," Tektronix offers you a choice of five practical service plans to further reduce your cost-of-ownership.

CHARACTERISTICS

All specifications are rated over all environmental extremes except where noted.

VERTICAL SYSTEM
(Electrical Channels)
Bandwidth (−3 dB) and Rise Time

	5 to 35°C	0 to 40°C
5V to 5 mV/div	50 MHz (7.0 ns)	40 Mhz (8.8 ns)

Bandwidth Limit (−3 dB)—−5 MHz ±20% (via X10 MAG).
Deflection-Factor Accuracy—(0 to 40°C 5 mV to 5 V/Div: ±3%. X10 Magnification: ±5%. Uncalibrated Variable: Continuously variable between steps by at least 2.5:1.
Step Response Aberrations—+5%, −5%, 5% p-p (5 mV to 0.5 V/div).
Display Modes—CH 1, CH 2, CH2 Invert, Add, Alt, Chop (500 kHz).
Common-Mode Rejection Ratio—For signals of 6 divisions or less at least 10:1 at 20 MHz.
Input R and C—1 MΩ, 25 pF.
Maximum Input Voltage—400 V (dc+peak ac) or 800 V p-p to 10 kHz (ac and dc coupled).
Channel Isolation—100:1 at 20 MHz.

(Optical Channel)
Bandwidth (−3 dB) and Rise Time

	5 to 35°C	0 to 40°C
200 μW to 500 nW/div	35 MHz (10 ns)	30 MHz (12 ns)
200 nW/div	5 MHz (70 ns)	5 MHz (70 ns)

Step Response Aberrations—+10%, −10%, 10% p-p (200 μW to 500 nW/div).
Maximum Input for Linear Display—2 mW.
Displayed Noise—≤100 nW tangential (50 nW RMS), referred to input at 850 nm.

Wavelength—Calibrated at 850 mm, operational from 450 to 1050 nm.
Coupling—DC or AC for settings 20 μW to 200 μW/Div, AC for settings 200 nW to 10 μW/Div.

OPTICAL POWER METER

Wavelength—Calibrated at 850 nm, Operational from 450 to 1050 nm.
Measuring Range—−60 to +3 dBm (dBm mode), 0.0 nW to 1.999 mW (Watts modes).
Measurement Accuracy—±0.5 dB 0 to −50 dBm, ±1 dB −50 to −60 dBm @25°C).
Measurement Resolution—0.1 dB (dBm mode), 0.001 X Full Scale (Watts Modes).
Display Modes—dBm, dB Ref, dB, Watts — Auto-ranging, Watts — Manual-ranging (199.9 nW, 1.999 μW, 19.99 μW, 199.9 μW, 1.999 mW).
Display Type—Custom Backlit LCD.

OPTICAL SOURCE

Output Power—≥10 μW mean.
Pulse Format—10 kHz, 50% Duty Cycle Nominal.
External Modulation—TTL levels dc to 10 MBits/sec.
Rise/Fall Time—10 ns Max.
Extinction Ratio—≥10 Minimum.
Wavelength—850 nm ±30 nm, LED, (measured from 100/140/0.3 NA test fiber with temperature at 25°C ±5°C).

HORIZONTAL SYSTEM

Time Base—0.05 μs to 0.5 s/div in 1-2-5 sequence. Maximum Sweep Rate (X10 magnification): 5 ns/div. Uncalibrated Variable: Continuously variable between steps by at least 2.5:1.

Sweep Accuracy

	15 to 35°C	0 to 40°C
Unmagnified X1	±3%	±4%
Unmagnified X5, X10	±4%	±5%
Magnified X50	±5%	±8%

Sweep Linearity—Specified over any 2 of the center eight divisions. Unmagnified X1: ±5%. Magnified X5, X10: ±7%. Magnified X50: ±9%.
Display Modes—X1, Alternate Magnification, Magnified.
Alternate Magnification—Display alternates between unmagnified (X1) and magnified sweep. Magnification levels: X5, X10, and X50. Magnifier Registration: Expansion occurs at center vertical graticule line.
Magnification Range—Magnification performed over any portion of the X1 (unmagnified) sweep.

TRIGGERING

Trigger Sensitivity

	Internal	External
5 MHz	0.3 div	40 mV
20 MHz	1.0 div	150 mV
50 MHz	1.0 div	150 mV

TV Trigger Sensitivity—TV field: 1.0 div of composite sync. TV Line: 0.3 div or 40 mV p-p external.
Trigger Operating Modes—Peak-to-Peak Automatic, Normal, TV Field, TV line, Single Sweep.
Trigger Sources—Internal CH1, CH2, Vert Mode, Line, External, and External÷10.
Trigger Coupoling—AC, DC, HF REF (attenuates signals below 30 kHz).
Variable Holdoff—Increases X1 Sweep holdoff time by at least 8:1.

X-Y OPERATION

Deflection Factors—Same as Vertical Deflection System.
Accuracy—(0 to 40°C) Y-Axis ±3%. X-Axis: ±5%.
Bandwidth—Y-Axis: Same as vertical deflection system. X-Axis: DC to 2 MHz.
Phase Difference Between X and Y axis—Amplifiers: ±3° dc to 150 kHz.

CRT AND DISPLAY FEATURES

CRT—8×10 cm; internal graticule; GH (P31) phosphor. Accelerating potential 12.6 kV.
Z-Axis—5 V causes noticeable modulation; positive voltage decreases intensity. Usable range: DC to 5 MHz.
Optical Power Meter—3½ digit custom backlit LCD with 8 mm digit height. Annunciators include: dB, dBm, nW, μW, mW, nm, REF, MAN.
Controls—Intensity, Focus, Beam Find, Trace Rotation.

OTHER CHARACTERISTICS

Probe Adjust—Square Wave, 0.5 V ±5%, 1 kHz ±20%.
Electrical Output of Optical Signal—10 m V/div of displayed signal on CRT.

POWER REQUIREMENTS

Line Voltage Range—One line switch: 95 to 128 V ac/190 to 250 V ac.
Line Frequency—48 to 440 Hz.
Maximum Power Consumption—60 W.
DC Power Operation—12 to 30 V with optional 1107, 1106, and 1105.

ENVIRONMENT AND SAFETY

Same as 2225 see page 185.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	327	12.9
w/ handle	380	15.0
Height	138	5.4
Depth	438	17.2
w/ handle	511	20.3
Weight	**kg**	**lb**
Net	7.6	16.8
Shipping	9.5	20.9

ORDERING INFORMATION

2815 OPTO-Scope™. **$3,795**
Includes: Two P6103 10X Voltage probes; Operator's manual (070-7236-00); Operator's reference card (070-7238-00); Front panel cover (200-3397-00); Pouch (016-0677-02).

OPTIONS

Option 26—FC Connectors. **NC**
Option 27—ST Connectors. **NC**
Option 1R—Rackmount Kit **+$150**

CONVERSION KIT

Rackmount Adapter—
Order 016-0819-00. **$190**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

WARRANTY-PLUS SERVICE PLANS

M1—2 Calibrations. **+$160**
M2—2 Years Service. **+$194**
M3—2 Years Service and 4 Calibrations. **+$515**
M4—5 Calibrations. **+$385**
M5—2 Years Service and 9 Calibrations. **+$890**

OPTIONAL ACCESSORIES

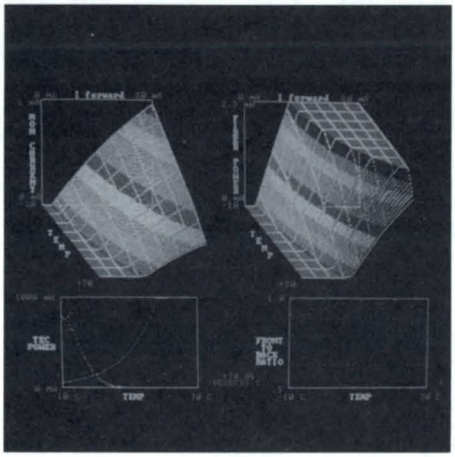
See 2225 optional accessories, page 187.
Service Manual—Order 070-7237-00.*1
Viewing Hoods—
(Collapsible) Order 016-0592-00. **$15**
(Polarized) Order 016-0180-00. **$60**
(Binocular) Order 016-0792-01. **$225**
CRT Light Filters—
(Clear) Order 337-2775-01. **$1.95**
Optical Cables—2 Meters 100/140 μ fiber.
(SMA to SMA) Order 174-0879-00. **$280**
(SMA to FC) Order 174-0878-00. **$295**
(SMA to ST) Order174-0876-00. **$250**
(SMA to Biconic) Order 174-0880-00. **$250**

RECOMMENDED PROBES

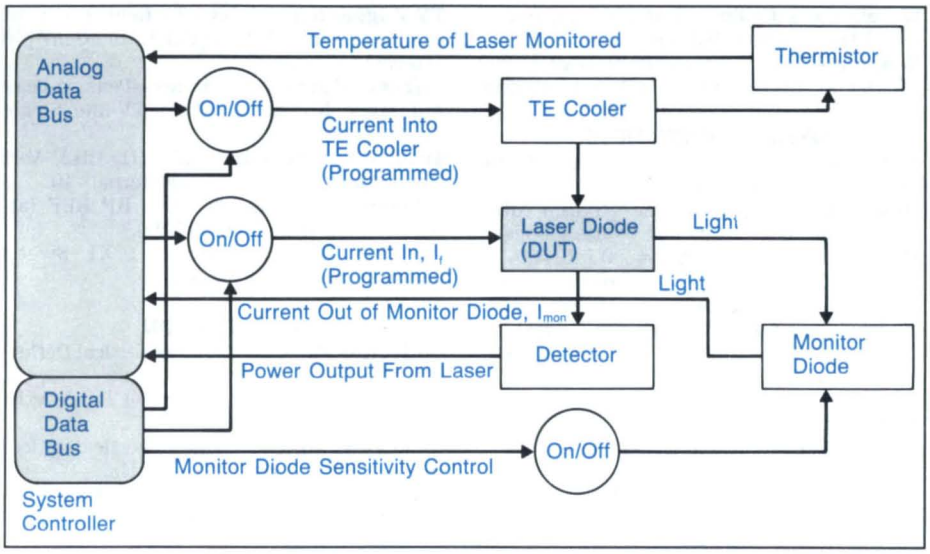
See Signal Acquisition Section for additional probes.
P6751—Spatial Input Head. **$310**
P6109—10X Probe. **$58**
P6062B—1X-10X Probe. **$175**
P6008—Environmental Probe. **$260**
P6009—High Voltage Probe. **$205**

RECOMMENDED CAMERAS

See Instrumentation Documentation Devices section, page 501.
C-5C—Option 04. **$495**
C-7—Option 02 **$610**
*1 *Contact your local sales office.*



Screen display from EOS System: Characterization of a laser diode over temperature.



NEW EOS-I

Laser Diode Test System

FEATURES

Superior Graphics

- **3-D Plots, 4 Plots per Display**
- **High-Quality Color Hard Copies from Tek 4693D Color Image Printer**

Statistic Displays

- **Test Temperature**
- **Threshold Current**
- **Fiber Power @I(th + 35 mA)**
- **Slope Efficiency**
- **I monitor @ I(th + 35 mA)**
- **LED Emission**
- **Dark Current @ −5 V**

The Laser Diode Test System consists of a test fixture, and an A-D card and cable to interface with a Tek PEP 301 or PC system controller, in addition to the system software. Laser diode testing involves applying a swept forward current to the device, and then measuring relevant parameters. It may be done in several modes: at a fixed temperature, at ambient temperature, as a pass/fail test, or over a user-specified temperature range.

ORDERING INFORMATION

EOS-1 Laser Diode Test System.
Contact your local Tektronix Sales Representative for more information, price and delivery.

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Illuminance Probes 497
Irradiance Probes 497
Luminance Probes 498
Uncorrected Probe 498
LED Test Probe 498
Application Notes 499

J16 Photometer/Radiometer

- **Digital LED Readout**
- **Eight Silicon Sensor Probes Quickly Interchange Without Recalibration**
- **Freedom From Saturation Effects over Entire Range**
- **Accurate Spectral and Cosine Corrections**
- **Metric and US Versions Available**
- **BCD/Analog Output (Option 07)**
- **AC or Internal Rechargeable Battery Versions**
- **Longer Battery Life—4-Hour Operation**
- **Application Notes Available**

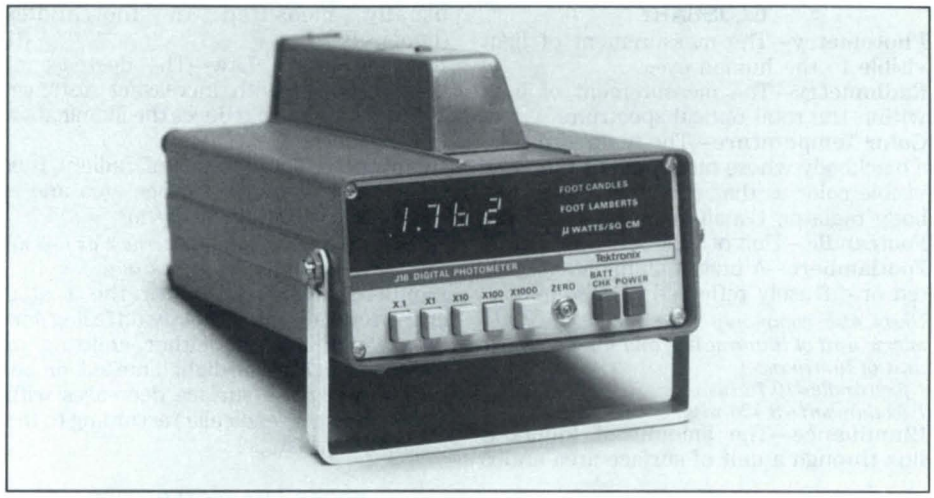
The Tektronix J16 is a portable digital photometer/radiometer capable of making a wide variety of light measurements—in the laboratory, in the field, or on the production floor. A J16 System consists of a J16 mainframe and one of eight detachable probes. Probes can be either mounted on the J16 or used on the end of an extension cable. All probes have a Hold switch to allow the reading to be held.

Eight quickly interchangeable probes are available for measuring illuminance, irradiance, luminance, light-emitting diode output, and relative intensity. Recalibration is not necessary when probes are interchanged. Connection of a probe to the J16 automatically selects the correct front panel units indicator. The 3½-digit LED display can be easily read under low ambient conditions.

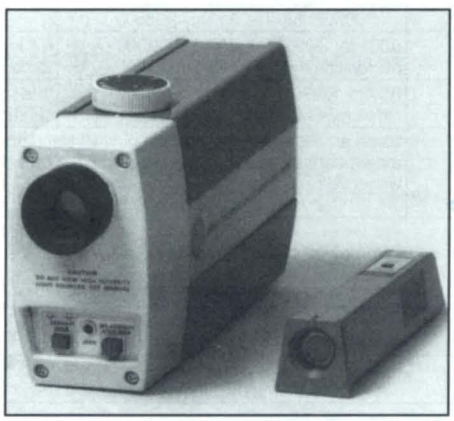
All probes use silicon photodiodes and multi-element glass filters for maximum stability and accuracy.

The optional BCD/analog output feature (Option 07) allows the user either a BCD output of the displayed reading or an analog signal (level) proportional to the light falling upon the sensor. The J16 can be also used with Tek MI 5010/50M30 system for interface with a GPIB system.

Under normal usage, the internal rechargeable nickel cadmium batteries will operate the J16 for four hours. An ac power supply is recommended for continuous operation.

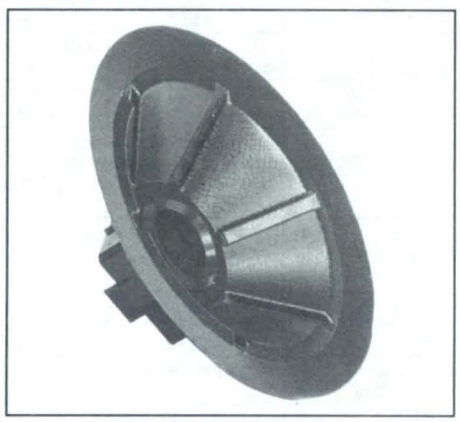


J16 with optional probe.



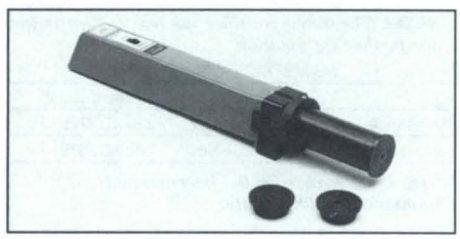
J6523

J6501 J6504
J6502 J6505
J6503



LIGHT OCCLUDER
016-0305-00

J6511 (shown) *J6512*



LED ADAPTER WITH EXTRA LED HOLDER (included with J6505) 014-0047-00

Power supplies or battery packs can be changed quickly by removing four screws on the J16's rear panel. The cabinet and probes have an internal threaded socket (¼ inch×20) for convenient mounting on a tripod or optical bench.

J16-TV Package

The J16-TV package is an excellent transfer mechanism which provides a simple, accurate method for adjustment of monitor screen color temperature. The primary colors are measured and adjusted to produce white color temperature balance.

The J16-TV with optional J6503 or J6523 measures monitor screen brightness on both color and black and white monitors. Other applications include measurement of studio lighting, camera lighting, and illumination of work areas.

The J16-TV package includes: J16 Battery-Operated Photometer, J6502 Irradiance Probe, light occluder, probe extension cable, and battery charger. See Application Note 58A-2926-1 for additional information.

GLOSSARY

Photometry—The measurement of light visible to the human eye.

Radiometry—The measurement of light within the total optical spectrum.

Color Temperature—The temperature of a blackbody whose radiation has the same visible color as that of a given nonblackbody radiator. Usually expressed in °K.

Footcandle—Unit of incident illumination.

Footlambert—A unit of illumination emitted or diffusely reflected by a source.

Units also commonly used include lux (the metric unit of illuminance) and nit (the metric unit of luminance).
1 footcandle=10.76 lux
1 footlambert=3.426 nits

Illuminance—The amount of luminous flux through a unit of surface area and is usually measured in footcandles (lumens/ft²).

Inverse Square Law—The decrease of light intensity with increasing distance. Twice the distance reduces the illumination to one-quarter.

Irradiance—The amount of radiant flux received by a unit of surface area and is usually measured in watts/cm².

Note: Other units of irradiance such as μW/cm² and W/m² are also used extensively.

Lambert's Law—Describes the spatial characteristics of a perfectly diffusing surface which may be either emitting or reflecting light. The light emitted or accepted by such a surface decreases with angle (from perpendicular) according to the cosine of the angle.

Luminance—The amount of light emitted or scattered by a surface and is usually measured in footlamberts.

Photopic—Spectral (color) sensitivity of the average human eye, predominantly peaked in the yellow-green region.

Steradian—A unit of area on the surface of a sphere equal to the radius squared. There are 12.6 steradians total area on a sphere.

Spatial—The directional characteristics of light in space.

Spectral—The distribution of light by wavelength within an electromagnetic spectrum.

Note that each radiometric unit has a photometric equivalent differing only in spectral response of the sensor. However, the units are not interchangeable.

PROBE CHARACTERISTICS

Application		Illuminance		Irradiance	Luminance		Uncorrected	Red LED
Probe		J6501	J6511	J6502/J6512	J6503	J6523	J6504	J6505
Range	US*2	0.001 to 1999 footcandles*1	0.001 to 1999 footcandles	0.001 to 1999 microwatts/cm²	0.1 to 199,900 footlamberts*1	0.1 to 19,990 footlamberts*1	Relative response only	0.001 to 1999 footcandles*1†
	Metric (Opt. 02)	0.01 to 19,990 lumens/m² (lux)*1†	0.01 to 19,990 lumens/m² (lux)*1†	0.01 to 19,990 milliwatts/m²	1 to 1,999,000 candelas/m² (Nits)*1	1 to 199,900 candelas/m² (Nits)*1	Relative response only	0.01 to 19,990 lumens/m² (lux)*1†
Accuracy (Including J16)		Within 5% of NBS standards and ±1 digit in last place. Calibrated with a 3100°k tungsten halogen light source traceable to NBS		Same as J6501, except calibrated with a 762 nm filter	Within 5% of NBS standards and ±1 digit in last place. Calibrated with a 3100°k tungsten halogen light source traceable to NBS		Probe-to-probe accuracy ±5% with tungsten light source	Same as J6501, except calibrated with a 656 nm filter
Spectral Response		Within 2% (integrated) of CIE photopic curve		Flat within ±7% from 450 to 950 nm	Within 2% (integrated) of CIE photopic curve		UV enhanced silicon spectral curve (250 to 1200 nm)	Within 2% (integrated of CIE phototopic curve from 600 to 710 nm
Acceptance Angle		50% sensitivity at 48° off axis	Cosine corrected (180°)	50% sensitivity at 48° off axis	8°	1°	50% sensitivity at 48° off axis	
Stability and Repeatability		Within 2% per year						
Linearity		Within 2% over entire range enabling single point calibration						

*1 *An additional decade of sensitivity is included and is usable if the J16 is carefully zeroed and used at a relatively stable temperature.*

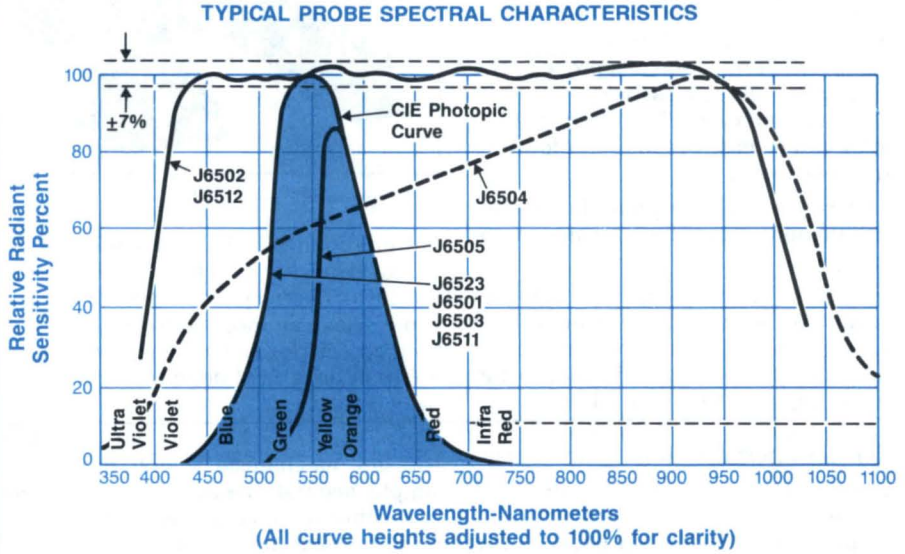
† *0.00001 to 199.9 candelas when used with 014-0047-00 LED adapter or at 3.8 inches source-to-sensor spacing. Luminous intensity readings of higher intensity light sources may be easily made at correspondingly greater distances using the formula: Footcandles × d²= candelas where d is the distance from the source to the sensor in feet. (For metric readings, use lux × d²= candelas where d is distance from the source to the sensor in meters.) Request J16 Application Notes 58A-2635 and 58A-2704-1 for further information.*

*2 US/METRIC CONVERSIONS

	US to Metric	Metric to US
Illuminance	Fc×10.764=Lux	Lux×0.0929=Fc
Luminance	FL×3.426=Nits	Nits×0.2919=FL

NOTE: C.I.E. stands for the International Commission on Illumination.

TYPICAL PROBE SPECTRAL CHARACTERISTICS

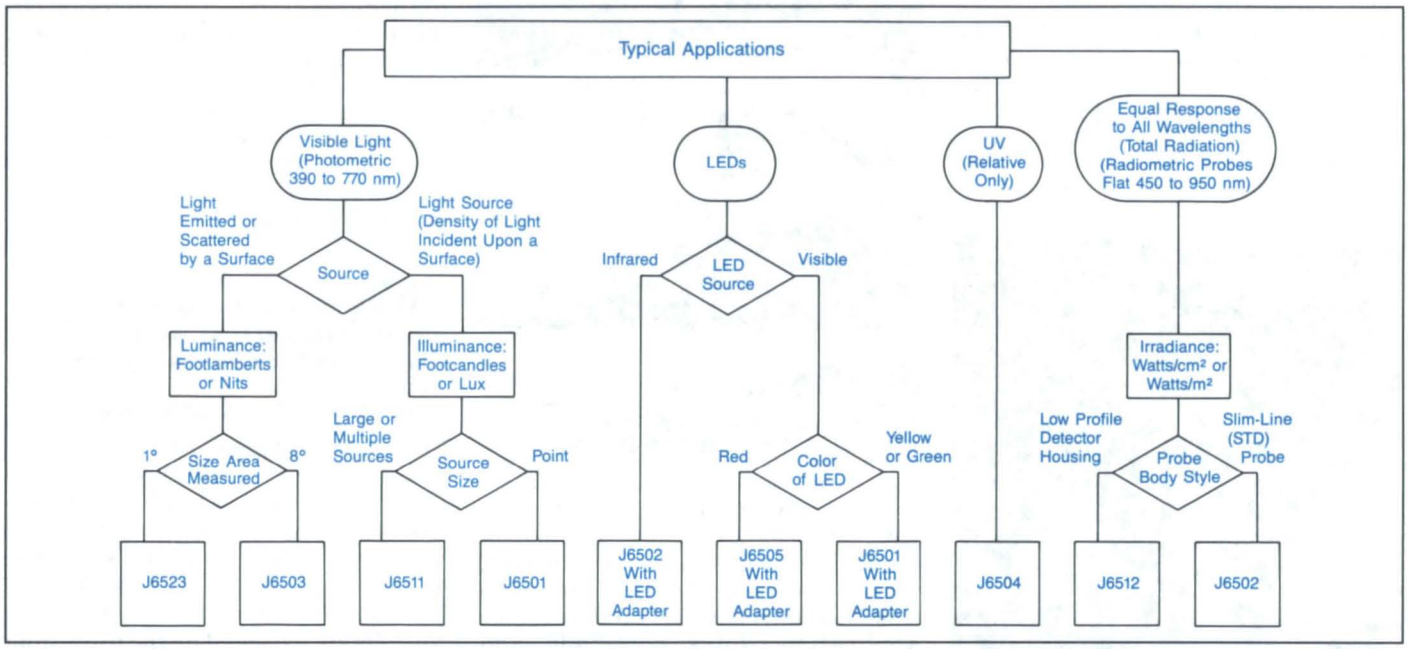


NOTE: *C.I.E. stands for the International Commission on Illumination.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

J16 PROBE SELECTION

Applications are too numerous to list, but this flowchart should help in your selection of J16 probes.*[1]



J6511/J6501

Illuminance Probes

Typical Measurement Applications

- **Roadway Illumination**
- **Office Lighting**
- **Work Surface Illumination**
- **Studio Lighting**
- **Camera Setup**
- **Yellow/Green LED Testing**

The J6511 is an illuminance probe with readout in footcandles [lumens/m² (lux) for the J6511 Option 02]. A multi-element glass filter and silicon photo-diode ensure a close match to the CIE photopic curve (color corrected). The silicon-sensor recovery time is virtually instantaneous; low-light levels can be measured immediately after exposure to bright sunlight.

The angular response is accurately cosine corrected, simulating an ideal 180° field-of-view detector. The low-profile probe has a leveling indicator to ensure accurate measurements where a significant proportion of the illumination comes from sources at low angles to the horizon.

A 25-foot cable between the probe (J6511) and J16 allows the user to be out of the field of view while making measurements. Where cosine correction is unnecessary, the standard J6501 probe is available with the same photopic correction and units as the J6511. The J6501 can be used to measure green and yellow LEDs.

*[1] *Refer to page 501 for available application notes.*

J16-TV System with J6502 being used for color monitor set-up.

J6502/J6512

Irradiance Probes

Typical Measurement Applications

- **Laser Research/Experimentation**
- **Radiant Efficiency**
- **Color CRT Setup**
- **Infrared LED Testing**

The J6502/J6512 measure irradiance in microwatts/cm² (milliwatts/m² with Option 02). The spectral response is flat from 450 to 950 nanometers, ±7%. The response is typically down 50% at 400 and 1030 nm.

An optional filter holder is available for the J6502 to mount standard 1 inch diameter customer-supplied filters of up to $^3/_8$ inch thickness. Where high intensity sources are used (over 1990 μwatts/cm²), neutral density filters can be used to extend the range of the J16. (An ND 1 filter has 10% transmission, an ND 2 1%, etc.). These filters may be held with an optional filter holder.

Where the 1 sq cm sensor is not completely filled by the source, for example with a laser beam, the reading obtained represents microwatts instead of μwatts/cm² or milliwatts × 10^{-4} instead of milliwatts/m² (Option 02). Small variations in sensor uniformity may add ±5% uncertainty to this measurement.

The J6512 has a low-profile detector head and six-foot cable. Longer cables available as special modifications.

J6503 8° Luminance Probe

Typical Measurement Applications

- **Video Screen Illumination**
- **Street Sign Illumination**
- **Work Surface Illumination**
- **Movie Screen Illumination**

The J6503 measures luminance in footlamberts (candelas/m² (nit) with Option 02) where light scattered or emitted by a surface must be measured. The probe is pointed at the emitting surface.

The probe's response is closely matched to the CIE photopic curve, ensuring accurate results even when measuring spectrally different light sources.

The acceptance angle is approximately 8 degrees, which is determined by internal field stop apertures. Providing that the 8 degrees field is uniformly filled, the probe can be held at any distance from the source. At 21 inches from the front of the probe, the field of view is approximately three inches in diameter. The footlambert or candelas/m² (nit) (Option 02) indicator automatically lights when the J6503 is connected.

Measuring Luminance with the Tektronix J16/J6523.

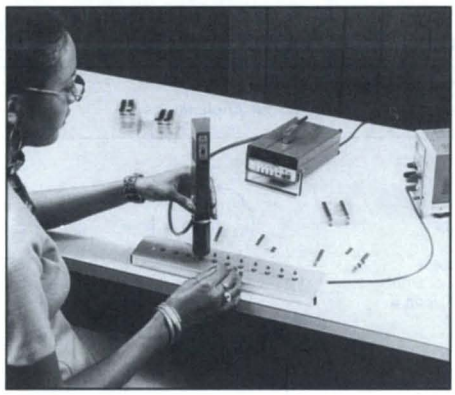
J6523 1° Luminance Probe

Typical Measurement Applications
- **Highway Lighting**
- **Video Display Illumination**
- **Photographic Equipment Illumination**
- **Lighting Equipment Illumination**

The J6523 will measure the luminance in footlamberts (candelas/m² with Option 02) of a spot as small as 0.32 inch in diameter. By using commercially available 55-mm stackable diopters, areas as small as 0.035 inch (+10 diopters) can be measured. These 55-mm diopters are physically similar to threaded 55 mm filters, and are available from most photography stores. (See Application Note 58-AX-3252.)

The 1-degree angle represents 0.21 inch per foot of distance from the probe to the source. Thus at 10 feet, the J6523 measures a 2.1-inch diameter spot.

The probe includes an optical sighting system with a 9-degree viewing field. The focusing range is 18 inches to infinity, closer with 55-mm close-up diopters. The spectral response is closely matched to the CIE photopic curve (color-corrected) for accurately measuring all commonly used light sources. The J6523 may be attached to the J16 or used with an optional probe extension cable. A standard ¼ inch×20 threaded socket allows it to be used on a tripod or an optical bench.



J6505 Red LED Test Probe

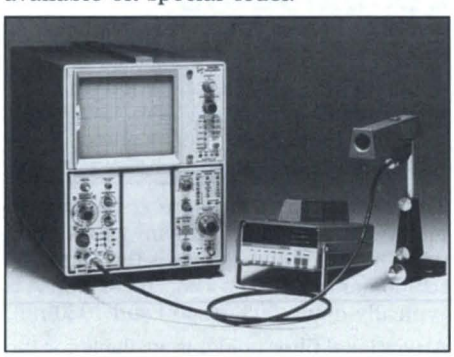
Typical Measurement Application
- **Output of Red LEDs (600-710 nm)**

Note: For yellow or green LEDs use the J6501 probe, for infrared LEDs use the J6502 probe.

The J6505 measures illuminance in footcandles (lumens/m² (lux) with Option 02), which can easily be converted into luminous intensity in candelas. (See Application Notes 58-A-2635 and 58-A-2704-1.)

An adapter supplied with the probe provides a controlled spacing between the sensor and the LED under test. The adapter excludes ambient light, and has internal baffles to prevent stray reflections during the measurement. Three inserts are supplied with the adapter to fit common sizes of LEDs (0.080 inch, 0.125 inch, and 0.200 inch diameter). These inserts are made of soft plastic that can be easily modified by the user.

With the adapter in place, a reading of 1 footcandle on the J16 represents 100 millicandelas of luminous intensity. With a metric version of the J16/J6505 (Option 02), 1 lumen/m² represents 10 millicandelas. A 10× increase in sensitivity is available on special order.



J16 used to measure pulsed light source. Refer to Application Note 58A-2702-1.

In the J6505, the silicon photodiode-filter combination provides an excellent match to the photopic curve in the region 600 nm to 710 nm. This close match requires compromising in the 380 to 600 nm region, making this probe unsuitable for general illuminance measurements. For LED measurements in the yellow or green regions, the LED adapter must be used with the J6501, and the same conversion factor for luminous intensity applies.

J6504 Uncorrected Probe

Typical Measurement Applications
- **Photoresist/Photo-Processing Light Sources**
- **Comparison of UV Light Sources**

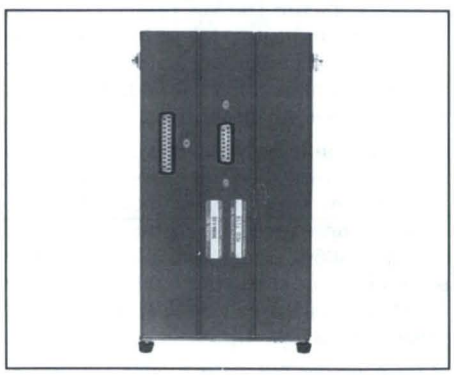
This probe is designed for applications where only relative measurements need be made. The J6504 has the widest spectral range, and is the most sensitive probe. Use is made of a UV-enhanced silicon sensor and a UV-transmitting window rather than spectral-correction filters.

No units are indicated on the three front panel indicators when using the J6504, since it provides relative readings only.

An optional filter holder may be used to mount standard 1-inch diameter filters on standard-configuration probes. Ultraviolet, visible, or near infrared filters can be used to select the wavelength of interest and exclude ambient light.

Option 07 BCD/Analog Output

Option 07 adds a 25-pin connector on the unit's top. This connector provides parallel TTL logic and BCD outputs, a "hold" input line (TTL), and a linear analog signal output 0 to −2 V or 0 to −6 V (depending upon the probe used), for a full-scale readout. The analog bandwidth is approximately 0.8 Hz. A cable-end connector and cover have been added to the accessories complement.



J16 with analog BCD output (Option 07).

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

CHARACTERISTICS

J16 MAINFRAME

Display—3½ digit LED readout and three LEDs automatically indicating correct units for probe in use. Metric version readout is also available (Option 02).
Stability—≤2% per year.
Linearity—≤2% over entire range (enables single point calibration).
Integration Time—≈100 ms.
Calibration—Electrical calibration of the J16 mainframe is performed with a calibrated voltage source or DVM traceable to NBS. Calibrated probes can be used with any J16 without additional calibration.

POWER REQUIREMENTS

Standard and Option 01—Has internal rechargeable NiCad batteries that require 16 hours for a full charge. The J16 will operate nominally four hours continuously on a charge. The J16 cannot be operated from the battery charger for continuous operation since the charging rate is ≈200 mA, while the J16 draws ≈400 mA. For continuous-operation an ac power supply is recommended.
Option 03 and Option 04—AC only operation, no internal batteries.

J16 AND PROBES ENVIRONMENTAL

Ambient Temperature—Nonoperating: −50 to +75°C. Operating: −15 to +40°C.
Altitude—Nonoperating: To 15 000 m (50,000 ft). Operating: To 4600 m (15,000 ft).
Humidity—Operating and Storage: Five cycles (120 hour) to 95% relative humidity at 40°C. Referenced to MIL-E-16400F.
Vibration—Operating: 15 minutes along each major axis, a total displacement of 0.025 in p-p (4 g's) from 10 to 55 to 10 Hz in one minute cycles. Held for three minutes at 55 Hz. All major resonances above 55 Hz.

PHYSICAL CHARACTERISTICS (With Probe And Battery Pack Installed)

Dimensions	mm	in.
Width	123	4.6
Height	60	2.4
Depth	203	8.0
Weight ≈	**kg**	**lb**
Net	1.5	3.3
Domestic Shipping	2.3	5.0
Export-packed	4.5	10.0

ORDERING INFORMATION

(PROBES NOT INCLUDED UNLESS NOTED)

J16 Photometer/Radiometer Battery Version, With 115 V ac, 50 to 400 Hz **$1,295**
Includes: Battery charger (119-0375-02); shoulder strap (346-0104-00); battery pack (016-0539-01); instruction manual (070 1879-00); or with Option 02 instruction manual (070-1880 00).

J16-TV Photometer/Radiometer Package for TV Color CRT Set-Up **$1,935**
Includes: Same as J16 plus J6502 irradiance probe, light occluder (016 0305-00), 42 inch probe extension cable (012-0414-02).

OPTIONS (J16/J16-TV)

Option 01—Battery version with 230 V ac, 50 to 400 Hz charger (119-0375-03). **NC**
Option 02[*1]—Metric Readout. **NC**
Option 03—115 V ac only operation, 50 to 400 Hz. **NC**
Option 04—230 V ac only operation, 50 to 400 Hz. **NC**
Option 07—BCD/Analog Output. **+$95**
[*1] *Option 02 must also be ordered for probes.*

PROBES

Actual plotted spectral curve is included with each probe.

J6501 Illuminance Probe **$600**
J6502 Irradiance Probe **$600**
J6503 8° Luminance Probe **$600**
J6504 Uncorrected Probe **$525**
J6505 LED Probe, Includes LED Adapter and 3 LED Holders **$610**
J6511 Illuminance Probe, Cosine Corrected (with 25-ft cable) **$600**
J6512 Irradiance Probe (with 6-ft cable) **$600**
J6523 1° Luminance Probe **$1,710**

OPTIONS (Probe)

Option 02—Metric probes required for metric readout J16s (Option 02). **NC**

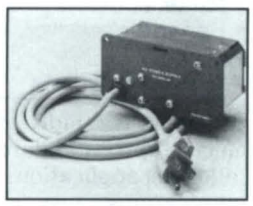
OPTIONAL ACCESSORIES

42-Inch[*1] **Probe Extender Cable**—Connects J16 to probe. Order 012-0414-02 **$120**
Light Occluder—For TV color CRT balancing. Order 016-0305-00 **$28**
Filter Holder[*2]—Mounts 1 in diameter filters, of up to 3/8 in thickness, to probes (except J6511, J6512, J6523). Order 016-0527-00 **$31**
LED Adapter—With 3 LED Holders (included with J6505). Order 014-0047-00 **$95**
Tripod—Order 016-0253-00 **$160**

[*1] *Longer length extender cables are available as a modified product by contacting your local Tektronix Sales office.*
[*2] *Filters available from vendors such as: ORIEL (203) 377-7877 or CORION CORP. (617) 429-5065 and others.*

POWER PACKS

Power packs can be quickly changed by removing four corner screws on the rear panel and sliding the power supply or battery pack out.



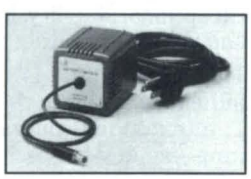
AC Power Supply

AC Power Supply—Allows J16 to be used without batteries. 115 V ac, 50 to 400 Hz (included with Option 03). Order 119-0404-00 **$255**
230 V ac, 50 to 400 Hz (included with Option 04). Order 119-0404-01 **$255**

Battery Pack

Spare Battery Pack—Order 016-0539-01 **$175**

Battery Chargers—When ordering a battery pack for your ac-powered J16, also order one of the following chargers.



Battery Charger—115 V ac, 50 to 400 Hz (included with Standard J16). Order 119-0375-02 **$150**
Battery Charger—230 V ac, 50 to 400 Hz (included with Option 01). Order 119-0375-03 **$95**

Within the basic limitations of the silicon sensors and the J16 design, a number of modifications are possible as modified products. Contact your local Tektronix Sales Office or Representative regarding special application requirements.

APPLICATION NOTES

Title	Literature #
Photometry/Radiometry primer, and standardizing CRT measurements	60-W-5750
Luminous intensity and visible LED measurements w/Tektronix J16 Photometer	58-A-2635
Measuring pulsed light sources with the J16 and an oscilloscope	58-A-2702-1
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LDM 1301/ LDM 1551/ LDM 1301PR LDC 600

TYPICAL APPLICATIONS

- **Test and Measurement**
- **Military**
- **Sensors**
- **Video**
- **Communications**

Tektronix is rapidly building a family of electro-optic standard products for the following applications: optical fiber communications, test and measurement, wavelength multiplexing, low-loss video links, R&D, and military systems.

LDM 1301

Our standard product LDM 1301 is a general-purpose, high-performance laser diode module that is a direct plug-in replacement for the 14-pin, dual-in-line, industry-standard package. This laser is ideally suited for either digital or analog applications, and features high-output 1300 nm single-mode emission through either a fiber pigtail or an optical connector. The package includes a photodiode for monitoring back-facet emission and a precision thermistor to monitor and control package temperature. It can be purchased with or without a thermal electric cooler.

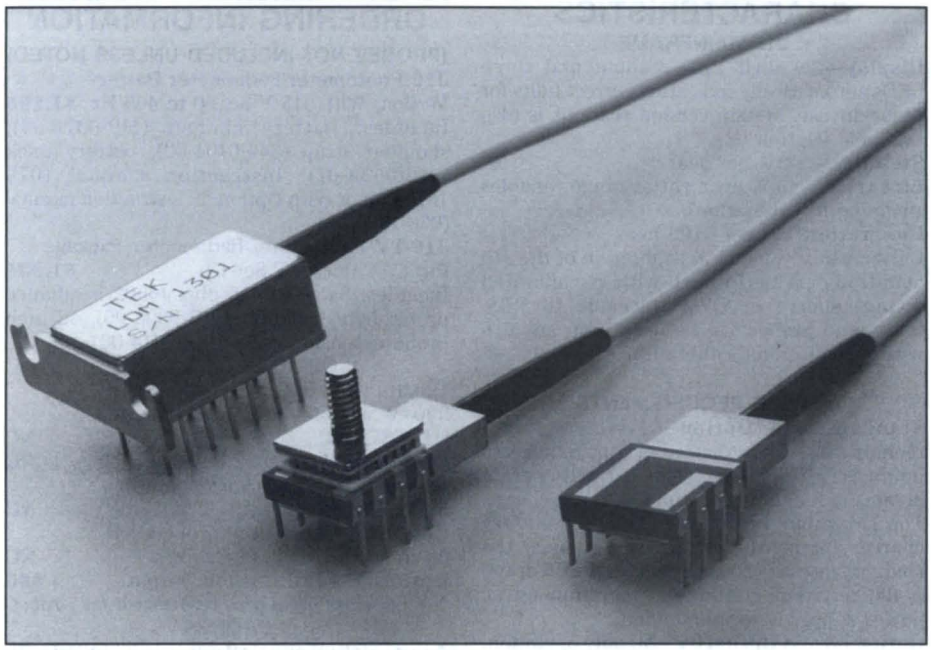
LDM 1551

The LDM 1551 is one of our latest additions to the family of electro-optic products. It features high-output emission, exceptional stability, hermetic packaging, and a wide operating temperature range.

The LDM 1551 is a pin-compatible, industry-standard, 14-pin DIP package. The extended operating temperature range makes it possible to operate the laser over 110 ° C temperature excursion. It also features high-output emission coupled into a low-bend loss, single-mode fiber. Tektronix' proprietary lensing and alignment process guarantees a continuous fiber output power of 1 mW minimum and exceptional operating stability.

LDM 1301PR

This device is ideal for a wide variety of performance and environmental applications, including test and measurement instruments, fiber gyroscopes, R&D, military systems, and optical sensors.



LDM Series

The LDM 1301PR is a pin-compatible, industry standard, 14-pin DIP package. It offers a true extended operating temperature range that makes it possible to operate the laser over an unprecedented 110 °C temperature excursion.

The proprietary lensing and alignment process guarantees a continuous fiber output power of 1 mW minimum, with an extinction ratio of 200:1.

In addition, packages are hermetically sealed in an inert environment containing neither epoxies nor organic compounds. This assures a reliable, highly stable operating lifetime.

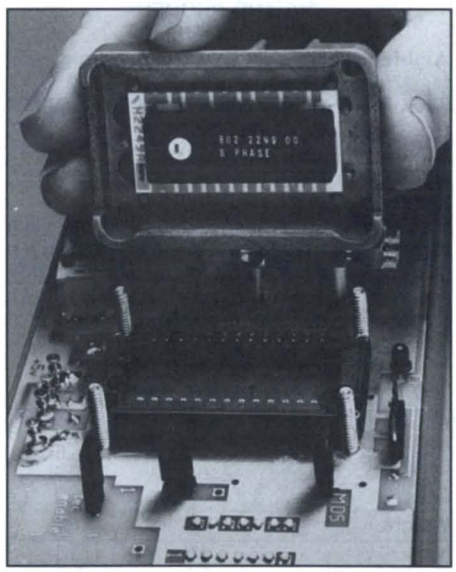
LDC 600

A microelectronics component capable of driving and controlling laser diodes at 600 MB/s.

Applications for Tektronix' LDC 600 Laser Driver/Controller include: digital fiber optic communications, digital video, local area networks (LANs), optical signal generation, and optical source testing. In addition, it can be used as a stable dc light controller.

When used in a subsystem and coupled to a compatible laser diode such as Tektronix' LDM 1301, the LDC 600 controls and maintains preset optical power while providing a current source for regulating a thermo-electric heater/cooler.

The LDC 600 laser driver/controller also features the standard interface for electrical circuits (50 ohm differential ECL inputs) required for easy incorporation into system designs, as well as slow start/



LDC 600

stop circuitry that guards laser systems from damage that might otherwise be caused when power is suddenly turned on or off.

For more information contact:

Tektronix, Inc.
Electro-Optic Products Group
P.O. Box 500 M/S 13-033
Beaverton, Oregon 97077
1-800-835-9433, Ext. 100
(503) 627-4220
FAX 503-627-4651

INSTRUMENTATION DOCUMENTATION DEVICES

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Video Copiers 501
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Film Based Cameras and Adapters 503

Documentation devices are a vital part of your test and measurement system. Tek's cameras and copiers allow you to document and communicate your test results with clarity and credibility.

Selecting the right documentation device for your application requires careful consideration of your needs and the capabilities of the recording instrument. Here are some important considerations:

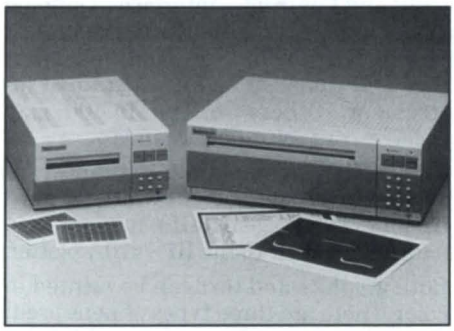
Do you need a film-based camera to capture events from your scope? Will you be recording repetitive or transient events? A general guideline is that the writing rate of the scope and the bandwidth of the signals to be captured will determine the camera to select.

Tek offers you a complete line of film-based cameras, from a low-cost hand-held model, ideal for capturing repetitive events, to high-speed models for single-shot events. A full selection of Polaroid® instant film allows you to make color transparencies or prints, and provides high-resolution negatives for publication.

Lenses, light gathering ability, magnification, field of view, and photographic writing speed are all important parameters to consider when selecting a camera. The discussion of key camera parameters on pages 505 through 509 will assist you in your selection.

Do you require hard copy capture of your signals in a form other than on film? The Tek HC01/HC02 Black and White Thermal Copiers provide low-cost, high resolution copies of PC graphics (CGA mode) or video images in seconds. The HC100 Color Plotter is a general purpose plotter that works without a controller with many Tek digitally based instruments.

The DCS01 Digitizing Camera System can also be used for documentation. The DCS01 adds digitizing and signal processing capabilities to analog oscilloscopes. A CCD video camera is optically coupled to the CRT to capture the waveform for display on your PC. Now you can capture a 1 GHz single-shot event with a Tek 7104 scope or a 400 MHz event with a Tek 2467B. Refer to pages 456 through 458 for additional information on the DCS01.



HC01/HC02 Video Copiers/Printers

HC01/HC02

Black and White Thermal Video Copiers

Applications: Imaging Products with Composite Video Outputs: Digitizing Camera System (DCS01, C1001); Logic Analyzers (except 1240 Series); Personal Computers (with CGA); VCR's; Medical Imaging; TV Camera; Ultrasound Systems; Manual Production; 7250 Digitizer

The HC01/HC02 offer copies in seconds (17 and 21 seconds, respectively) of the most complex computer-screen graphics (with CGA graphics card only) or TV/CRT display-monitor images. The copiers are ideal for a wide range of applications, such as permanent records of teleconferences, medical diagnostics, and measurement and instrumentation data.

CHARACTERISTICS

INPUT SIGNALS

NTSC/PAL/SECAM Composite Video—1 V p-p, 75-Ω terminated, negative sync (video bridged out).

RGB TTL From PC—TTL Level (bridged out), F (H) = 15.75 kHz.

Parallel Data Interface/Teletext/Videotex—TTL Level.

POWER REQUIREMENTS

Line Voltage—120 V ac ± 10%.
Line Frequency—50/60 Hz.
Power Consumption—HC01: 60 W. HC02: 110 W.

For A1–A5 Versions

Line Voltage—220/240 V ac ±10%.
Line Frequency—50 Hz.
Power Consumption—HC01: 60 W. HC02: 120 W.

RESOLUTION (DOTS×LINES)

Composite Video Signal

	Frame Mode	Field Mode
NTSC	640×476	640×238
PAL/SECAM	640×512	640×289

RGB TTL Signal—
Field Mode: 640×200 (Noninterlaced).
Frame Mode: 640×400 (Interlaced).

Parallel Data—640 Dot 80 Column; ASCII 96 Character Built-in; Graphic Mode Application; Printing Speed 160 CH./s

Gray Scale—16 tones.

PHYSICAL CHARACTERISTICS

	HC01		HC02	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	210	8.3	368	14.5
Height	112	4.4	119	4.7
Depth	358	14.1	337	13.3
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	5.5	12.1	7.7	17.0

ORDERING INFORMATION

Each copier includes a roll of thermal paper, 75-Ω cable, BNC to RCA cable, and a manual.
HC01 4×5 in. Video Copier (110 V ac). **$1,235**
HC02 8×10 in. Video Copier (110 V ac). **$1,645**

INTERNATIONAL POWER PLUG OPTIONS
A1 through A5 (220/240 V ac) are available.

OPTIONAL ACCESSORIES

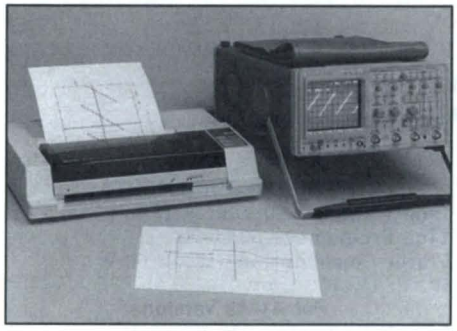
Super Grade Thermal Paper—Four rolls per box.
(HC01) Order 016-0867-01 **$45**
(HC02) Order 016-0868-01 **$85**

Data Cable—10 foot, male-to-male 9-PIN DB connectors. For connection to RGB TTL PC output.
Order 174-0537-01 **$20**

PRINT SPECIFICATIONS

Paper—Super grade thermal type (black and white).

	HC01	HC02	
		Side Mode	Norm. Mode
≈ Prints/roll	180	75	94
Width	110 mm (4.3 in.)	216 mm (8.5 in.)	
Length	21 m (85 ft)	21 m (85 ft)	
Print Size	110×115 mm (4.3×4.1 in.)	216×279 mm (8.5×11 in.)	216×220 mm (8.5×8.6 in.)
Image Size	100×74 mm (3.9×2.9 in.)	200×148 mm (7.8×5.8 in.)	
Print Speed	≈17 s	≈21 s	



HC100 Plotter shown with 2430A.

HC100 Color Plotter

- **Compatibility*[1]: 2220/2221 Opt 10, 2230 Opt 10, 2430, 2430A (Version 1.8 Firmware or Above), 2432, 2440, 7854, 7D20, 336 Opt 01, 468 Opt 02, RTD 710 via GPIB; 370, 371 and SPD S3FG130 via Centronics**
- **Direct Plots from Many Tek Instruments without Using a Controller**
- **GPIB and Centronics Interfaces are Both Standard**
- **Can Be Used as a General Purpose Plotter By Using HPGL Command Set**
- **Four Color Pens in Three Styles**
- **Replaceable Pen Cartridge**
- **Compact Size**
- **Handles A4 and US Letter Size**

* [1]*Contact your local sales office for additional instrument compatibility.*

TYPICAL APPLICATIONS

- **Documentation from Digitally-Based Instruments**
- **General Purpose Plotter for Hard Copies or Transparencies**

The HC100 is a low-cost, four-pen, color plotter that is used for direct output of waveform plots and setup information from various Tek digitally-based instruments. It can be operated as a general purpose plotter, allowing mixed graphics and text, or as an Epson compatible printer. A full ASCII 96-character set is provided for text output. International character sets for 11 countries can also be selected.

Digital scopes and other instrumentation control the HC100. Instruments send information such as waveforms, front panel settings and pen selection. Depending on the controlling instrument, the front panel or keyboard is used to initiate the plot. Up to six waveforms in X-T format (amplitude versus time) can be contained in a single plot, depending on instrument model and memory capacity.

The HC100 comes standard with both GPIB and Centronics interfaces. Optional cables are available to attach the plotter to your instrument. Note: Only one interface at a time can be attached to an instrument. Otherwise, the HC100 may receive conflicting commands.

The HC100 is compatible with most instruments that use Hewlett-Packard Graphics Language (HPGL). It operates in a manner similar to the HP 7470A plotter.

Both graphics and text can be printed in color. There are three types of pens used: Fiber-tip pens with water-based ink for paper, fiber-tip pens with oil-based ink for overhead projection film, and ball-point pens with water-based ink for paper. Ball point pens produce a finer line than a fiber pen. Additional or replacement pens are available through Tektronix.

The HC100 pen cartridge holds four pens. The pens can be different colors, ink types, or point styles. The pen cartridge is easily changed allowing the user to quickly change colors or pen types. The plotter also has an automatic capping feature, which extends the life of the pens.

The HC100 is not recommended to be used in a multi-controller environment, such as with a GPIB instrument and GPIB controller, unless attached to the controller (PEP301 or equivalent) via Centronics interface and using SPD software. If the HC100 is used in a multi-controller environment on the same GPIB bus, handshaking errors may appear.

The HC100 is available in 120 V or 220/240 V versions. The power supply is not selectable. The HC100 comes in your choice of one of the power selections.

CHARACTERISTICS

Effective Drawing Size—267 mm (X-axis)×192 mm (Y-axis).
Maximum Drawing Speed—230 mm/s (along pen axis).
Maximum Resolution—0.1 mm.
Pen Response Speed-15 times/s.
Number of Pens—4 (changed automatically).
Pen Types—Fiber pens: aqueous ink or oil-based ink. Ball-point pens: aqueous ink.
Pen Colors—Set of black, blue, red, and green.
Paper Sizes—ISO A4: 297×210 mm. B5: 257×182 mm. US letter size: 279×216 mm.
Paper Types—Ordinary paper; OHJ film.
Pen Movement Precision—Single Pen: 0.3 mm. Different Pens: 0.5 mm.
Pen Change Precision—Within 0.3 mm.

FUNCTIONS

Drawing Modes—Self Test, Plotter, Printer.
Character Types—ASCII (96 types); International (32 types for 11 countries).

POWER REQUIREMENTS

Line Voltage—Standard: 117 V ac ±10%. Options A1-A5: 220/240 V ac ±10%.
Line Frequency—49.5 to 60.5 Hz.
Power Consumption—30 W.

ENVIRONMENTAL

Temperature—Operating: 5 to 35 °C. Nonoperating: 30 to 70 °C.
Humidity—Operating and Nonoperating: 85%
Note: Operating and nonoperating ranges overlap.

RELIABILITY

Pen Lifetime—Aqueous fiber pen: ≈200 m. Oil-based Fiber Pen: ≈400 m. Aqueous ball-point pen: 400 m.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	415	16.5
Height	81	3.2
Depth	272	10.8
Weight ≈	**kg**	**lb**
Net	6	13.2

ORDERING INFORMATION

HC-100 Color Plotter. **$825**
Includes: 1 package of each pen set: Fiber tip/water based (016-0879-00); Fiber tip/oil based (016-0878-00); Ball point (016-0877-00); Operator's Manual; One pen cartridge (016-0876-00).

OPTIONS

Option 01—GPIB cable (012-0991-01). **+$140**
Option 02—Centronics to PC 25-pin D cable (012-1250-00). **+$45**
To get a 220 V/240 V, 50 Hz version order one of these options.
Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A5—Switzerland 220 V, 50 Hz.
(Example: An HC100 Option A1 will be a 220 V, 50 Hz Plotter with a universal Euro plug.)

OPTIONAL ACCESSORIES

Cables—
(1 m GPIB) Order 012-0991-01 **$140**
(8 ft Male Centronics to PC 25-pin D) Order 012-1250-00 **$45**
(9 ft Male Centronics to Male Centronics for 370/371) Order 012-1284-00 **$75**
Extra Pen Cartridge—
Order 016-0876-00 **$15**
Pens—Four colors in each package.
Fiber tip/aqueous ink. 016-0879-00 **$9**
Fiber tip/oil-based ink. 016-0878-00 **$9**
Ball point/aqueous ink. 016-0877-00 **$9**
Pens—Black pen sets with four pens.
Fiber tip, Aqueous ink. 016-0939-00 **$9**
Fiber tip, oil-based ink. 016-0940-00 **$9**
Ball-point, aqueous ink. 016-0941-00 **$9**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

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C-7 510
C-4 512
C-30 Series 514
C-50 Series 515
C-59A 516

A camera can be a key part of your measurement system. It allows you to capture single events and to document and communicate your results with clarity and credibility.

MOUNTING ADAPTERS

The camera and adapter selection guide indicates the recommended camera and appropriate adapters required for most Tektronix instruments. In some cases, adapters are available from Hewlett-Packard or other oscilloscope and CRT-based manufacturers to mount Tektronix cameras to their instruments.

VIEWING

The C-30 and C-50 Series are hinge mounted and can be swung aside to allow a wide-angle view of the CRT. The lightweight C-5C and C-7 can easily be removed to view the CRT or you can use the viewing door in the flash unit. C-5Cs and C-7s without a flash have a large lift-up viewing door in its place. The C-50 Series cameras have an off-axis viewing hood that accommodates eyeglasses for a comfortable binocular view.

GRATICULE LIGHTING

Most scopes have graticule illumination. For those that do not, an image of the graticule may be obtained by using the flash on the C-5C or C-7 Cameras, or a storage scope's background illumination (flood guns).

LENSES

Tektronix camera lenses differ mainly in speed (light-gathering ability), field of view, and magnification.

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-5C and the C-7 Cameras 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-31B and C-51 Cameras.

Field of View

The field of view 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. (See "Maximum Magnification" chart below.)

Magnification

The rated magnification of a lens signifies its image-to-object ratio. For example, if a lens has a magnification of 0.85, then for every square centimeter on the CRT face the camera would record 0.85 square centimeter of image on the film.

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. Most Tektronix cameras are designed for use at one lens magnification. One exception is the C-30B 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 3.8×6.3 cm to 8×10 cm.

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 667 pack film, which has an image area of 73×95 mm. Usually, 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. See chart below.

SHUTTERS

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. They may be actuated by an insulated switch closure.

POWER REQUIREMENTS

The C-5C uses four AA alkaline batteries.

The C-7 has three choices of power available: battery pack utilizing eight AA alkaline batteries; ac power supply; or external remote power.

The C-51 and C-53 electric shutters require +15 volts, normally supplied by a 7000-Series oscilloscope. An optional battery pack (016-0270-02) 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. The C-59A uses an internal battery pack (batteries not included) or can use power from the 7000-Series mainframe.

MAXIMUM MAGNIFICATION NEEDED TO RECORD ENTIRE SCREEN

Screen Size	5×6.3 cm	7.2×9 cm	8×10 cm	9.76×12.2 cm
Polaroid 3¼×4¼-in. pack and roll film	1.0	1.0	0.85*1	0.67*1
4×5 in. films	1.0	1.0	1.0	0.85 or less
6×7 cm format roll film (70 mm, 120 mm, 220 mm, etc.)	1.0	0.67	0.67	Not recommended

*1 *Preferred magnification ratio for the screen size and to fill most of the usable image area of the film type.*

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 sensitivities of various film types. Wet process, roll, or cut films can be used if the proper back is selected. (See the respective camera for optional backs.)

Selected Polaroid films are available through Tek. Technical assistance with Polaroid film and back questions or problems is available directly from the Polaroid Corporation. Call 1-800-343-5000 toll free within the U.S.

FILM BACKS

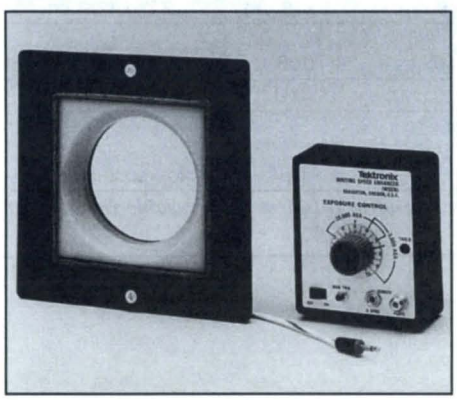
There is a wide variety of cameras and backs. Backs within a series are interchangeable. See the specific camera for information on a particular back.

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.

Increasing Writing Speed

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 (WSEN) is designed to fill this need.



WSEN (Writing Speed Enhancer) diffuser with control box.

STANDARD AND OPTIONAL FILM BACKS AND HOLDERS AVAILABLE FROM TEK

Tek Modified Polaroid Backs	C-30 Series	C-50 Series	C-4, C-5C, C-7
3¼×4¼-in. pack	Std on "P" models	Std on "P" models	Noninterchangeable (C-5C & C-4)
Roll*1	Yes*1	Yes*1	NA
4×3-in. AutoFilm	NA	NA	C-7 only
Graflok-Type*2 Interface	Optional*2 Back	Std on*2 "G" models	NA
Polaroid 3¼×4¼-in. pack holder	Yes	Yes	
Polaroid 4×5-in.single-sheet holder	Yes	Yes	
Polaroid 4×5-in. pack holder*3	*3	*3	
120-mm roll	Yes	Yes	
70-mm roll	Yes	Yes	
4×5-in. cut film holder*4	*4	*4	

*1 *Polaroid is gradually reducing the number of its roll films. Replacement roll backs are available in limited quantities from Tektronix.*
*2 *Requires one of the film holders listed in order to be usable.*
*3 *Will work but available only from Polaroid.*
*4 *Will work but not available from Tek, see your local camera store.*

The enhancer installs in minutes, and can be triggered in three ways: by a push-button 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. The WSEN is powered by two 9-V batteries (not included), which are inside the control box.

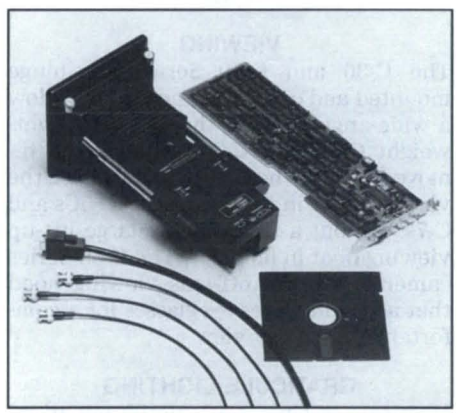
The film can be fogged before, after, or while the sweep occurs. The techniques are respectively called prefogging, postfogging, and simultaneous fogging. Of these modes, simultaneous fogging provides the greatest gain in writing speed. Automatic, simultaneous fogging is easily achieved by triggering the enhancer with the oscilloscope-sweep +gate.

For more information on photographing high-speed signals, request Application Note 42-W-5335-1.

Polaroid Film		Relative Film Writing Speed	
ASA Equivalent Speed	Type	Unfogged	Fogged
3,000	667, 107, 084, 47	1 (Reference)	3*1
20,000	612	>2	>3.5

*1 *Value depends on film, scope, CRT, camera, and the operator.*

DIGITIZING CAMERA SYSTEM



DCS01

The DCS01 Digitizing Camera System combines CCD technology with an IBM PC, XT, AT, or compatible to acquire and digitize repetitive and transient waveforms displayed on oscilloscopes, spectrum analyzers, and other displays. Used with scopes having the microchannel plate CRT, such as the 7104, 11302A, and 2467B, the DCS01 can acquire repetitive and transient signals at the full bandwidth of the scope. With other scopes, the DCS01 will acquire repetitive events at the full scope bandwidth and transient events according to the photographic writing rate of the oscilloscope. Refer to page 456 for additional information.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

CAMERA SELECTION GUIDE

Camera	C-51	C-53	C-59A	C-30B	C-31B	C-5C	C-4	C-7
Features	Fastest writing speed Adjustable film and shutter speed Built-in view port Remote shutter actuation Interchangeable film backs Single-sweep mode	General purpose for instruments with 8×10 cm CRTs Adjustable film and shutter speed Built-in view port Remote shutter actuation Interchangeable film backs Single-sweep mode	General purpose for CRTs up to 6½ inches; low cost Adjustable film and shutter speed Built-in view port Internal batteries Interchangeable film backs OEM pricing available	Continuously variable magnification Dual swing-away hinge for viewing the CRT Easy operation Interchangeable film backs Compact size OEM pricing available	Max writing speed for portable scopes Dual swing-away hinge for viewing the CRT Easy operation Interchangeable film backs Compact size	Low cost, mounts on most scopes Graticule illuminator Viewing door Easy to use Fixed focus OEM pricing available	Lowest price Tek camera, hand held Easily interchangeable hoods Scope and video hoods Easy to use Fixed focus OEM pricing available	Motorized film back Auto developing prints; uses Polaroid AutoFilms Audible indicators Remote shutter activation Fixed focus OEM pricing available
Lens Apertures	f/1.2 to f/11	f/1.9 to f/16	f/2.8 to f/16	f/1.9 to f/16	f/1.3 to f/16	f/16 fixed	f/4.5 to f/32	f/16 fixed
Magnification	0.5	0.85	0.67	Variable: 0.7 to 1.5 (0.8 with Opt 01)	0.5 (0.43 with Opt 01)	0.67 or 0.85	0.80, 0.70, 0.85 depending on hood	0.67 or 0.85
Relative light gathering	3.0	1.0	0.65	1.0 (0.9 with Opt 01)	2.7 (2.9 with Opt 01)	0.02	0.14 (0.85 mag) 0.18 (0.70 mag)	0.02
Field of view with Polaroid pack (cm)	8×10		10.2×12.7	8×10 (Opt 01); 7×9 (std)		9.8×12.2 or 8×10	9.1×11.87 (std) 10.4×13.5 (Opt 02) 8×10 (Opt 03)	8.1×10.7 (0.85 mag) 10.3×13.8 (0.67 mag)
Resolving Power: at center: (lines/mm)	30 or better		10 or better	at 1:1 25 or better	30 or better	6 or better		
at corners: (lines/mm)	15 or better		4 or better	10 or better	15 or better	3 or better		
Shutter Type	Electrical, 1/60 to 4 s (bulb, time, single sweep), remote shutter actuation, x-sync, scope "+gate" input		Mechanical, 1/125 to 1 s (bulb and time) x-sync			Electrical, 1/10 to 5 s, (Time Mode)	Mechanical, 1/125 to 1 s (bulb), x-sync	Electronic actuated 1/10 to 5 s, (Time Mode)
Film backs	Polaroid pack standard with "P" models, Graflok back standard with "G" models			Polaroid pack standard with "P" models, Graflok back available (016-0487-00)		Polaroid pack noninterchangeable		Polaroid AutoFilm noninterchangeable (CB-33)
Recommended films (see page 510 for ordering	612 667	667 612 691	667 669 691	667 612 669 691	612 667	667 669 691	667 669 691	AutoFilm Only 331 339
Options	Opt 11 corrector lens for 11301/A Opt 12 corrector lens for 11302/A	Opt 11 corrector lens for 11302/A	Opt 11 corrector lens for 11301/2/A	01 Provides the correct adaptor (016-0269-03) for Tek portables with 8×10 cm displays. Also includes a corrector lens for optical correction		See page 511 for specific selections of options	01 (0.8 mag) 02 (0.7 mag) 03 (0.85 mag) 10 (7.2 in diagonal) 11 (8.3 in diagonal) 12 (12.5 in diagonal) See C-4 description	See C-7 description for specific selections
Optional Accessories	Mounting adaptors, battery pack (for C-51, C-53), writing speed enhancer (one for each model), Polaroid pack film back, Graflok 4×5 in. back and film holders, x-sync connector, carrying case, foot switch (for C-51 and C-53)			Mounting adaptors, writing speed enhancer, Polaroid pack film back, Graflok 4×5 in. back and film holders, and carrying case; x-sync cable, portra lens (for C-30B only)		Mounting hood adaptors, flash unit, viewing door	Scope and video adaptor hoods, color filter kit (122-0909-00)	Film, foot switch, mounting hood adaptors, flash unit, battery pack, 110 V ac power supply
Page	516	516	516	514	514	509	512	510
Prices begin at	$2,510	$2,090	$1,475	$1,600	$1,860	$495	$410	$610

ACCESSORIES FOR OLDER TEKTRONIX CAMERAS

Polaroid Pack Film Back for Older Cameras: C-12, C-19, C-13, C-27
The Pack Film Back accepts the Polaroid pack film. (3¼×4¼ in.).
Order 122-0671-01 **$310**

Mounting Adapters for C-12—
C-12 to 7000 Series and 5000 Series.
Order 016-0299-00 **$100**
C-12 to 530, 540, 550 Series.
Order 016-0226-01 **$85**
C-12 to 560 Series rectangular CRTs.
Order 016-0217-00 **$115**

Writing Speed Enhancer—For C-12, C-27. Provides controlled film fogging to increase writing speed by 3× for 3,000 ASA film and >3.5× with 20,000 ASA film. Installs in minutes. Order 016-0280-02 **$380**

POLAROID REPLACEMENT ROLLER ASSEMBLIES FOR PACK FILM BACKS

(Gray) Order 401-0304-00 **$35**
(Red and Black) Order 401-0303-00 **$26**

Note: Because of mechanical differences, both roller assemblies are incompatible with each other's back.

CAMERA AND MOUNTING-ADAPTER SELECTION GUIDE

Where two or more cameras are recommended, compare features and specifications to optimize for your application. Tek cameras fit many non-Tek CRT-based products. Contact your Tek Sales Representative for more information.

Oscilloscope or Display Device	Recommended Cameras			Mounting Adapter Part Numbers			
	High Writing Rate	General Purpose	Low Cost	C-4*11	C-5C, C-7	C-51, C-53, C-59A, C-27, C-28	C-30BP*13, C-31BP*13
11000 Series							
11301(A)	C-51 Opt 11	C-59A Opt 11	C-5C; C-7	NR	016-0357-01	016-0249-06	NR
11302(A)	C-51 Opt 12	C-53 Opt 11		NR	NR	016-0249-06	NR
11401 11402			C-4*16 Opt 10	122-0897-01	NR	NR	NR
7000 Series							
8×10 cm Display; i.e., 7104, 7503, R7103, 7504, 7514, 7613N, 7623, 7633, 7704(A), 7834, 7844, 7854, 7934, R7903, 7904, 7904A, T922R*2	C-51 C-31BP Opt 01*10*13	C-53 C-30BP Opt 01*10*13	C-4 Opt 02 C-5C C-5C Opt 01 C-7 C-7 Opt 01	122-0895-01	016-0357-01	016-0249-06	016-0248-01
Large Screen Display*1; i.e., 7403, 7603, 7603N		C59A	C-4 Opt 02 C-5C C-5C Opt 01 C-7 C-7 Opt 01	122-0895-01	016-0357-01	016-0249-06	NR
5000 Series							
5100 Series Nonstorage*1*3; i.e., 5110, 5112, D10, D12, 577/D1, 5116*6		C-59A	C-4 Opt 02 C-5C C-7 C-7 Opt 01	122-0895-01	016-0357-01	016-0249-06	NR
5100 Series Storage*1*2; i.e., 5111, 5111A, 5113, 5115, D11, D13, D15, 577/D2		C-59A	C-4 Opt 02 C-5C C-7 C-7 Opt 01	122-0895-01	016-0357-01	016-0249-06	NR
5400 Series Nonstorage*1*2; i.e., 5403/D40, 5440, 5444, D40		C-59A	C-4 Opt 02 C-5C C-7 C-7 Opt 01	122-0895-01	016-0357-01	016-0249-06	NR
5400 Series Storage*2*4; i.e., 5403/D41, 5441, D41	C-51	C-53	C-4 Opt 02 C-5C C-7 C-7 Opt 01	122-0895-01	016-0357-01	016-0249-06	016-0248-01
5223*1		C-59A	C-4 Opt 02 C-5C C-7 C-7 Opt 01	122-0895-01	016-0357-01	016-0249-06	NR
Portables							
Older with 0.8-cm Graticule*5; i.e., 422, 453, 454, 485, 491	C-31BP	C-30BP	C-4*4	122-0894-01	No adapter	No adapter*5	016-0306-01
Newer with 1-cm Graticule*5; i.e., 2235, 2245, 2246 Option 01; 2400 Series, 455, 464, 465, 465B, 465M, 466, 468, R468, 475, 475A, 432, 434, 442	C-31BP*7 Opt 01	C-30BP*7 Opt 01	C-4; C-5C Opt 02 C-5C Opt 04 C-7 Opt 02 C-7 Opt 03	122-0894-01	016-0359-01	No adapter*5	016-0269-03
1-cm Nonilluminated Graticule*5; 2213(A), 2215(A), 2220/21, 2225, 2230, 2235, 2236			C-7 Opt 02 C-5C Opt 04	NR	016-0359-01	No adapter*5	016-0269-03
¼-inch Graticule*4*5*12; i.e., 305, 314, 326, 335, 336, 1501, 1502		C-30BP Opt 01*10	C-4 Opt 03*4	122-0896-01	No adapter	No adapter*5	016-0327-01
TM 500*5; i.e., SC 502, SC 503, SC 504*4		C-30BP Opt 01*10		NR	No adapter	No adapter*5	016-0327-01
Nonilluminated Graticule*5*8; 2335, 2336, 2336YA, 2337			C-5C Opt 04*8 C-7 Opt 02*8	NR	016-0359-01	No adapter*5	No adapter
Display Monitors							
8×10 cm*3; i.e., 601, 602, 605, 606, 606B, 607		C-30BP Opt 01*10 C-59A	C-4 Opt 02 C-5C C-7 C-7 Opt 01	122-0895-01	016-0357-01	016-0249-06	016-0248-01
Large Screen 10 × 12 cm*1; i.e., 603, 604, 608, 620, 624, 634		C-59A	C-4 Opt 02 C-5C C-7 C-7 Opt 01	122-0895-01	016-0357-01	016-0249-06	NR

continued on next page

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

CAMERA AND MOUNTING-ADAPTER SELECTION GUIDE

Where two or more cameras are recommended, compare features and specifications to optimize for your application. Tek cameras fit many non-Tek CRT-based products. Contact your Tek Sales Representative for more information.

	Recommended Cameras			Mounting Adapter Part Numbers			
Oscilloscope or Display Device	**High Writing Rate**	**General Purpose**	**Low Cost**	**C-4*11**	**C-5C, C-7**	**C-51, C-53, C-59A, C-27, C-28**	**C-30BP*13, C-31BP*13**
Older 5 Inch Round*2							
502, 503, 504, 515, 516, 519, 530/540/550/580 Series, 575	C-51*2*10	C-53*2*10	C-59A*10	NR	No adapter	016-0225-04	016-0243-00
Older 5 Inch Rectangular							
560 Series*2; i.e., 561, 564, 567, 568		C-53*2*10	C-59A*10	NR	No adapter	016-0224-01	016-0244-00
Television Products							
380, 381		C-30BP Opt 01*10	C-4 Opt 03	122-0896-01	No adapter	No adapter	016-0327-01
520, 520A, 521, 521A, 522A*1*2		C-59A*10		NR	No adapter	016-0295-01	No adapter
1480C		C-53*2*10	C-59A*9*10	NR	No adapter	016-0342-00*9	No adapter
528A*2, 1420, 1421, 1422, 1424*1*2		C-59A	C-4 Opt 02 C-5C C-7 C-7 Opt 01	122-0895-01	016-0357-01	016-0249-06	016-0248-01
529*1		C-53*10				016-0224-01	
1705, 1710B, 1711B, 1720/21, 1730/31, 1740, 1741, 1742, 1750, WFM300		C-30BP Opt 01*15	C-4 C-5C Opt 02 C-5C Opt 04 C-7 Opt 02 C-7 Opt 03	122-0894-01	016-0359-01	No adapter*5	016-0269-03*15
Spectrum Analyzers							
2710		C-30BP Opt 01	C-5C Opt 04 C-7 Opt 02	NR	016-0359-01	No adapter	016-0269-03
491*5		C-30BP		NR	No adapter	No adapter*5	016-0306-01
492A, 492P, 494, 494P, 495, 496, 496P*2, 2754/55/P		C-59A	C-4 Opt 02 C-5C C-7 C-7 Opt 01	122-0895-01	016-0357-01	016-0249-06	016-0248-01
Other Products							
370, 371		C-59A	C-4 Opt 02 C-5C C-7	122-0895-01	016-0357-01	016-0249-06	NR
576, 5030, 5031		Only C-59(A)*10		NR	No adapter	016-0288-01 [C-59(A) only]	No adapter
OF150, OF151, OF152, OF235 TDR			C-4 Opt 02 C-5C C-7 C-7 Opt 01	122-0895-01	016-0357-01	NR	NR
1240*8*14			C-4 Opt 11	122-0898-01	NR	NR	NR
T900 Series, excluding T922R (see 7000 Series)			C-5C Opt 03 C-7 Opt 04	NR	016-0358-01	No adapter*5	No adapter
308			C-4 Opt 03	122-0896-01	NR	NR	NR

*1 *Only cameras with <0.7 magnification can record the entire screen area of a 10×12 cm display.*

*2 *These scopes do not have camera power. The C-51 and C-53 may be used only if powered with 016-0270-02 battery pack.*

*3 *These scopes require modification for graticule illumination.*

*4 *Though these scopes do not have illuminated graticules, the graticule may be photographed using storage flood guns on storage models.*

*5 *Due to physical configuration, the C-50 Family cannot be mounted.*

*6 *The C-7 can only be used for color if the image is electronically reversed.*

*7 *A corrector lens is required to increase cameras field of view so that the full 8×10-cm CRT display area can be recorded. The camera should be changed from standard to Option 01. To do this, order 016-0301-01 for the standard C-30B or 016-0269-04 for the standard C-31B. These kits include the mounting adapter and corrector lens.*

*8 *These scopes have no CRT bezel; therefore, a camera cannot be mounted. A hand held C-5C, C-7, or C-4 can obtain a record.*

*9 *The C-59A may be used with 016-0224-01, however the image size is reduced.*

*10 *Adapter not included with camera. Order adapter separately.*

*11 *Use on scopes with graticule illumination or bistable storage.*

*12 *Scopes do not have graticule illumination.*

*13 *C-30 Series may cut off the first and last small graticule "tick" marks on some scopes.*

*14 *Must use f/22 or f/32 to get enough depth of field for good focus.*

*15 *C-30 Series will not fit models 1740, 1741, 1742, 1750, and WFM300.*

*16 *Cuts off some of the CRT.*

NR=*Not recommended*

ORDERING INFORMATION

CAMERA MOUNTING ADAPTER AND HOOD

016-0217-00	$115	016-0295-01	$90
016-0224-01	$149	016-0299-00	$100
016-0225-04	$90	016-0301-01*3	$115
016-0226-01	$85	016-0306-01*4	$100
016-0228-01	$120	016-0327-01	$175
016-0243-00	$145	016-0342-00	$235
016-0244-00	$110	016-0357-01*5	$20
016-0248-01	$95	016-0358-01*6	$20
016-0249-06*1	$105	016-0359-01*7	$21
016-0263-00	$100	122-0894-01*8	$55
016-0269-03	$115	122-0896-01*9	$60
016-0269-04*2	$110		

*1 *Included with C-50 Series Cameras.*

*2 *Adapter and lens included with C-31B Option 01 Cameras.*

*3 *Adapter and lens kit included with C-30B Option 01 Cameras.*

*4 *Included with Standard C-30B, C-31B Cameras.*

*5 *Included with C-5C and C-5C Option 01 Cameras.*

*6 *Included with C-5C Option 03 Cameras.*

*7 *Included with C-5C Option 02 and Option 04 Cameras.*

*8 *Included with C-4 (Standard).*

*9 *Included with C-4 Opt 02 and Opt 03.*

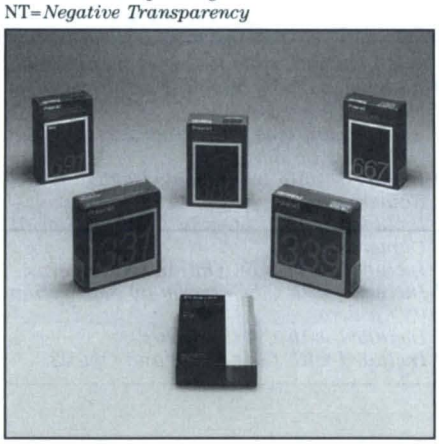
To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

COMMONLY USED POLAROID FILMS
Shaded text indicates films available through Tektronix.*5

Film Type	ASA Equivalent Speed	Development Time (seconds at 75°F)	Format	Resolution	Characteristics	CRT Recording Uses: Repetitive	Stored	Single Sweep	Video Display	Scintillation Type Display	Color Displays	Scanning Electron Microscope
3¼×4¼-in. Pack Films—Actual image area 7.3×9.5 cm (2⁷/₈×3¾-in.), 8 prints per pack												
611*1	200	45	PP	20	Low Contrast, Wide Gray Scale				✓	✓		●
612*5	20,000	30	PP	20 to 25	High Contrast			✓				
			N	160 to 180								
665*4	75	30	PP	14 to 20	Medium Contrast, Wide Gray Scale	●*4	●*4		●*4			✓
107	3000	15	PP	16 to 20	Medium Contrast	●	●	●	●			
084	3000	15	PP	16 to 22	Medium Contrast	●	✓		●	✓		
667*1*5	3000	30	PP	11 to 14	Medium Contrast, coaterless	✓	✓	●	●	✓		✓
669*5	80	60	CP	11 to 14	Balanced for Color—Electronic Flash	●			●		✓	
691*5	80	4 min	CT		Includes Mounts	●			●	●	✓	
AutoFilm (For C-7 only)—Actual image area 10×7.5 cm (4×3 in.), 10 prints per pack												
331*1*3*5	400	60	PP	20	Medium Contrast, Extended Gray Scale	●	●		✓	✓		✓
339*1*2*5	640	>60	CP*2	7 to 9	Medium Contrast, High Speed Color				●*2		✓*2	
4×5 Films—Actual image area 9.0×11.4 cm (3½×4½-in.)												
55			PP	22 to 25								
55 P/N	50	20	N	150 to 160	Medium Contrast, Wide Gray Scale	●	●		●			
57	3000	15	PP	16 to 20	Medium Contrast	✓	✓	●	●			
553 (8 Pack)	800	30	PP	16 to 22	Medium Contrast	●	●		✓			✓

Polaroid Roll Film Backs are no longer available from Tektronix on new cameras. Polaroid still manufactures some roll films. . . Call their toll free number 1-800-343-5000 for roll film availability.

✓ *Preferred film for application.*
● *Acceptable performance.*
*1 *No coating required.*
*2 *Requires electronic scan reversal to yield a correct reading image.*
*3 *Seconds at 75°F.*
*3 *Similar to Type 611.*
*4 *Allow prints to be made from negative; good for documentation or publications.*
*5 *Available from Tektronix. See right.*
PP = *Positive Print*
N = *Negative*
CP = *Color Positive Print*
CT = *Color Transparency*
NT = *Negative Transparency*



POLAROID PACK FILMS AVAILABLE FROM TEKTRONIX

Recommended for all cameras with a Polaroid 3¼×4¼ inch Pack Back.

Type 667—B&W print, no coating required (3,000 ASA). (3 twin packs) 48 prints. Order 006-6824-00 **$46**
(25 twin packs) 400 prints. Order 006-6825-00 **$365**

Type 612—B&W print, high contrast (20,000 ASA). (3 single packs) 24 prints. Order 006-6822-00 **$38**
(50 single packs) 400 prints. Order 006-6823-00 **$595**

Type 669—Color print (80 ASA). (3 twin packs) 48 prints. Order 006-6826-00 **$70**
(25 twin packs) 400 prints. Order 006-6827-00 **$520**

Type 691—Color transparency with mounts, (80 ASA). (3 single packs) 24 trans. Order 006-6845-01 **$42**
(50 single packs) 400 trans. Order 006-6845-02 **$660**

Polaroid AutoFilm (C-7 only).

Type 331*1—B&W print, with extended gray scale (400 ASA). (3 twin packs) 60 prints. Order 006-6815-00 **$65**
(10 twin packs) 200 prints. Order 006-6816-00 **$200**

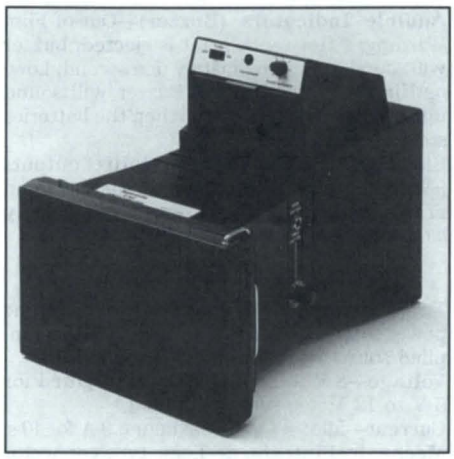
Type 339*2—Color print (640 ASA). (3 twin packs) 60 prints. Order 006-6813-00 **$80**
(10 twin packs) 200 prints. Order 006-6814-00 **$240**

*1 *Type 331 (ASA 400) is a black-and-white-print film with extended-gray-scale for recording the full range of brightness levels displayed on video monitors and scope CRT's. At present there is no high-speed AutoFilm, thus the C-7 is not useful for recording fast single sweeps.*

*2 *Type 339 (ASA 640) is a fast color film for color CRT displays. It's not recommended for normal CRT recording because it produces a print with a reversed or mirror image of the CRT display unless the display is electronically reversed before making the exposure. This is a function of the film design and not of the C-7.*

For technical assistance on Polaroid films and backs call Polaroid directly (800) 343-5000 toll free within the U.S. Outside the U.S., Polaroid has Service Centers and Offices, or write Polaroid Corp., 784 Memorial Drive, Cambridge, MA 02139.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.



Standard C-5C (with flash).

C-5C

TYPICAL APPLICATIONS

- **Oscilloscopes**
- **Small Video Displays**
- **Medical Imaging/Ultrasound**
- **Nuclear Medicine**
- **CAD/CAM Displays**

BENEFITS

- **Lightweight—Easy to Use**
- **No Focusing Required**
- **Fits Most Tek and non-Tek Scopes**
- **Covers Widely-Used 8×10 cm and 9.8×12.2 cm CRT Displays**

FEATURES

- **Uses Polaroid 3¼×4¼ in. Pack Films**
- **Graticule Flash**
- **Hood Mounts to CRT Bezel**
- **Electronically-Controlled Shutter**
- **Interchangeable Adapter Hoods**

Versatile Performance at Low Cost

If your application doesn't require special photo techniques, such as recording fast single sweeps, the C-5C will satisfy your documentation needs for a versatile general-purpose CRT camera at a friendly price.

The C-5C uses standard Polaroid 3¼×4¼ in Pack Film; i.e., 667, 665, etc. See page 510 on Polaroid films available from Tektronix.

CHARACTERISTICS

Aperture—Fixed at f/16.
Lens—Three glass elements.
Magnification—0.67 or 0.85.
Relative Light-Gathering Ability—0.02.
Shutter—Electronic; 1/10 to 5 s; time.
Field of View—9.8×12.2 cm (0.67 magnification) or 8.0×10.0 cm (0.85 magnification).
Power—The C-5C requires (4) AA alkaline batteries (not included). Battery holder inside camera.

PHYSICAL CHARACTERISTICS*1

Dimensions	mm	in.
Width	168	6.6
Height	140	5.5
Depth	257	10.1
Weights ≈	**kg**	**lb**
Net	1.4	3.0
Shipping	1.9	4.1

*1 *Standard C-5C.*

The C-5C and C-7 are separate camera systems; therefore, a C-5C cannot be converted into a C-7 and vice versa. However, they do use the same hoods and flash assemblies.

ORDERING INFORMATION

Camera includes one hood. Additional hoods purchased separately, see below.

C-5C Camera **$495**

Includes: Adapter hood (016-0357-01); flash unit (016-0642-02); battery holder, instruction manual (070-2824-00).

OPTIONS

Option 01—016-0357-01 adapter hood, no flash. **–$30**

Option 02—016-0359-01 adapter hood, no flash. **–$30**

Option 03—016-0358-01 adapter hood with flash. **NC**

Option 04—016-0359-01 adapter hood with flash. **NC**

OPTIONAL ACCESSORIES

For ordering films see page 510.

Large Viewing Door—Fits all three mounting adapter hoods. (Included with C-5C Options 01 and 02.)
Order 016-0630-00 **$9**

Graticule Flash Unit—Fits all three mounting adapter hoods. (Included with C-5C and C-5C Options 03 and 04.) Order 016-0642-02 **$165**

Additional Mounting Adapter Hoods—
Requires flash unit or large viewing door.
(C-5C and C-5C Option 01)
Order 016-0357-01 **$20**
(C-5C Options 02 and 04)
Order 016-0359-01 **$21**
(C-5C Option 03)
Order 016-0358-01 **$20**

Special pricing, terms, and conditions are available to qualified OEMs. Contact your local Tektronix Sales Engineer for complete information.

FEATURES COMMON TO C-5C AND C-7

ELECTRONICALLY-CONTROLLED SHUTTER

Both the C-5C and C-7 use a highly reliable and accurate shutter which is easily adjusted and triggered by convenient panel controls. The shutter can also be triggered remotely by an optional foot switch via the Shutter/Remote Trigger jack.

GRATICULE FLASH

For scopes with a non-illuminated graticule. A variable-intensity xenon flash makes the CRT phosphor glow and evenly backlight the graticule. The flash unit also comes on the C-5C Options 02 and 03 or C-7 Options 02 and 04, and can easily be retrofitted on C-5C's or C-7's that don't have it.

AN ADJUSTABLE LENS SYSTEM

To accommodate different-size CRT displays you can easily configure the three-element f/16 glass lens system to 0.67 or 0.85 magnification, with no focus adjustment required.

CAMERA-TO-PRODUCT COMPATIBILITY

The C-5C and C-7 cover the most widely-used CRT displays: 8x10 cm and 9.8x12.2 cm. They can be used with most Tek and non-Tek scopes. Please see the "Camera Guide" on pages 507–508.

ADAPTER HOODS

As listed in the table below, one of three interchangeable adapter hoods comes with each model of the C-5C or C-7. The hoods are easily changed by removing four screws inside the hood. Additional hoods can be ordered separately.

CRT VIEWING DOORS

A door on the flash unit provides a direct view of the CRT. Non-flash models replace the flash unit with a large lift-up viewing door (016-0630-00).

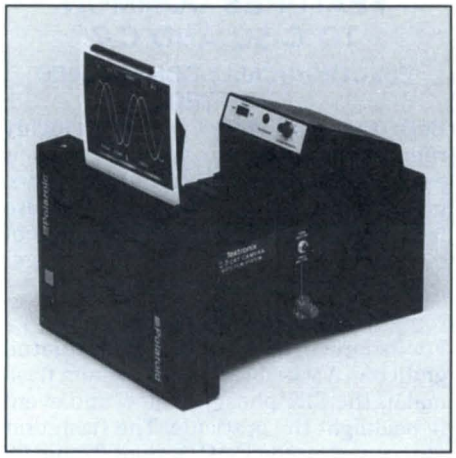
EASY CAMERA-TO-INSTRUMENT MOUNTING

For convenient mounting and removal, the adapter hood mounts into a groove atop the CRT bezel and swings down snugly around its perimeter.

C-5C AND C-7 ADAPTER HOODS

	016-0357-01		016-0359-01		016-0358-01	
Hood Dimensions*1	**cm**	**in.**	**cm**	**in.**	**cm**	**in.**
Height: Inside	13.0	5.13	10.5	4.13	9.5	3.74
Outside	13.7	5.38	11.2	4.40	11.2	4.41
Width: Inside	14.2	5.60	12.0	4.74	11.8	4.65
Outside	14.9	5.85	12.7	4.99	13.1	5.14

*1 *All dimensions are approximate since each hood has additional plastic notches and grooves for mounting onto the CRT bezel.*



C-7 Option 02 with ejected print.

C-7

TYPICAL APPLICATIONS

- **Clean Rooms**
- **Medical Imaging/Ultrasound**
- **Nuclear Medicine**
- **Oscilloscopes**
- **Instrument CRT Displays**
- **Small Video Displays**

BENEFITS

- **No Focusing Required**
- **Film Auto Ejects and Self Develops**
- **Dry Prints in a Minute**

FEATURES

- **Uses Integral Polaroid AutoFilms™**
- **Graticule Flash**
- **Motorized Film Back**
- **Electronically-Controlled Shutter**
- **Snap-on Print-Hold Chamber**
- **Buzzer Alarm For Low Batteries and Last Print**

This general-purpose CRT camera incorporates Polaroid's AutoFilm™ system which includes a motorized film back, two integral films, and a snap-on print holding chamber.

After each exposure, the film automatically ejects and self-develops to a clean dry print with no peeling, development timing, or coating necessary.

In less than four seconds after an exposure, the camera is ready to take another picture while the exposed films are developing.

You don't touch the exposed prints while they're developing, which is especially important in medical and clean-room applications where the handling of film might cause chemical contamination. Prints are collected in a light-tight, snap-on holder.

In addition, the film-back's rollers require infrequent cleaning since the processing chemicals are sealed within the print and don't contact the rollers.

The C-7/AutoFilm™ system is certified for use in Class 100 cleanrooms.

Wide Product Compatibility

The C-7 uses the same adapter hoods as the C-5C and can be used with most Tektronix oscilloscopes and small monitors. Non-Tek displays can also be photographed if the instrument has a Tek-style CRT bezel, or if the camera can be held up to the CRT.

Audible Alarms

An exposure counter in the filmback monitors the film supply, and sounds an alarm when the last film ejects. A buzzer also sounds to indicate low voltage input.

Polaroid Autofilm

The C-7 Camera uses Polaroid's AutoFilm™ exclusively in its motorized film back. AutoFilm comes in convenient 10-exposure packs.

The AutoFilm's usable image area is 4x3 inches; the actual image size on the film depends, of course, on the lens magnification setting and the size of the CRT display. For additional information on Polaroid Autofilm, see page 510.

CHARACTERISTICS

OPTIONAL/MECHANICAL

Relative Aperture—Fixed at f/16.
Magnification Factor—0.67 or 0.85.
Lens—Three glass elements.
Relative Light-Gathering Ability—0.02.
Field of View (Nominal)—8.1×10.7 cm (13.4-cm diagonal) at 0.85 mag; or 10.3×13.8-cm (17.3-cm diagonal) at 0.67 mag.
Shutter—Electronic Actuated: 1/10 to 5 s, open-shutter mode.
Remote Shutter Jack—Open collector TTL compatible (for use with foot switch).
Time Between Shots—≈4 s (plus shutter time).

Audible Indicators (Buzzer)—Out-of-Film Warning: After tenth print is ejected, buzzer will sound for approximately one second. Low- or High-Voltage Warning: Buzzer will sound during the film-eject cycle when the batteries start to get weak.
Status Outputs—Various status outputs (switch closures and openings) such as "end of film," "dark slide," etc., are available only as a modified product.

POWER REQUIREMENTS

The C-7 requires external power from an ac power supply, battery pack, or a customer supplied source via a Lemo connector.
Voltage—8 V to 12 V. (Can be configured for 5 V to 12 V, see service manual.)
Current—Idle: ≈1 mA. Maximum: 3 A for 10 s.
Mechanical Interface—Lemo type connector (cable end connector, Tektronix part number 131-0778-00).

POWER SUPPLIES (OPTIONAL)

110 V (119-1847-02)—Output Voltage: 9.5 V nominal. Output Current: 1.5 A nominal, 3 A peak. Line Voltage: 90 to 132 V ac, 50 to 60 Hz nominal.

Battery Pack (016-0799-01)—Number of Cells: Eight. Type of Cells: Alkaline or NiCad AA. (Batteries not included, velcro strips included.)

PHYSICAL CHARACTERISTICS

Std C-7 w/Flash Dimensions ≈	mm	in.
Width	180	7.1
Height to top of flash	196	7.7
Height with chamber	264	10.4
Depth	251	9.9
Weight ≈	**kg**	**lb**
Net	1.3	3.7
Shipping	2.6	5.8

Hoods—Uses C-5C adapter hoods. Refer to hood's dimensions on page 511.

The C-5C and C-7 are separate camera systems; therefore, a C-5C cannot be converted into a C-7 and vice versa. However, they do use the same hoods and flash assemblies.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

Shown above: C-7 and options. Rear left to right: Standard C-7, with Option 01, with Option 02, with Option 03, with Option 04, with Option 05, with Option 20, OEM camera with view ports. Front left to right: Print holding chamber, foot switch, battery pack, service manual, 110 V ac power supply.

ORDERING INFORMATION

C-7 requires a power source (does not come as a standard accessory). Order Opt 30*1, Opt 31*1, or use your own power via Lemo connector.

C-7 Camera with Flash **$610**
Includes: Adapter hood (016-0357-01); print holding chamber (122-1039-00); circuit board covers for 0.67 mag (200-3074-00); for 0.85 mag (200 3031-00); operator manual (070-5127-00).

OPTIONS

Option 01—016-0357-01 Hood and no Flash. **– $30**
Option 02—016-0359-01 Hood and Flash. **NC**
Option 03—016-0359-01 Hood and no Flash. **– $30**
Option 04—016-0358-01 Hood and Flash. **NC**
Option 05—016-0358-01 Hood and no Flash. **– $30**
Option 20—Camera Body Only, no Flash or Hood. **– $40**
Option 30*1—With 016-0799-01 Battery Pack (batteries not included). **+ $37**
Option 31*1—With ac Power Supply (110 V). **+ $65**

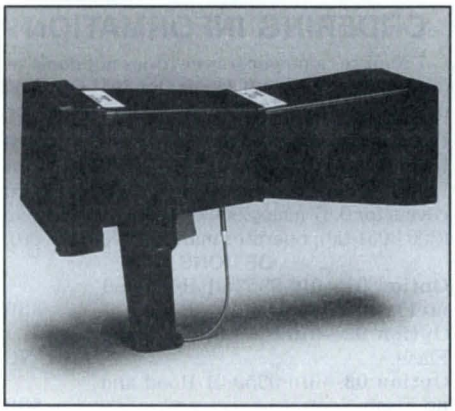
*1 *One of each power source can be ordered.*

OPTIONAL ACCESSORIES

Polaroid AutoFilm—Type 331—B&W print, with extended gray scale (400 ASA) 3 twin packs (60 prints). Order 006-6815-00 **$65**
10 twin packs (200 prints). Order 006-6816-00 **$200**
Type 339—Color print (640 ASA) 3 twin packs (60 prints). Order 006-6813-00 **$80**
10 twin packs (200 prints). Order 006-6814-00 **$240**
Extra Print Holding Chamber—Order 122-1039-00 **$22**
Foot Switch With 8-ft Cable—Order 260-1189-02 **$22.50**
Extra Battery Pack With Lemo Connector—Batteries not included. Order 016-0799-01 **$40**
Lemo Connector for Power-In—Order 131-0778-00 **$17**
AC Power Supply—8-ft cable with Lemo Connector, 110 V ac Version. Order 119-1847-02 **$90**
Service Manual—C-7 Camera. Order 070-5051-00 **$10**

For additional hoods, graticule flash unit, or large viewing door, see C-5C Optional Accessories section on page 509.

Special pricing terms and conditions are available to qualified OEMs. Contact your local Tektronix Sales Engineer for complete information.



Standard C-4 Hand-Held Camera.

C-4

TYPICAL APPLICATIONS

- **Oscilloscopes**
- **Instrument CRT Displays**
- **PC Terminals**
- **Video Displays**
- **Medical Imaging/Ultrasound**
- **CAD/CAM Displays**

BENEFITS

- **Hand Held—Easy to Use**
- **Widest Product Compatibility**
- **Adapts to Most Tek and Non-Tek Scopes and CRT Displays**
- **No Focusing Required**

FEATURES

- **Uses Polaroid 3¼x4¼ in. Pack Films**
- **Rugged Mechanical Shutter**
- **Adjustable Lens Aperture**
- **Six Snap-on Adapter Hoods**

The C-4 is a versatile high-quality CRT camera at a budget price. It produces sharp photos with convenient Polaroid Pack Films that develop in seconds to clear prints or transparencies. From oscilloscopes to video displays. . . the C-4 is an ideal CRT camera for the lab, classroom, medical facility, TV studio, and design bench.

A Snap to Use
Simply hold the C-4 up to the CRT and pull the shutter trigger. You can easily make quality pictures after just a few minutes of self study with the camera and manual. No special photographic skill or training is required!

The C-4 has a contoured pistol grip and squeeze-style shutter trigger for easy one-hand operation. A four-element glass lens system requires no focus adjust, and projects a sharp image over the entire film area with virtually no distortion.

Handy and Portable
Since the C-4 is light and hand held to the CRT, you can easily move it between test locations and instruments without having to fuss with adapter hardware.

The Adapter Hoods
The adapter hoods are a key part of the C-4 system: they block out ambient light and place the camera at the correct object distance from the CRT screen. A corrector lens in each hood provides a focused film image and proper magnification for the hood's field of view. The hoods are secured to the camera body by two snap locks for quick changing.

Recommended Use
We recommend the C-4 for scopes with an illuminated graticule, or with a storage display that can backlight the graticule with floodguns. On scopes with a nonilluminated graticule, the C-4 will record only the waveform. (The Tektronix C-5C Camera with flash is recommended for scopes with an unilluminated graticule.)

Film
The C-4 uses Polaroid 3¼x4¼ Pack Film. A table on page 510 describes eight types of film, and lists our recommendations for best use.

Camera-to-Product Compatibility
Six interchangeable adapter hoods fit the C-4 to most Tek and non-Tek oscilloscopes and CRT displays. Please see the "Video Product Guide" table for camera-to-product recommendations.

Useful with Other Products, Too
With its many various-size adapter hoods, the C-4 can also be used with other CRT-based instruments that aren't listed in the "Compatibility Guides." To help determine if there's an adapter hood to fit such products, check the hood front-lip dimensions in the "Adapter Hood Selection Guide" on the next page. (The hoods can fit around the CRT bezel or they can fit inside the bezel against the CRT face itself.)

Also use the same "Selection Guide" to determine if the "Scope Hood" has enough "Field of View" to fully record the CRT display.

CHARACTERISTICS

Aperture—f/32 to f/4.5 (continuously variable).
Lens—Four glass elements.
Focal Length—105 mm nominal (without hood).
Magnification—Dependent on hood. See Adapter Hood Selection Guide.
Resolving Power—At Center: At least 6 lines/mm. At Camera: At least 3 lines/mm.
Relative Light Gathering Ability—See Adapter Hood Selection Guide.
Field of View—Dependent on hood. See Adapter Hood Selection Guide.
Shutter—Mechanical; $^1/_{125}$ s to 1 s, and bulb.
Synchronization—X-sync switch closure occurs when the shutter reaches its fully open position.

C-4 VIDEO PRODUCT COMPATIBILITY GUIDE

The following lists compatibility currently tested. Please refer to pages 508 and 509 for determining compatibility with products not listed.

Display	C-4 Video Hood	
	Opt 11	Opt 12
Option 10 hood fits the 11401*1 and 11402*1 equivalent time scopes		
Tektronix: 4104(A), 4105(A), 4106(A), 4107(A)		✓
Ann Arbor Ambassador*1*4		✓
Apple II Monitor G0905	✓	
Apple MacIntosh Display	✓	
Compaq "Plus"*2	✓	
DEC VR-241*1		✓
DEC MATE II VR-201A*2*3*4		✓
Heathkit H-19*2		✓
IBM PC Jr. Monitor 4863*1		✓
IBM Color PC Monitor 5153		✓
IBM PC Portable	✓	
NEC JB-1201M Monitor		✓
Panasonic TR-930 Monitor	✓	
Quad Chrome Color Monitor		✓
Sony KV1217 Color Monitor		✓
Tandy Color Monitor 16-230	✓	
Zenith ZVM-122*2	✓	
Zenith ZVM-121*2*4		✓
Zenith ZVM-135		✓

*1 *Cuts off some of the CRT.*
*2 *Tends to have soft focus.*
*3 *Possible light leaks since CRT has less curvature than the hood.*
*4 *Optical distortion more noticeable.*

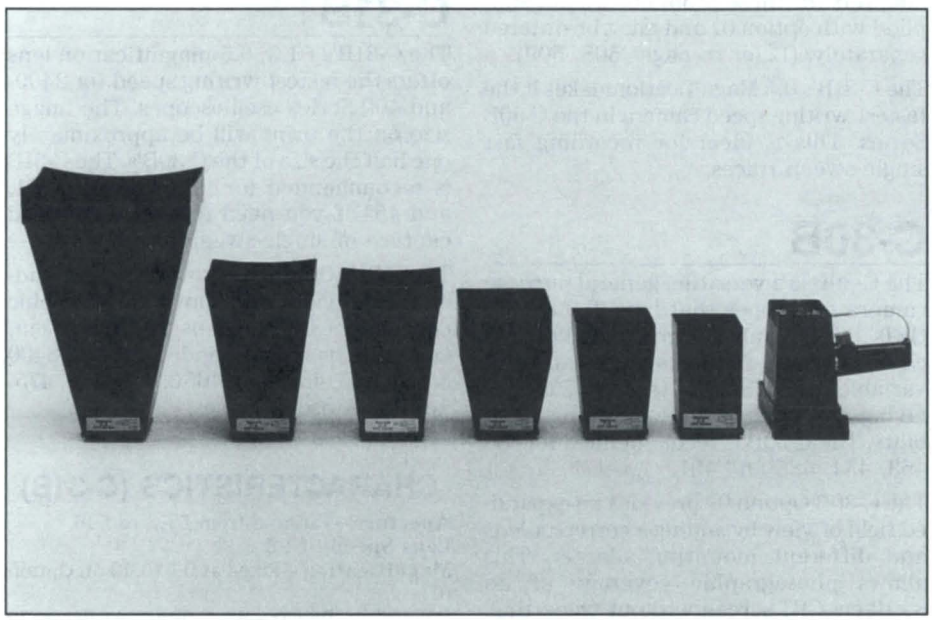
Note: Will not work on:
- *Tek: 4025, 4027, or 4050 Series.*
- *Tandy Computers with built-in CRTs.*
- *Apple IIc Monitor A2M2010.*

For additional hoods, see next page.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	180	7.4
Height		
With pistol grip	236	9.3
Without pistol grip	119	4.7
Depth		
With standard hood	363	14.3
Without standard hood	185	7.3
Weight ≈	**kg**	**lb**
Net		
With standard hood	1.0	2.1
Without standard hood	0.8	1.8

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.



C-4 Camera Body with hoods: (Left to Right) Option 12, Option 11, Option 10, Option 02, standard, and Option 03.

ORDERING INFORMATION

Additional hoods must be purchased separately. See Adapter Hood Selection Guide.

C-4 Camera **$410**

Includes: Body; Pistol Grip (122-0901-00); hood (122-0894-01); operator manual (070-5000-00).

OPTIONS

Option 01—Delete Hood (Body only). **– $45**

Option 02—Substitute 122-0895-01 Hood. **NC**

Option 03—Substitute 122-0896-01 Hood. **NC**

Option 10—Substitute 122-0897-01 Hood. **+ $40**

Option 11—Substitute 122-0898-01 Hood. **+ $40**

Option 12—Substitute 122-0899-01 Hood. **+ $65**

OPTIONAL ACCESSORIES

Split-Image Focus Plate—Fits into the pack film back (with no film loaded, useful to determine if image is properly in focus and entirely within the camera's field-of-view).
Order 387-0893-02 **$5.50**

Color Filter Kit—Consists of 40.5-mm screw-in 85B filter, corrects the color film balance for most color CRTs.
Order 122-0909-00 **$16**

For ordering films, see page 304.

Special pricing terms and conditions are available to qualified OEMs. Contact your local Tektronix Sales Engineer for complete information.

ADAPTER HOOD SELECTION GUIDE

Extend the C-4's flexibility with additional snap-on hoods

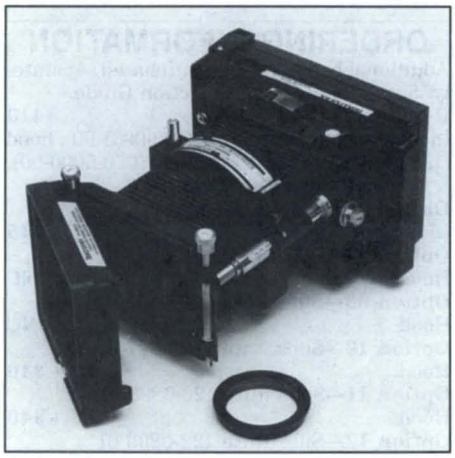
SCOPE HOODS

Scope Hood Part Number	Dimensions*1 Nominal Front Lip Height*3 mm	Height*3 in.	Width*3 mm	Width*3 in.	Hood Length*2*5 mm	Hood Length*2*5 in.	Relative Light Gathering	Field of View*1 (cm)	Magnification	Hood Net Weight kg	Hood Net Weight lb	Hood Price Only
122-0894-01 with Std C-4	108	4.2	122	4.8	178	7.2	0.15	9.1×11.87	0.8	0.1	0.3	$55
122-0895-01 with Option 02	132	5.2	143	5.6	206	8.1	0.18	10.4×13.5	0.7	0.2	0.4	$60
122-0896-01 with Option 03	80	3.2	100	3.9	171	6.8	0.14	8.0×10.0*2	0.85	0.1	0.3	$60

VIDEO HOODS

Video Hood Part Number	Dimensions*1 Nominal Front Lip Height mm	Height in.	Width mm	Width in.	Diagonal Inside mm	Inside in.	Outside mm	Outside in.	Hood Length*5 mm	Hood Length*5 in.	Magnification	Hood Net Weight kg	Hood Net Weight lb	Hood Price Only
122-0897-01 with Option 10	114*3	4.5*3	159*3	6.3*3	183	7.2	188	7.4	244	9.6	0.55	0.3	0.7	$ 90
122-0898-01 with Option 11	127*3	5.0*3	168*3	6.6*3	211	8.3	213	8.4	257	10.1	0.55	0.3	0.7	$ 90
122-0899-01 with Option 12	186*4	7.3*4	262*4	10.3*4	318	12.5	323	12.7	404	15.9	0.35	0.6	1.4	$110

*1 *Nominal dimensions.*
*2 *Image size is limited by front opening of the hood.*
*3 *For outside dimensions add 0.30 cm (0.12 in.) to each value. Each wall thickness nominally is 0.15 cm (0.06 in.).*
*4 *For outside dimensions add 0.14 in. to each value. Each wall thickness nominally is 0.07 in.*
*5 *From mounting surface to front lip.*



C-30 Option 01 (With Corrector Lens Off)

C-30 Series

BENEFITS

- **Adaptable to Many Instruments**
- **Fast Light-Gathering Ability, With C-31B (0.5 Mag)**
- **OEM Pricing on C-30B**

FEATURES

- **Cover 0.8 cm/div CRTs (Standard C-30)**
- **Optimized for 8×10-cm CRTs (C-30 Option 01)**
- **Continuously Variable Magnification (C-30B)**
- **Writing Speed Enhancer Available**
- **Interchangeable Backs**
- **Swings Away for CRT Viewing**

Dual swing-away hinges allow the camera to be swung out of the way, either to the left or right, for direct viewing of the CRT. The cameras are focused using a split-image focus plate placed inside the Polaroid back. Graflok back cameras use the Graflock's built-in viewing glass. Both use highly reliable mechanical shutters with a f/1.9 (C-30B) or f/1.2 (C-31B) lens.

The standard versions of the C-30B and C-31B are primarily for use on the older 400-Series portables that have 0.8 cm/div CRTs.

Option 01 adds a slip-on corrector lens and a different mounting adapter (016-0269-03) for coverage of 8x10-cm displays, such as for the 2400 Series, 465, etc. Option 01 can also be used on some 7000- and 5000-Series Lab scopes; 300 Series; Sony/Tek portables; and some 600 Series monitors. Appropriate mounting adapters for these products are not supplied with option 01 and must be ordered separately. (Refer to pages 508, 509).

The C-31B's 0.5 Magnificationmakes it the fastest writing speed camera in the C-30B Series. This is ideal for recording fast single-sweep traces.

C-30B

The C-30B is a versatile, general purpose camera for scopes that have 0.8-cm/div CRTs. It is the only Tektronix oscilloscope camera that features continuously variable magnification (from 0.7 to 1.5) giving you greater photographing flexibility. The C-30B is recommended for the 453, 454, 485 and 491.

The C-30B Option 01 provides an expanded field of view by adding a corrector lens and different mounting adapter. This allows photographic coverage of an 8×10-cm CRT screen without vignetting. Option 01 is recommended for the 2400 Series, 455, 464, 465, 465B, 466, 468, 475, and 475A oscilloscopes.

Option 01 is optimized for use at 0.8 mag only.

CHARACTERISTICS (C-30B)

Aperture—Variable from f/1.9 to f/16.
Lens Speed—f/1.9.
Magnification—Variable from 0.7 to 1.5 (0.8 magnification on Option 01 with C-30B set to 1.0 magnification).
Resolving Power—(at 1:1 magnification). At Center: At least 25 lines/mm. At Corners: At least 10 lines/mm.
Relative Light-Gathering Ability—1.0 (0.9 on Option 01).
Shutter—Mechanical; 1/125 to 1 s; bulb and time.
Synchronization Output—X-sync contact closure.
Field of View—Standard: 7.0×9.0-cm. Option 01: 8.0×10.0-cm.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	191	7.5
Height	130	5.1
Depth	254	10.4
Weight ≈	**kg**	**lb**
Net	2.2	4.8
Shipping	4.1	9.0

C-31B

The C-31B's f/1.3, 0.5-magnification lens offers the fastest writing speed for 2400- and 400-Series oscilloscopes. The image size on the print will be approximately one half the size of the C-30B's. The C-31B is recommended for the 453, 485, 491, and 454 if you need fast writing speed capture of single-sweep traces.

The C-31B Option 01 provides an expanded field of view. This allows photographic coverage of CRT screens up to 8x10-cm. Option 01 is recommended for the 2400 Series, 455, 464, 465, 465B, 466, 468, 475, and 475A oscilloscopes.

CHARACTERISTICS (C-31B)

Aperture—Variable from f/1.3 to f/16.
Lens Speed—f/1.3
Magnification—Fixed at 0.5 (0.43 on Option 01).
Resolving Power—At Center: At least 30 lines/mm. At Corners: At least 15 lines/mm.
Relative Light-Gathering Ability—2.7 (2.9 on Option 01).
Shutter—Mechanical; 1/125 to 1 s; bulb and time.
Synchronization—X-sync contact closure.
Field of View—Standard: 7 cm×9 cm. Option 01: 8 cm×10 cm.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	231	9.2
Height	140	5.5
Depth	269	10.6
Weight ≈	**kg**	**lb**
Net	3.1	6.8
Shipping	5.4	11.0

ORDERING INFORMATION

("P" denotes that the camera has a 3×4 in. pack film back. All models include Polaroid pack film back.)

C-30BP Camera **$1,600**
Includes: Polaroid pack film back with split image focus plate (122-0752-02); mounting adapter (016-0306-01); instruction manual (070-2825-00).
Option 01—Expanded Field of View. **+$65**
Includes: Same as C-30BP except with 016-0269-03 mounting adapter and corrector lens (352-0341 01).
C-31BP Camera **$1,860**
Includes: Same as C-30BP, except instruction manual 070-2869-00 instead.
Option 01—Expanded Field of View. **+$65**
Includes: Same as C-31BP except with 016-0269-03 mounting adapter and corrector lens (122-0980 00).

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

C30B/C31B continued

CONVERTING OPTION 01 MODEL TO STANDARD MODEL

The Option 01 versions of the C-30B and C-31B Cameras can be converted to standard models by simply removing the corrector lens, removing the mounting adapter, and adding the 016-0306-01 mounting adapter.

CONVERTING STANDARD MODEL TO OPTION 01 MODEL

A standard-model C-30A/B or C-31B can be converted to an Option 01 model by means of a conversion kit which contains a mounting adapter (016-0269-03) plus the appropriate corrector lens.

Std C-30A/B to Option 01—
Order 016-0301-01 **$115**

Std C-31B to Option 01—
Order 016-0269-04 **$110**

OPTIONAL ACCESSORIES (C-30 SERIES)

Mounting Adapters—See pages 508–509.

Writing-Speed Enhancer—(For C-30A/B and C-31B) Increases effective film speed about 3X for 3,000 speed film. Now supports 20,000 ASA (612) film. Installs in minutes. See page 506. Order 016-0284-02. **$290**

Polaroid Pack Film Back—Accepts Polaroid 3×4 in. pack film for C-30A and C-30B. Standard on "P" models. (Focus plate included.) Order 122-0752-02. **$200**

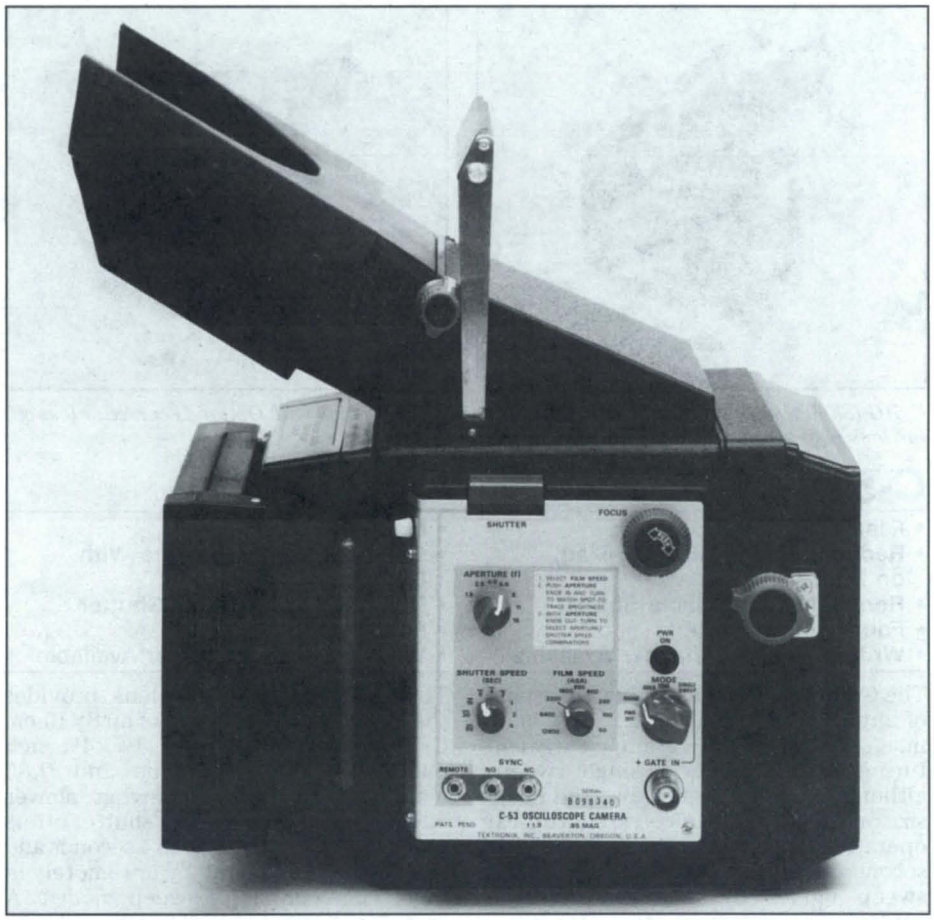
Split-Image Focus Plate—Order 387-0893-02. **$5.50**

Graflok Type 4 × 5 in. Back—Accepts Polaroid Land 4×5 in. film holders, standard cut-film holders, filmpack adaptors, roll-film holders (except heavy motorized roll film holders). Order 016-0487-00. **$275**
See page 506 for film holders which are required for operation.

Carrying Case—Molded high-impact plastic case with polyurethane foam liners to protect your camera in transit. 18.5×14.5×8 in. Order 016-0587-00. **$140**

X-Sync Cable—Order 012-0364-01. **$30**

Portrait 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 maximum distance of 21 in. the camera covers 19×21 in. Usable on the C-31A or C-31B). Order 016-0246-02. **$38**



C-50 Series

- **Electronic-Actuated Shutter (C-51, C-53)**
- **High-Resolution Images**
- **Photometer Exposure Aid**
- **Range-Finder Focusing**
- **Interchangeable Film Backs**
- **Swings Away From Scope**

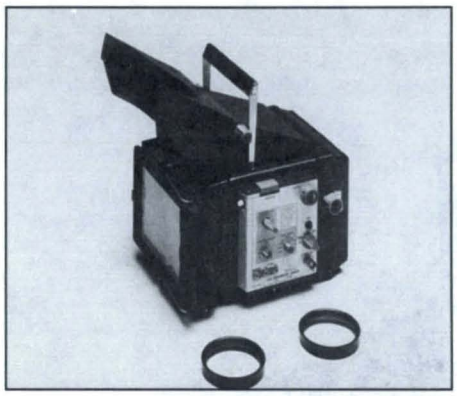
The Top of the Line

The C-50-Series cameras are designed for use with all Tektronix 7000-Series oscilloscopes, the 11301(A), 11302(A), and can be adapted to fit most 5000-Series oscilloscopes and other Tek instruments. Full selection of film backs, and adjustable film and shutter speeds provide the flexibility to best record your measurements. The photometer exposure aid, similar to light meters used in conventional photography, provides an easy way to approximate the correct exposure for repetitive or stored traces. X-sync connectors allow the camera shutter to trigger the event. The camera's built-in viewing tunnel lets you see what's on the display when the camera is in place.

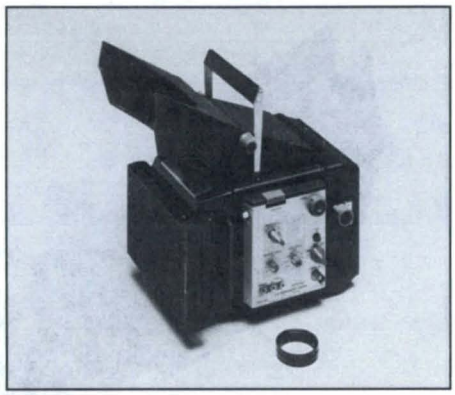
The camera shutter (C-51 and C-53) is electrically actuated, open and close, by shutter button or remotely through a remote-input connector located on the side control panel.

When a C-50-Series camera is used with Tektronix 7000-Series, 11301(A) or 11302(A) oscilloscopes, a three-pin connector in the scope bezel applies power to the camera and receives from the camera a pulse for resetting the scope sweep when the scope and camera are both in single-sweep mode. Also, when the scope and camera (C-51 and C-53 only) are in the single-sweep mode, the "+gate" output from the scope can be applied to the "+gate" input connector on the camera to close the shutter five seconds after the end of the scope sweep.

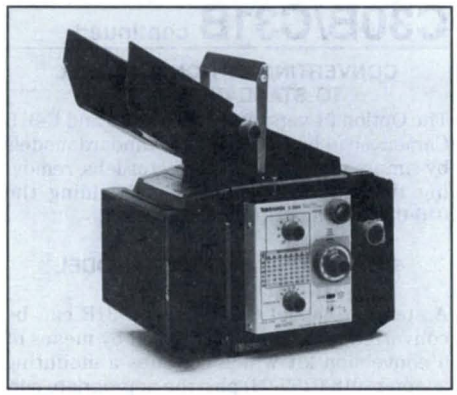
The C-51 and the C-53 are available in ruggedized versions. Contact your Tektronix Sales Office for further details.



C-51G (Shown with Option 11 and 12 corrector lens off)



C-53P (Shown with Option 11 corrector lens off)



C-59AP

C-51

- **Fastest Writing Speed**
- **Reduced Image Size (0.5 Mag) on Print**
- **Remotely Controllable Shutter**
- **Foot Switch Available**
- **Writing Speed Enhancer Available**

The C-51 offers the fastest writing speed of any Tek camera. The f/1.2 lens shoots images at 0.5 magnification, clearly capturing fast transients or single sweeps, although at some expense to the image size on the film. The electric shutter can operate at speeds ranging from 1/60 to 4 seconds and offers bulb, time, and single-sweep modes by manual or remote control. Two screw-on connector lenses for 11301(A)/11302(A) compatibility are available.

C-53

- **Medium Speed**
- **General-Purpose Camera With 0.85 Mag**
- **Remotely Controllable Shutter**
- **Foot Switch Available**
- **Writing Speed Enhancer Available**

The C-53, with 0.85 mag lens, provides the largest practical image of an 8×10-cm CRT display on Polaroid 3¼×4¼-inch pack film. Its f/1.9 lens and 0.85 magnification offer somewhat slower writing speed. The electric shutter offers speeds ranging from 1/60 to 4 seconds and can be operated manually or remotely in bulb, time, or single-sweep modes. A screw-on corrector lens is available for 11302(A) compatibility.

C-59A

- **For Larger CRTs (0.67 Mag)**
- **Mechanical Shutter**
- **Lowest Priced C-50 Series**
- **Photometer Exposure Aid**
- **Range-Finder Focusing**
- **Internal Battery or External Power**
- **OEM Pricing Available**

The C-59A is designed for CRTs up to 6½ inches (10.2×12.7-cm field of view with Polaroid pack film). With the 016-0288-01 kit, the field of view is expanded to fully cover the display and adjacent scale readout characters of the Tek 576 Curve Tracer and 5000-Series scopes. Many of the features of the higher priced C-50-Series are standard on the C-59A: photometer exposure aid, range-finder focusing, bulb/time operating modes, x-sync contacts, and film-back interchangeability.

CHARACTERISTICS

	C-51	C-53	C-59A
Aperture (Variable)	f/1.2 to f/16	f/1.9 to f/16	f/2.8 to f/16
Magnification	0.5	0.85	0.67
Resolving Power			
Center	At least 30 lines/mm	At least 30 lines/mm	At least 10 lines/mm
Corners	At least 15 lines/mm	At least 15 lines/mm	At least 4 lines/mm
Relative light Gathering Ability	3.0	1.0	0.65
Shutter	Electric; 1/60 to 4 s, bulbtime, and single-sweep modes, manual or remote control. Scope's "gate" is used for shutter actuation.		Mechanical; 1/125 to 1 s bulb time.
Synchronization	x-sync switch closure	x-sync switch closure	x-sync switch closure
Power Requirement	+15V from 7000 Series, 11301(A), or 11302(A) oscilloscopes, or an optional battery pack*[1]		
Field of View	8x10 cm (with pack film)		10.2 x 12.7 cm (wider with 016-0288-01 adapter frame/corrector lens)

*[1]*C-59A has an internal battery holder (352-0355-00), 8AA size alkalines required (12V).*

PHYSICAL CHARACTERISTICS

	C-51		C-53		C-59A	
Dimensions	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**
Width	248	9.8	191	7.5	193	7.7
Height	292	11.5	292	11.5	292	11.5
Depth	273	10.8	273	10.8	273	10.8
Weight ≈	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
Net	4.3	9.5	2.4	7.5	3.2	7.0
Shipping	6.8	15.0	5.4	12.0	5.0	11.0

See next page for ordering information.

C50 Series

ORDERING INFORMATION

"P" Models accept only Polaroid pack film. "G" Models have a Graflok-type back that requires a film holder.

Note: Optional battery pack (016-0270-02) is required when C-51 or C-53 are used on other than 7000 Series or 11301(A)/11302(A) scopes. Battery holder (352-0355-00) is supplied standard on C-59A. All C-50 Series battery packs require eight AA size alkaline batteries (not included).

C-51G Camera **$2,600**
Includes: Mounting adapter for all 7000, 5000, 11301(A)/11302(A) and small 600 Series (016-0249-06); camera visor (337-0411-02); Graflok film back (122-0931-01) with integral focusing screen; instruction manual (070-1011-03).

C-51P Camera **$2,510**
Includes: Same as C-51G except it has a Polaroid pack film back (122-0926-02) instead of Graflok film back, and a focus plate (387-0893-02).
Option 11*- Corrector lens for 11301(A) **+$90**
Option 12*[1] Corrector lens for 11302(A) **+$90**

C-53P Camera **$2,090**
Includes: Same as C-51P.
Option 11- Corrector lens for 11302(A) **+$90**

C-59AG Camera **$1,500**
Includes: Same as C-51G except instruction manual (070-3632-00).
Option 11- Corrector lens for 11301(A) **+$90**

C-59AP Camera **$1,475**
Includes: Same as C-51P, except instruction manual (070-3632-00)
Option 11- Corrector lens for 11301(A) **+$90**

C-59A Kit for 576 and 5030 Series— Expands the field of view to fully cover the 6½-inch CRT and adjacent scale readout characters of the 576 Curve Tracer and 5030-Series oscilloscopes. The slip-on corrector lens (352-0293-00) reduces the effective magnification of the C-59 from 0.67 to 0.5 so it can record the entire display on Polaroid 3½×4½-in. film (for the C-59A camera only). Adapts camera to 576, 5030, and 5031.
Order 016-0288-01 **$195**

*[1] *One or both options can be ordered.*

C-50 SERIES OPTIONAL ACCESSORIES

11301(A)/11302(A) Connector Lenses—These lenses easily screw in or snap on the camera lens. No additional tools required.
(C-51/11301(A)) Order 122-1043-00 **$90**
(C-51/11302(A)) Order 122-1044-00 **$90**
(C-53/11302(A)) Order 122-1045-00 **$90**
(C-59A/11301(A)) Order 122-1046-00 **90**

Mounting Adapters—See pages 507-508.

Battery Pack—Provides auxiliary +15-V power source for using the C-51, C-53 Cameras with oscilloscopes without 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. Includes three-pin female connectors for external power in (131-0716-00). Net weight, including batteries, is 1.2 lb. Requires eight AA size alkaline batteries (not included). Order 016-0270-02. **$340**

Writing Speed Enhancer—Provides controlled film fogging to increase writing speed by 3× for 3,000 ASA film and ≥3.5× with 20,000 ASA film. Installs in minutes. See page 504 for more information.
(C-51) Order 016-0279-02 **$270**
(C-53) Order 016-0300-02 **$290**
(C-59A) Order 016-0290-02 **$300**

X-Sync Connnector Plug—Not shown. Order 134-0079-00 **$1.50**

Foot Switch—For Remote Shutter Actuation of the C-51, C-53, with 8-ft. cable. Order 260-1189-02 **$22.50**

Carrying Case—Holds a complete C-50 Series camera with extra film backs and accessories. Order 016-0177-00 **$285**

Polaroid Pack Film Back—Included with "P" models. Order 122-0926-02 **$195**

Focus Plate—Included with "P" models. Order 387-0893-02 **$5.50**

Graflok Type Film Back—Included with "G" models (requires a film holder, see this page), accepts Polaroid 4×5-in. film holders, standard cut-film holders, film-pack adapters, roll-film holders*[1] (except heavy motorized models). Includes integral focusing screen.
Order 122-0931-01 **$265**

*[1] *Other film holders and adapters (4×5-cm cut-film, back film, or roll film) are available at local camera stores.*
*[2] *Contact your local Sales Office.*

OPTIONAL FILM HOLDERS FOR GRAFLOK TYPE BACKS (C-50 Series "G" Models or C-30 Series with Graflok Back)

Cameras with Graflok type backs must have a film holder in order to be functional.

There are several holders*[1] that allow the use of roll film, or 4×5-in. Polaroid films. Order these holders from Tek, the manufacturer, or from your local camera store.
Polaroid Land #545 4×5 in. Film Holder—For Polaroid 4×5 in. Single Exposure Film Packets.
Order 016-0201-01 **$285**
RH/10 120 Roll-Film Holder—Ten exposures 2½×2¾-in. for 4×5-in. Graflok backs.
Order 122-0736-01 **$385**

Roll film holders are also manufactured by several other companies.

*[1] *Other film holders and adapters (4×5-cm cut film, pack film, or roll film) are available at local camera store.*

The following film holders are available only through Polaroid (1-800-343-5000 in the U.S.).
Polaroid #550 Film Holder—For Polaroid 4×5-in. pack films. Holder fits most 4×5 cameras and instruments equipped with Graflok backs, which accept conventional 4×5-in., film holders.
Polaroid #405 Film Holder—For Polaroid 3¼×4¼-in. pack films. Holder fits most 4×5-in. cameras or instruments equipped with Graflok backs, which accept conventional 4×5-in. film holders.

THE STRONGEST LINK BETWEEN YOUR TEK INSTRUMENT AND RESULTS

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Tek instruments are designed for users who place a premium on equipment quality and on reliability of results. Tek probes are engineered, assembled and tested to provide the most compatible link possible between tests instruments and the circuits under test.

No factor is more critical to optimized system performance than proper probe selection. A probe that's not right for your application can mean a significant loss in measurement results, plus costly delays and errors.

For over 35 years, Tektronix had been designing probes that are matched not only to our scopes, but to your own instrument and application needs. Tektronix offers both Fixtured and Handheld probes to help you optimize signal quality, from the device under test, to the scope.

Tektronix Fixtured mounted probes are designed specifically for ATE, manufacturing, and other application areas that require testing, either singularly or automatically, of circuit boards, hybrids, IC's, SMD's, or applications which require high density probing.

Tektronix is continually expanding its line of Handheld probes for higher bandwidths, lower circuit loading, reduced aberrations, and increased ruggedness. This helps extend and enhance system performance. By extending our resistive-wire, center-conductor cable technology, Tek 10X Passive probes can transfer a signal frequency that exceeds 400 MHz and presents minimal loading to the circuit.

Tektronix modular probes are designed to save you money in repair and maintenance over the life of the probe. With modularity, you can replace only the part of the probe that is defective. The modules (probe head, cable, and connector/compensation box) quickly snap or screw together eliminating the need for soldering or special tools. Spare modules can be ordered and stocked, reducing downtime or the need to ship it back for repair (see page 545). Modularity, rugged construction and highly reliable hybrid circuitry make Tektronix probes a cost effective solution to your signal acquisition needs.

You can depend upon Tektronix probes for quality and reliability. To back this up, all Tektronix probes carry a one (1) year warranty from the date of shipment.

Tektronix also offers a wide variety of adapters and probe tips which feature Tek's special alloy coating that minimizes low current conduction problems. These adapters allow you alternative means to select the right adapter for acquiring the signal from the device under test.

PROBE SELECTION

Bandwidth/rise time, input voltage, input impedance/circuit loading and aberrations are all characteristics to evaluate in terms of your own application. While electrical considerations are of major importance in your selection, physical parameters, such as probe length and proper tip adapter, can be equally crucial. Unecessary cable length for example, will decrease bandwidth and increase the loading capacitance of the probe.

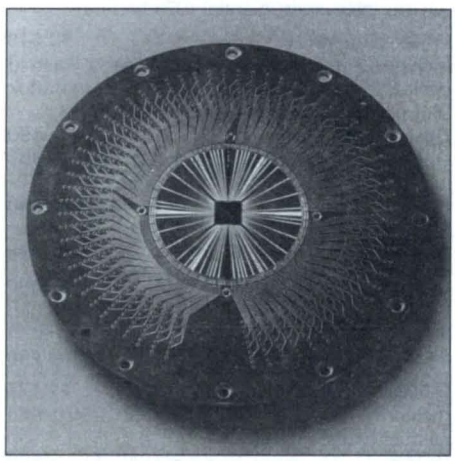
THE ABCs OF PROBES

A comprehensive primer on signal acquisition probes with sections on understanding probe specifications, applications, and how to select the best probe for your application. Easy to use charts and tables speed the selection process.

For your free copy, ask your Tektronix Sales Engineer for Literature 60-W-6053 or call toll-free in the U.S.A. 1-800-426-2200. In Oregon, call collect (503) 627-9000.

PROBE AND SIGNALS CONCEPTS

A 53 minute video tape with a 40-page booklet describes practical uses of passive, active, and current probes. Emphasis is on selecting the correct probe for your application. The video tape is available in 3/4 inch U-MATIC, Beta, or VHS format. To order, contact your local Sales Representative and request part number 068-0229-XX (specify tape format: -00 3/4 inch U-MATIC, -01 Beta, -02 Beta II, -03 Beta III, -04 VHS). Additional booklets are available at $1.50 each under Literature number 60-W-6770.



Very High Density Wafer Probe Card

P6521

Very High Density Probe Card

TYPICAL APPLICATIONS

- **VLSI Testing**

FEATURES

- **AC Die Sort at Probe**
- **Controlled Impedance to Probe Tip**
- **2 GHz, 175 ps Risetime**
- **Decoupling: <800 Mils from Die**
- **Low Maintenance**
- **Density**
  - **>360 Contacts**
  - **4 Mil Pitch**

The VHD Probe Card is used for AC/DC die-sorting at wafer probe to guarantee performance prior to packaging. Whether the problem is excessive packaged costs, interconnected unpackaged ICs (on a substrate, a hybrid) with critical AC speeds, or a required reprobing of the die, the P6521 Probe Card is the solution.

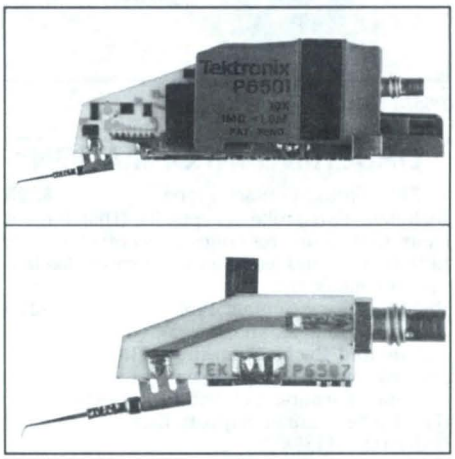
Contact your local Sales Office for further information on the P6521.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

FIXTURED MICROPROBES FOR IC, HYBRID, AND SMD CIRCUITS

P6501
1 MΩ Fixture Mountable Active Probe

P6507
50 Ω Fixtured Mountable Probe



P6501 (top) and P6507.

P6501

- **DC to 750 MHz Bandwidth**
- **<1.8 pF Capacitive Loading**
- **1 MΩ Input Resistance**
- **10X Attenuation**
- **Probe Card Mountable**
- **Replaceable Probe Tips**
- **Hybrid, IC, and SMD Probing**

The P6501 Microprobe is a 1 megohm input active probe optimized for probe card mounting and use with probing stations. Its very low profile (about 0.5 in. high) avoids interference with the objective lenses of microscopes and lasers. The narrow body (about 0.100 in. wide) makes it well suited for high-density probing applications.

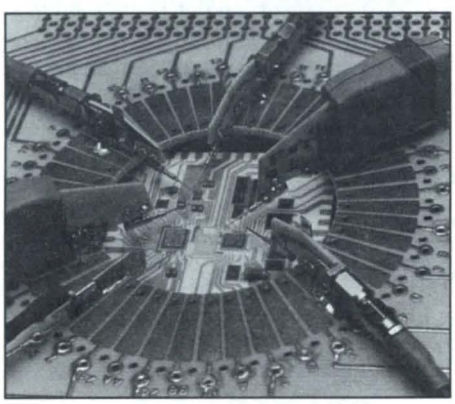
Power and signal cables to the probe attach through connectors for convenient set up and storage of probe cards between uses. The 50-ohm coaxial signal cable uses a miniature 50-ohm connector at the probe end and a BNC connector on the instrument end. Allowance for a minimum-length ground reference connection is built into the probe. The P6501 requires an external power supply capable of supplying ±15 V at 20 mA and ±5 V at 17 mA. Option 01 includes a power supply which plugs directly into a 115 V, 60 Hz line and powers one P6501 probe. Option 02 includes a TEKPROBE™ interface cable which allows the P6501 to be powered by 11000 Series plug-ins. The Tek 1102 power supply provides power for up to four P6501's. See page 520 for ordering information. No external power supply is required with Option 02.

P6507

- **DC to 1 GHz Bandwidth**
- **50 Ω Input**
- **1X Attenuation**
- **Probe Card Mountable**
- **Replaceable Probe Tips**
- **Hybrid, IC, and SMD Probing**

The P6507 Microprobe is a 50-ohm input probe and companion to the P6501. The probe can be used as either a 50-ohm input or output probe in card-mounted applications. It consists of a 30 mil thick Alumina hybrid substrate with a 50 ohm-stripline.

The P6507 maintains a low profile thus allowing use of multiple probes in dense microprobing of hybrids, wafers, and other high density circuits. The P6507 uses a miniature 50 ohm connector to help eliminate troublesome hand soldering coaxial cables to the microprobes.



CHARACTERISTICS

	P6501	P6507
Bandwidth	750 MHz	1 GHz
Rise Time	450 ps	350 ps
Attenuation	10X	1X
Input R	1 MΩ	50 Ω
Input C	≤1.8 pF	N/A
Dynamic Range	±10 V	N/A
Maximum Nondestructive Input Voltage	±26.5 V	±42.5 V
Power Supply Requirements	±15 V at 20 mA, ±5 V at 17 mA	N/A

ORDERING INFORMATION

P6501 1 MΩ Active Microprobe **$495**
Includes: Two tungsten probe tips (206-0371-01); Ground lead (196-3141-00); Instruction sheet (070-6300-00).

OPTIONS

Option 01— Add 115 V ac, 60 Hz power supply and 1.5 m 50 Ω cable. **+$155**
Option 02—Add Tekprobe™ cable (015-0540-00). **+$155**
Option 03—Micropositioner Beam Adapter **+$150**
P6507 50 Ω Microprobe **$50**
Includes: One tungsten probe tip (206-0371-01); instruction sheet (070-6301-00).

OPTION

Option 01—Add 0.5 m 50 Ω cable. **+$30**

OPTIONAL ACCESSORIES

P6501

Manual—Order 070-6188-00 **$10**
Power Supply—Order 119-2461-00 **$130**
50 Ω Cable—Miniature to BNC, 1.5 m. Order 174-0538-00 **$30**
Ground Lead Assembly—Order 196-3141-00 **$3.10**

P6507

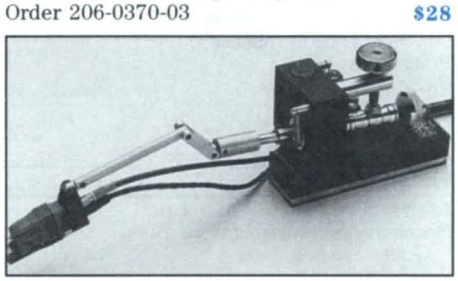
50 Ω Cable—Miniature to BNC 0.5 m. Order 174-0668-00 **$30**
Ground Lead Assembly—Order 196-3141-00 **$7**

REPLACEABLE TIPS

The P6507/P6501 use the same replaceable tips and connectors. The replaceable tips offer versatility and long life. Both tungsten and palladium tips are available, conveniently plugging into the probe's input receptacle. Tips can be easily replaced as they wear, or as different applications dictate. Tips are available in two lengths. Standard tips extend 0.200 in. from the connector plug. Long tips extend 0.458 in. from the connector plug.

Standard Length

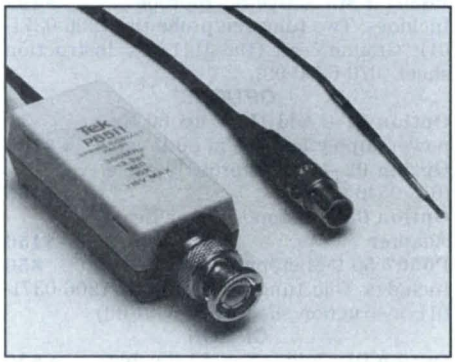
Tungsten Probe Tip—Pkg of 5. Order 206-0371-02 **$28**
Palladium Probe Tip—Pkg of 5. Order 206-0370-02 **$28**
Tungston Probe Tip—Long Length Pkg of 5. Order 206-0371-03 **$28**
Palladium Probe Tip—Pkg of 5 Order 206-0370-03 **$28**



P6501 shown with Option 03 (Micropositioner Beam)
Note: Micropositioner arm is not included.

NEW

P6511/P6513/ P6515/P6517



P6511 shown.

TYPICAL APPLICATIONS

- **Bed-of-Nails Fixture Testing**
- **Other Fixtured Applications Which Require High B/W, Low Loading**

FEATURES

- **High Impedance (1 MΩ, <3.8 pF for P6511/P6513) (<40 pF for P6515/P6517)**
- **Drives 50 Ω Coax Cable**
- **DC to 300 MHz Bandwidth (250 MHz for P6515/P6517)**
- **Standard 100 MIL or 25.4 mm Spacing (P6511, P6513)**
- **Standard 50 MIL or 12.7 mm Spacing (P6515, P6517)**
- **Automated Scanning Available**

The P6511, P6513 are 10X, DC-to-300 MHz (DC-to-250 MHz for P6515, P6517) probes designed for placement into a bed-of-nails fixture or other fixtured applications. The probe is designed for low circuit loading and high-bandwidth signal acquisition. This enables acquisition of ac parametric waveform information from high-impedance test points.

Electrically, the probe consists of a high impedance spring-loaded contact receptacle and active circuitry to drive a 50 ohm transmission line. The probe's spring contact receptacle allows the user to interchange spring contacts to accommodate a variety of different tip configurations.

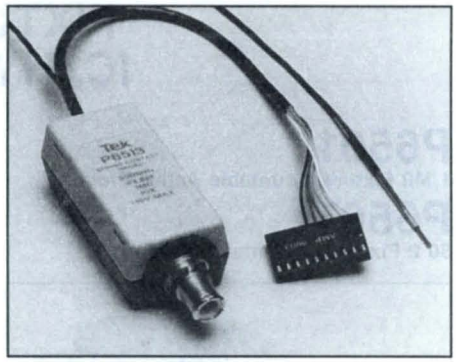
P6511/P6515 has a standard twist-on BNC; the P6513/P6517 has a push-on BNC for ease of connection when used within the TSI 8150 System. Power connection is made with a Berg connector for the P6513/P6517. The P6511/P6515 uses a DIN connector for power.

Programmable P6513/P6517 scanning is provided by the TSI 8150 product line. Complete support packages, including probe power, are available in 12-probe multiples. These packages facilitate use of the probes in automated testing applications such as functional board test. The probe receptacle's diameter permits mounting on 100 MIL (50 MIL for P6515/P6517) centers, used in most circuit board testing.

CHARACTERISTICS

ELECTRICAL	P6511/P6513	P6515/P6517
Bandwidth	300 MHz	250 MHz
Rise Time	<1.17 ns	<1.4 ns
Attenuation	10X	
Input R	1 MΩ	
Input C	≤3.8 pF	≤4.0 pF
Dynamic Range	±15 V	
Maximum Nondestructive Input Voltage	±30 V at dc	
Power Supply Requirements	±15 V at 30 mA/±5 V at 45 mA	
Low-Frequency Compensation	Fixed, flat ±3%	
Propagation Delay	3.8 ns±100 ps	
Probe Aberrations	<±6%, 8% p-p in the first 4 ns <±2%, 3% p-p after 4 ns	
Output Zero	±2 mV	
DC Thermal Drift	<50μV/°C	

PHYSICAL		
Net Weight	55 g (2.0 oz)	
Recommended Minimum Center Spacing	0.100 inches (25.4 mm)	0.05 inches (12.7 mm)
Full Travel	0.240 inches	0.190 inches
Recommended Travel (⅔ Full)	0.167 inches	0.127 inches
Spring Force—Pre-loaded	2.0 oz	1.2 oz
⅔ Travel	5.5 oz	3.5 oz
Mounting Hole diameter	0.067 to 0.069 inches	0.037 to 0.038 inches
Recepticle (outside diameter)	0.066 inches	0.036 inches



P6513 shown

ORDERING INFORMATION

P6511—Spring Contact Probe **$225**
Includes: Two probe receptacles (that have a short tail), four ground-lead receptacles (long tail), four ground leads, and five spring-loaded, crown contact tips.

P6513—Spring Contact Probe **$225**
Includes: Same as P6511.

Automated Probe Scanning—Three packages are available to support automated scanning of P6513 probes.*1
(ITA Probe Scanner Support Kit) Order 021-0443-00.*1
(ITA Receiver Power Probe Scanner Support Kit) Order 021-0444-00*1
(ITA/Receiver Probe Scanner Expansion Kit) Order 021-0444-20.*1

P6515—Spring Contact Probe*1
Includes: Five receptacles, two signal leads, four ground leads, and five 50 MIL spring-loaded, crown contact tips.

P6517 Spring Contact Probe*1
Includes: Same as P6515, except for 50 MIL centers.

An optional unterminated conntector P/N 131-4408-00 is available so the P6511/P6515 can be powered from other power supplies.

Additional receptacles and tips may be purchased separately from Tektronix. Contact tips are also available with various point styles and may be ordered directly from various vendors such as Q.A. Technology Inc. or Everett/Charles by requesting 2500-Series compatible spring contacts.

*1 *Contact your Tek sales representative for more information.*

NEW 1102 Power Supply

The Tektronix 1102 Power Supply will provide power for up to four P6511s or P6515s.

The 1102 Power Supply's electrical characteristics are identical to the 1103 power supply's characteristics (see page 528).

ORDERING INFORMATION

1102 Accessory Power Supply **$300**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

A PROBE FOR VIRTUALLY EVERY APPLICATION

Tektronix offers many probes for your different probing requirements. This guide lists those probes which offer the best performance match, along with other usable combinations.

	Passive																		Active						Differ-ential			High Voltage			Spe-cialty			Current					
	P6006	P6008*3	P6028	P6048	P6053B	P6056/57	P6060	P6062B	P6063B	P6101A	P6102A	P6105A	P6106A	P6107A	P6108A	P6122	P6130	P6134	P6156	P6201*4	P6202A*4	P6203	P6204	P6230*4	P6231	P6055	P6046	A6902B	P6007	P6009	P6015	P6420	P6601	P6125	P6021*1	P6021*2	P6022*1	P6022*2	A6302*5	A6303*5
11000 Series																																							
11A32					–	+			–	R								S	R	+	+	+	+		+		–	–		–				–	–	–	–	–	–
11A33*9					+	+			+	R								+	R	+	+	+	+		+		–	–		–				–	–	–	–	–	–
11A34					–	+			–	R								S	R	+	+	+	+		+		–	–		–				–	–	–	–	–	–
11A52						+													R	+	+	R	R		S		–	–							–		–	–	–
11A71						+													R	–	–	R	R		S		–	–							–		–	–	–
7000 Series																																							
7A13	–	–	–	–	+		–	–	+	R		R	+	–	–	–	+			+	+			+		R	–	–	–	–	–				–	–	+	–	–	–
7A15A	–	+	–	+	+		–	+	+	R		R	+	+	+	R	+			+	+			+		–	+	–	–	+	–				–	–	+	–	–	–
7A16A	–	–	–	–	–		–	–	–	R		–	R	–	–	–	R			+	+			+		–	+	–	–	–	–				–	–	–	–	–	–
7A18A	–	+	–	+	+		–	+	+	R		+	+	+	+	+	+			+	+			+		–	+	R	–	+	R				–	–	+	–	–	–
7A19						R													R	+	–			+			–	–								–		–	–	–
7A22	+	+	+				+	+	+	R	+			+						+	+					R	+	+	+	+	+				+	+	+	+	+	+
7A24						R													R	+	+			+			–									–		–	–	–
7A26	–	–	–	–	R		–	–	R	R		–	+	–	–	–	+			+	+			+		–	–	–	–	–	–				–	–	+	–	–	–
7A29/P						R													R	R	–			+			–									–		–	–	–
7A42	–	–	–		–	R	–	–	–	R		–	R	–	–	–	R		R	+	R			R				–	–	–	–				–	–	–	–	–	–
7D12	+	+	–	+	+		+	+	+	R		+	+	+	R	+	R			+	+			+		S	+	–	–	+	+				+	+	+	+	+	+
7D13A																																R	S							
7D20	–	+	–	+	R		–	+	+	–		+	+	+	+	+	+	+		+	+			+		–	+		–	+	+				–	–	–	–	–	–
5000 Series																																							
5A13N	+		+				+			R	R			+						+	+			+			+	+	+						+	+	+	+	+	+
5A14N/15N/18N	+	+	+				+	R		R	R			+						+	+			+			+	+	+	+	+				+	+	+	+	+	+
5A21N	+	+	+				+	+		R	R			+						+	+			+		R	+	+	+						S	+	+	+	+	+
5A22N	+	+	+				+	+		R	R			+						+	+			+		R	+	+	+	+	+				+	+	+	+	+	+
5A26	+	+	+				+	+		R	R			+						+	+			+		R	+	+	+	+	+				+	+	+	+	+	–
5A38	–	+	–	+	+		+	+	+	R		R	+	+	+	+	+			+	+			+			+	R	–	+	+				+	–	+	+	–	–
5A45	–	+	–	+	+		–	+	+	R		+	+	+	+	+	+			+	+			+		+	+	–	–	+	+				+	–	+	+	+	–
5A48	–	+	–		+		–	+	+	R		R	+	+	+	+	+			+	+			+			+	R	+						+	+	+	+	+	+
5D10	+	+	+				+	+		R	R			+						+	+			+		+	+	+	+	+	+				+	+	+	+	+	+
TM 500 Series																																							
AM 502	+	+	+				+	+		+	+			+						+	+			+		R	+	+	+	+	+				+	+	+	+	+	+
AM 503																																						R	R
DM 501A																																R	S							
DM 502A																																R	S							
DM 505																																R	+							
SC 501	+	+	+				+	R		R	R			+						+	+			+		+	+	+	+	+	+				+	+	+	+	+	+
SC 502	+	+	+				+	R		R	R			+						+	+			+		+	+	+	+	+	+				+	+	+	+	+	+
SC 503	+	+	+				+	R		R	R			+						+	+			+		+	+	+	+	+	+				+	+	+	+	+	+
SC 504	–	+	–	+	+		–	R	+	R		R	+	+	+	+	+			+	+			+		–	+	–	–	+	–				–	–	+	–	–	–
TM 5000 Series																																							
DC 5009	–	–	–				–	–		–		–	+	–	–	–	+			+	+			+		–	–	–	–	–	–			R	–	–	+	–	–	–
DC 5010	–	–	–	–	–		–	–	–	–		–	–	–	–	–	–			+	+			+		–	–	–	–	–	–			R	–	–	–	–	–	–
DM 5010																														+	R									
SI 5010						R													R	+	R			R			–	–								–		–	–	–

S Indicates probe shipped with product or instrument option.
R Indicates recommended best combinations of probes and instruments.
+ Indicates usable combinations where probe bandwidth exceeds that of instrument.
– Indicates usable combinations where probe bandwidth is less than scope and may limit system bandwidth.
Blank indicates not recommended combinations.

**1 With Termination*
**2 With 134 Amplifier*
**3 Environmental Probe*
**4 May require 1101A power supply*
**5 With AM 503*
**6 P6133/P6136 or P6133 Opt. 25/P6136 Opt. 25*
**7 465M Standard Probe P6104A/P6101A*
**8 Requires 1103 TekProbe power supply.*
**9 11A33 standard probe P6135 differential pair.*

THE ABCs OF PROBES

This is a comprehensive booklet discussing signal acquisition probes with sections on understanding probe specifications probe applications, and how to select the best probe for your application. Includes easy to use charts and tables to help speed your selection process for the correct probe for your signal acquisition needs.

For your free copy, ask your Tektronix Sales Engineer for Literature 60-W-6053 or call toll-free in the USA 1-800-426-2200. In Oregon, call collect (503) 627-9000.

	Passive																						Active			Differential		High Voltage			Specialty		Current					
	P6006	P6008*3	P6028	P6048	P6053B	P6056/57	P6060	P6062B	P6063B	P6101A	P6102A	P6103	P6105A	P6106A	P6107A	P6108A	P6109	P6121	P6122	P6130	P6131	P6133*6	P6136*6	P6137	P6149A	P6201*4	P6202A*4	P6230*4	P6046	A6902B	P6007	P6009	P6015	P6420	P6602	P6021*1	P6021*2	P6022*1	P6022*2	A6302*5	A6303*5
T900 Series																																								
T912/21	S	+	R				+	+		R			+	+	+	+			+	+						+	+	+			+	+	+			+	+	+	+	+	+
T922R	S	+	R					+		R			+	+	+	+			+	+						+	+	+			+	+	+			+	+	+	+	+	+
T932A/35A	R	+	R				+	+		R			+	+	+	S			+	+						+	+	+			–	+	+			+	+	+	+	+	–
300 Series																																								
305/14	+	+	+				+	+		R	+				+										S	+	+	+			+	+	+			+	+	+	+	+	+
335	–	+	–		+		+	+		R			+	+	+	+			+	+					S	+	+	+			+	–	+			+	+	+	+	+	–
336	–	+	–				+	+		R			+	+	+	+			+	+					R	+	+	+			–	+	+			+	–	+	+	–	–
390AD D	–	+	–		+		+	R		R		R	+	+	+	+			+	+						+	R	R			–	+	+			+	+	+	+	+	–
390AD S	–	+	–		+		–	R		R		R	+	+	+	+			+	+						+	+	+			–	+	+			+	–	+	+	–	–
400 Series																																								
434	R	+	–	+	–		+	+	+	R			S	+	+	+	+	+	R	+						+	+	+			–	+	+			+	+	+	+	+	–
455	–	+	–	+	–		–	+	+	R			S	+	+	+	+	+	+	+						+	+	+			–	+	+			+	–	+	+	–	–
464	–	+	–	+	–		–	S	+	R			R	+	+	R	+	R	R	+						+	+	+			–	R	–			–	–	–	–	–	–
465/M*7	–	+	–	+	–		–	R	+	S			R	+	+	R	+	R	R	+						+	+	+			–	R	–			–	–	–	–	–	–
465B	–	+	–	+	–		–	R	+	R			S	+	+	R	+	R	R	+						–	+	+			–	R	–			–	–	–	–	–	–
466	–	+	–	+	–		–	R	+	R			S	+	+	R	+	R	R	+						+	+	+			–	R	–			–	–	–	–	–	–
475	–	–	–	–	–		–	–	R	R			–	S	–	–	–	–	–	+						+	R	+			–	R	–			–	–	–	–	–	–
475A	–	–	–	–	–		–	–	R	R			–	S	–	–	–	–	–	R						+	R	+			–	R	–			–	–	–	–	–	–
485	–	–	–	–	–	+	–	–	R	R			–	–	–	–	–	–	–	R						+	R	+			–	R	–			–	–	–	–	–	–
2200 Series																																								
2205	+	–	–	+	+		+	R	+	R		R	+	+	+	+	+	+	R	+						+	+	+			–	–	–			–	–	–	–	–	–
2213A/15A	–	+	–	+	+		–	+	+	R			+	+	+	+	S	+	R	+						+	+	+			–	+	+			R	–	+	+	–	–
2221	–	+	–	+	+		–	+	+	R			+	+	+	+	S	R	+	+						+	+	+			–	+	+			R	–	+	+	–	–
2225/10	–	+	–	+	+		–	+	+	R		S	+	+	+	+	+	+	+	+						+	+	+			–	+	+			+	–	+	+	R	–
2235/20	–	+	–	+	+		–	R	+	R			+	+	+	R	S	S	R	+						+	+	+			–	R	–			–	–	R	–	–	–
2236/30	–	+	–	+	+		–	R	+	R			R	+	+	R	S	S	R	+						+	R	+			–	R	–	R	R	–	–	R	–	–	–
2245/46A	–	+	–	+	+		–	R	+	R			+	+	+	R	S	R	R	+						+	R	+			–	R	–			–	–	R	–	–	–
2300 Series																																								
2335	–	R	–	R	–	–	R	+	–	R			R	+	R	S	+	R	R	+						+	+	+			–	R	–			–	–	R	–	–	–
2336	–	R	–	R	–	–	R	+	–	R			R	+	R	S	+	R	R	+						+	+	+			–	R	–			–	–	R	–	–	–
2336YA	–	R	–	R	–	–	R	+	–	S			R	+	R	S	+	R	R	+						+	+	+			–	R	–			–	–	R	–	–	–
2237	–	R	–	R	–	–	R	R	+	R			R	+	R	S	+	R	R	+						+	+	+			–	R	–	R	R	–	–	R	–	–	–
2400 Series																																								
2430	–	–	–	–	+	+	–	–	+	R			–	+		–	–	–			S	S	+	+		+	+	+			–	–	–			–	–	–	–	–	–
2430A/M	–	–	–	–	+	+	–	–	+	R			–	+		–	–	–			+	S	+	+		+	+	+			–	–	–			–	–	–	–	–	–
2432	–	–	–	–	–	+	–	–	–	R			–	–		–	–	–			–	–	R	S		+	+	+			–	–	–			–	–	–	–	–	–
2432M	–	–	–	–	–	+	–	–	–	S			–	–		–	–	–			–	–	R	S		+	+	+			–	–	–			–	–	–	–	–	–
2440	–	–	–	–	–	+	–	–	–	R			–	–		–	–	–			–	–	R	S		+	+	+			–	–	–			–	–	–	–	–	–
2445	–	–	–	–	–	+	–	–	+	R			–	–		–	–	–			S	–	+	+		+	+	+			–	–	–	R	R	–	–	–	–	–	–
2445A	–	–	–	–	–	+	–	–	+	R			–	–		–	–	–			+	S	+	+		+	+	+			–	–	–	R	R	–	–	–	–	–	–
2445B	–	–	–	–	–	+	–	–	+	R			–	+		–	–	–			+	R	S	R		+	+	+			–	–	–	R	R	–	–	–	–	–	–
2455A	–	–	–	–	–	+	–	–	–	R			–	+		–	–	–			+	–	S	+		+	+	+			–	–	–	R	R	–	–	–	–	–	–
2455B	–	–	–	–	–	+	–	–	–	R			–	–		–	–	–			+	–	R	S		+	+	+			–	–	–	R	R	–	–	–	–	–	–
2465	–	–	–	–	–	+	–	–	–	R			–	–		–	–	–			S	–	R	+		R	R	+			–	–	–	R	R	–	–	–	–	–	–
2465A	–	–	–	–	–	+	–	–	–	R			–	–		–	–	–			–	–	S	R		R	R	+			–	–	–	R	R	–	–	–	–	–	–
2465B	–	–	–	–	–	+	–	–	–	R			–	–		–	–	–			–	–	R	S		R	R	+			–	–	–	R	R	–	–	–	–	–	–
2467	–	–	–	–	–	+	–	–	–	R			–	–		–	–	–			–	–	S	R		R	R	+			–	–	–	R	R	–	–	–	–	–	–
2467B	–	–	–	–	–	+	–	–	–	R			–	–		–	–	–			–	–	R	S		R	R	+			–	–	–								

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PROBE AND SIGNALS CONCEPTS

A 53 minute video tape with a 40-page booklet describes practical uses of passive, active, and current probes. Emphasis is on selecting the correct probe for your application. Additional booklets are available at $1.50 each under Literature number 60-W-6770. Ordering information for the video tape is on page 520.

A FEW TIPS FOR SELECTING PROBES

For amplitude measurements, the capacitance and resistance of the probe form a voltage divider with the circuit under test. For frequencies lower than 5 MHz, the resistive component is usually the most important and should be at least two orders of magnitude greater than the circuit source impedance. For frequencies higher than 30 MHz, the capacitance becomes the prime consideration.

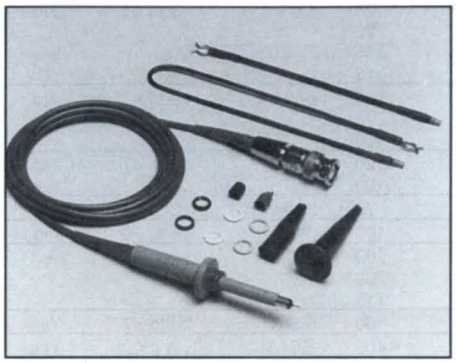
The probes listed here meet the requirements of a broad range of applications. In addition, the P610X, P612X, and P613X probes are modular in design, so you can snap tips and other probe parts together without complicated tools. Maintenance and repair is fast and inexpensive. You don't have to replace the entire probe when one is damaged, just the defective section.

[1] All lengths are nominal and measured electrically for optimum performance.
[2] Rating varies with scopes having other than 20 pF inputs.
[3] Designed for use with scopes having differential inputs.
[4] 25 Ω source.
[5] Trace identification button.
[6] P6131/P6133/P6136/P6137 probes are designed specifically for 2400 Series oscilloscopes.
[7] Differential probe pair (includes two probes) for use on 11000 Series differential amplifiers only.
[8] Compact tipstyle slightly larger than subminiature.

PASSIVE PROBE SELECTION CHART

Type	Attenuation	Length[1]	Loading		BW MHz[2][4] at -3 dB	DC Maximum	Scope C in pF	Readout
P6007 Opt 01	100X	3.5 ft	10 MΩ	2.0 pF[2]	25	1.5 kV	15 to 55	No
P6007		6 ft		2.2 pF	20			
P6007 Opt 03		9 ft		2.4 pF	15			
P6007 Opt 04		12 ft		2.6 pF	13			
P6008 Opt 01	10X	3.5 ft	10 MΩ	7.5 pF	100	600 V	12 to 47	No
P6008 (Environmentalized)		6 ft			100			
P6009 Opt 14	100X	9 ft	10 MΩ	2.5 pF	120	1.5 kV	12 to 47	No
P6009		9 ft		2.5 pF	100			Yes
P6015	1000X	10 ft	100 MΩ	3.0 pF	75	20 kV	12 to 47	No
P6048	10X	6 ft	1 kΩ	1.0 pF	100	20 V	15 to 20	No
P6053B Opt 01	10X	3.5 ft	10 MΩ	9.5 pF	200	500 V	15 to 24	Yes[5]
P6053B		6 ft		12.5 pF	200			
P6053B Opt 03		9 ft		13.5 pF	115			
P6055 Opt 01[3]	10X	3.5 ft	1 MΩ	10.0 pF	60	500 V	20 to 47	Yes
P6057	100X	6 ft	5 kΩ	1.0 pF	1400	50 V	N/A (50Ω)	Yes
P6062B Opt 01	10X or 1X	3.5 ft	10 MΩ 1 MΩ	13.5 pF 100.0 pF	100 8	500 V	15 to 47	Yes
P6062B	10X or 1X	6 ft	10 MΩ 1 MΩ	14.0 pF 105.0 pF	100 6			
P6062B Opt 03	10X or 1X	9 ft	10 MΩ 1 MΩ	17.0 pF 135.0 pF	95 4.5			
P6063B Opt 01	10X or 1X	3.5 ft	10 MΩ 1 MΩ	11.0 pF 80.0 pF	200 12	500 V	15 to 24	Yes
P6063B	10X or 1X	6 ft	10 MΩ 1 MΩ	14.0 pF 105.0 pF	200 6			
P6101A Opt 01	1X	1 m	1 MΩ	32.0 pF	34	500 V	Any	N/A (IX)
P6101A		2 m		54.0 pF	15			
P6101A Opt 03		3 m		78.0 pF	8			
P6102A	10X	2 m	10 MΩ	13.2 pF	60	500 V	36 to 55	Yes
P6103 Opt 01	10X	1 m		10.9 pF	50	500 V	15 to 35	
P6103		2 m	10 MΩ	13.2 pF	50			No
P6103 Opt 03		3 m		15.5 pF	50			
P6105A Opt 01	10X	1 m	10 mΩ	8.7 pF	100	500 V	15 to 35	Yes
P6105A		2 m		11.2 pF	100		15 to 35	
P6105A Op 03		3 m		13.2 pF	90		15 to 30	
P6106A Opt 01	10X	1 m	10 MΩ	8.7 pF	250	500 V	15 to 35	Yes
P6106A		2 m		11.2 pF	250		15 to 35	
P6106A Opt 03		3 m		13.2 pF	150		15 to 30	
P6107A	10X	2 m	10 MΩ	13.0 pF	100	500 V	20 to 51	Yes
P6108A Opt 01	10X	1 m	10 MΩ	8.7 pF	100	500 V	15 to 35	No
P6108A		2 m		11.2 pF	100		15 to 35	
P6108A Opt 03		3 m		13.2 pF	90		15 to 30	
P6109 Opt 01	10X	1.5 m		11.8 pF	150	500 V	15 to 35	
P6109		2 m	10 MΩ	13.2 pF	150		15 to 35	Yes
P6109 Opt 03		3 m		15.5 pF	100		15 to 30	
P6115	1X	1.5 m	1 MΩ	64 pF	>5	42 V	Any	No
P6121	10X	1.5 m	10 MΩ	11.0 pF	100	500 V	20 to 26	Yes
P6122	10X	1.5 m	10 MΩ	11.0 pF	100	500 V	15 to 35	No
P6122 Opt 02		2 m		12.0 pF	100			
P6122 Opt 03		3 m		14.0 pF	90			
P6125	5X	1.5 m	5 MΩ	20.0 pF	200	250 V	15 to 33	No
P6130 Opt 01	10X	1.5 m	10 MΩ	12.7 pF	250	500 V	15 to 35	Yes
P6130		2 m		13.2 pF	250		15 to 35	
P6130 Opt 03		3 m		14.5 pF	150		15 to 30	
P6131[6]	10X	1.3 m	10 MΩ	10.8 pF	300	500 V	14 to 18	Yes
P6131 Opt. 02[6]		2.0 m		13.5 pF	250			
P6131 Opt 03[6]		3.0 m		14.5 pF	150			
P6133 Opt 01[6]	10X	1.3 m	10 MΩ	11.4 pF	150	500 V	10 to 25	Yes
P6133[6]	10X	2 m		12.7 pF	150			
P6133 Opt 03[6]	10X	3 m		14.5 pF	120			
P6133 Opt 25[8]	10X	1.3 m	10 MΩ	11.4 pF	150			
P6134	10X	1.5 m	9 mΩ	11.3 pF	300	500 V	12 to 18	Yes
P6135[7]	10X	1.5 m	1 MΩ	11.3 pF	150	500 V	13.5-16.5	Yes
P6136[6]	10X	1.3 m	10 MΩ	10.8 pF	350	500 V	12 to 18	Yes
P6136 Opt 25[8]	10X	1.3 m	10 MΩ	10.8 pF	350	500 V	12 to 18	Yes
P6137[6][8]	10X	1.5 m	10 MΩ	10.8 pF	400	500 V	12 to 18	Yes
P6149A	10X	2 m	10 MΩ	13.0 pF	50	500 V	20 to 51	No
P6156[8]	10X	1.5 m	500 Ω	1 pF	3500	15 V	N/A (50 Ω)	Yes
P6156 Opt 26[8]	20X	1.5 m	1 KΩ	1 pF	3500	22 V	N/A (50 Ω)	Yes
P6156 Opt 27[8]	1X	1.5 m	N/A (50 Ω)		1500	Scope Input	N/A (50 Ω)	Yes

P6101A
DC to 34 MHz, 1X
Modular



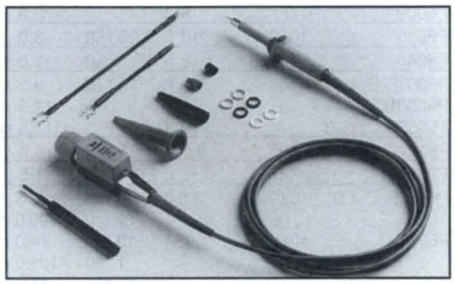
P6101A

P6102A
DC to 60 MHz, 10X
Modular
With Readout

P6106A
DC to 250 MHz, 10X
Modular
With Readout

P6105A
DC to 100 MHz, 10X
Modular
With Readout

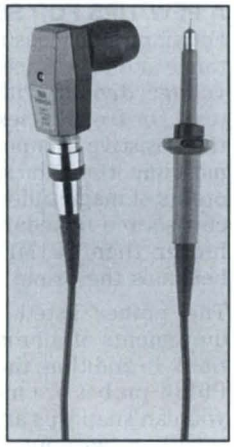
P6108A
DC to 100 MHz, 10X
Modular



P6106A

P6107A
DC to 100 MHz, 10X
Modular
With Readout

P6149A
DC to 50 MHz, 10X
Modular



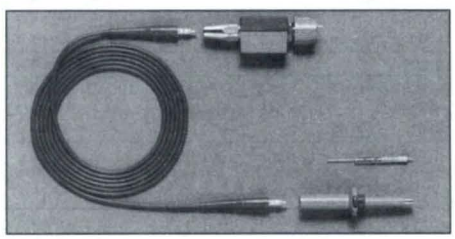
MODULAR PROBES

Tektronix modular probes are designed to save you money in repair and maintenance over the life of the probe. The three modules (probe head, cable, and connector/compensation box) quickly snap or screw together eliminating the need for soldering. Spare modules can be ordered and stocked, reducing down-time and eliminating the need to send a probe in for repairs (see page 545). Modularity, rugged construction and highly reliable hybrid circuitry make these Tektronix probes a cost effective probing solution.

For 1 MΩ Input

- **Simplified, Faster Maintenance and Repairs**
- **High Fidelity Signal Acquisition at Low Cost**
- **Hybrid Circuitry for Improved Performance**
- **Rugged for Greater Reliability**

Tektronix modular passive probes are used to acquire high fidelity signals from low source impedance circuits. The P6102A, P6105A, P6106A and P6107A will automatically scale the readout on oscilloscopes equipped with this feature. All but the P6101A and P6108A provide a ground reference button on the probe head for quick trace identification. The P6107A and P6149A feature a right angle BNC connector.



P6106A in modular form

CHARACTERISTICS

	Length	Attenuation	Loading	Bandwidth	DC Max	Scope C in pF
P6101A	1 m	1X	1 MΩ 32.0 pF	34 MHz	500 V	Any
	2 m	1X	1 MΩ 54.0 pF	15 MHz	500 V	Any
	3 m	1X	1 MΩ 78.0 pF	8 MHz	500 V	Any
P6102A	2 m	10X	10 MΩ 13.2 pF	60 MHz	500 V	36-55
P6105A	1 m	10X	10 MΩ 8.7 pF	100 MHz	500 V	15-35
	2 m	10X	10 MΩ 11.2 pF	100 MHz	500 V	15-35
	3 m	10X	10 MΩ 13.2 pF	90 MHz	500 V	15-30
P6106A	1 m	10X	10 MΩ 8.7 pF	250 MHz	500 V	15-35
	2 m	10X	10 MΩ 11.2 pF	250 MHz	500 V	15-35
	3 m	10X	10 MΩ 13.2 pF	150 MHz	500 V	15-30
P6107A	2 m	10X	10 MΩ 13.0 pF	100 MHz	500 V	20-51
P6108A	1 m	10X	10 MΩ 8.7 pF	100 MHz	500 V	15-35
	2 m	10X	10 MΩ 11.2 pF	100 MHz	500 V	15-35
	3 m	10X	10 MΩ 13.2 pF	90 MHz	500 V	15-30
P6149A	2 m	10X	10 MΩ 13.0 pF	50 MHz	500 V	20-51

ORDERING INFORMATION

P6101A 1X, 34 MHz, 2 m Modular Probe. **$53**
Includes: Retractable hook tip (B3, 013-0107-05); Probe tip ground cover (B16, 166-0404-01); 5-in Ground lead (175-0124-01); 12-in Ground lead (G7, 175-0125-01); Alligator clip (344-0046-00); Two each of black, white and silver cable markers; Instruction sheet (070-5299-00).

P6105A 10X, 100 MHz, 2 m Modular Probe. **$93**
Includes: Same as the P6101A plus adjustment tool (F3, 003-1364-01); Instruction sheet (070-5516-00).

P6106A 10X, 250 MHz, 2 m Modular Probe. **$140**
Includes: Same as the P6105A except 3-in Ground lead (G7, 175-0263-01) instead of 12-in Ground lead; Instruction sheet (070-5517-00).

P6108A 10X, 100 MHz, 2 m Modular Probe. **$75**
Includes: Same as the P6105A; Instruction sheet (070-5519-00).

OPTIONS
(for above probes)

Option 01—1-m cable. **+$5**
Option 03—3-m cable. **+$15**

P6102A 10X, 60 MHz, 2 m Modular Probe **+$65**
Includes: Same as the P6105A; Instruction sheet (070-5824-00).

P6107A 10X, 100 MHz, 2 m Modular Probe. **$120**
Includes: Same as the P6105A; Instruction sheet (070-5518-00).

P6149A 10X, 50 MHz, 2 m Modular Probe **$115**
Includes: Same as the P6105A; Instruction sheet (070-5510-00).

OPTIONAL ACCESSORIES
MANUALS

P6102A Order 070-5847-00 **$1**
P6105A Order 070-5231-00 **$3**
P6106A Order 070-5232-00 **$3**
P6107A Order 070-5297-00 **$3**
P6108A Order 070-5233-00 **$3**
P6149A Order 070-5247-00 **$3**

For probe accessories, see page 546.
For replaceable modular subassemblies, see page 545.
Instrument compatibility chart is on pages 521 and 522.

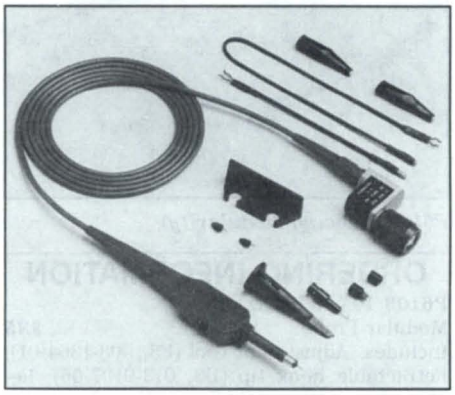
To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

P6062B

DC to 100 MHz, 1X/10X With Readout

P6063B

DC to 200 MHz, 1X/10X With Readout



P6063B

For 1 MΩ Input

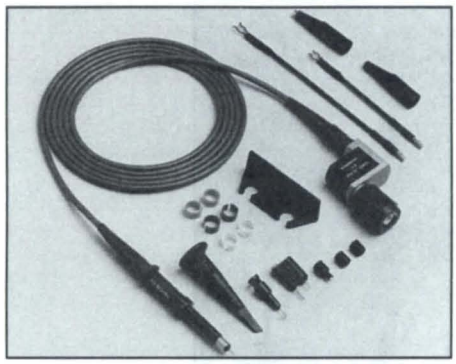
- **1X and 10X Selectable Attenuation**
- **Attenuation Switch on Probe Body**
- **Scope Readout Changes to Selected Attenuation**

The P6062B and P6063B are passive dual attenuation probes designed for oscilloscopes with bandwidths to 100 and 200 MHz. A sliding switch on the probe body selects 1X or 10X attenuation. This 1X-10X switch allows the user to switch in and out a decade of sensitivity without returning to the test instrument. Attenuation may be arbitrarily switched from 1X to 10X to evaluate the effects of loading of the oscilloscope on the circuit under test.

Both probes activate the readout coding for oscilloscopes which have readout capability. Readout changes with the probe attenuation switch so the correct attenuation setting is always displayed on the oscilloscope. A pushbutton for ground reference is standard with both probes. This provides an easy way to identify a trace in a multitrace display. Both probes are compatible with the miniature accessories.

P6053B

DC to 200 MHz, 10X With Trace Identify and Readout



P6053B

For 1 MΩ Input

- **Miniature Probe Tip Size**
- **Trace Identify Button for Remote Selection of 7D20 Menus**
- **Fast Rise Time**

The P6053B is a miniature fast-rise 10X probe designed for Tek instruments having a nominal input capacitance of 15 to 24 pF. The probe has a pushbutton for actuating the trace-identify function of the oscilloscope mainframe and readout capability. The P6053B is compatible with all miniature probe accessories.

ORDERING INFORMATION

P6062B 100 MHz, 6 ft Switchable Attenuation Probe **$175**
Includes: Retractable hook tip (B3, 013-0107-05); Probe tip ground cover (B16, 166-0404-01); 5 in. Ground lead (G7, 175-0124-01); 12 in. Ground lead (G7, 175-0125-01); Hook tip (B6, 206-0114-00); Two replaceable tips (B25, 206-0191-00); Probe holder (352-0351-00); Two alligator clips (A16, 344-0046-00); Instrument sheet (062-2927-00).

OPTIONS

Option 01—3.5 ft cable. **+$5**
Option 03—9 ft cable. **+$15**

P6063B 200 MHz, 6 ft Switchable Attenuation Probe **$220**
Includes: Same as P6062B except 3-in. Ground lead (G7, 175-0263-01) instead of the 12-in. Ground lead; Instruction sheet (062-2928-01)

OPTIONS

Option 01—3.5 ft cable. **+$5**

P6053B 10X, 6 ft Trace Identify Probe **$150**
Includes: Bayonet tip (B15, 013-0085-01); Retractable hook tip (B3, 013-0107-05); To probe tip ground covers (B16, 166-0404-01); 5-in. Ground lead (G7, 175-0124-01); 3-in. Ground lead (G7, 175-0263-01); hook tip (B6, 206-0114-00); Two alligator clips (A16, 344-0046-00); Probe holder (352-0351-00); Two each of black, white and silver cable markers; Instruction sheet (070-1594-00).

OPTIONS

Option 01—3.5 ft cable. **+$5**
Option 03—9 ft cable. **+$15**

CHARACTERISTICS

	Nominal Probe Length	P6062B		P6063B		P6053B
Attenuation		1X	10X	1X	10X	10X
Accuracy		Same as Scope	3%*1	Same as Scope	3%*1	3%
Input Resistance		Same as Scope	10 MΩ*1	Same as Scope	10 MΩ*1	10 MΩ
Input Capacitance	3½ ft 6 ft 9 ft	100 pF 105 pF 135 pF	13.5 pF 14 pF 17 pF	80 pF 105 pF NA	11 pF 14 pF NA	9.5 pF 12.5 pF 13.5 pF
Bandwidth	3½ ft 6 ft 9 ft	8 MHz 6.7 MHz 4.5 MHz	100 MHz 100 MHz 95 MHz	12 MHz 6 MHz NA	200 MHz 200 MHz NA	200 MHz 200 MHz 115 MHz
Maximum DC Voltage		100 V	500 V	100 V	500 V	500 V
Derated Above		450 kHz	3.5 MHz	450 kHz	4.5 MHz	4.2 MHz
Derated to Frequency		35 V @ 10 MHz	35 V @ 50 MHz	35 V @ 10 MHz	30 V @ 50 MHz	
Aberrations		N/A	±3%, <5% p-p	N/A	±3%, <5% p-p	
Rise Time		N/A	3.5 ns	N/A	1.7 ns	N/A
Scope C in pF		15 to 47 pF		15 to 24 pF		15 to 24 pF

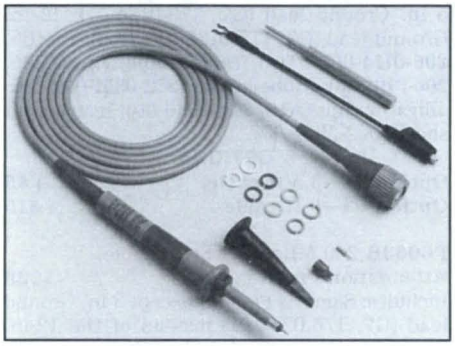
*1 *In 10X position the input R=10 MΩ ±0.5% with an oscilloscope input R=1 MΩ ±2%.*

P6103
DC to 50 MHz, 10X Modular

P6109
DC to 150 MHz, 10X Modular, With Readout

P6121
DC to 100 MHz, 10X Modular, With Readout

P6122
DC to 100 MHz, 10X Modular



P6103 with standard accessories.

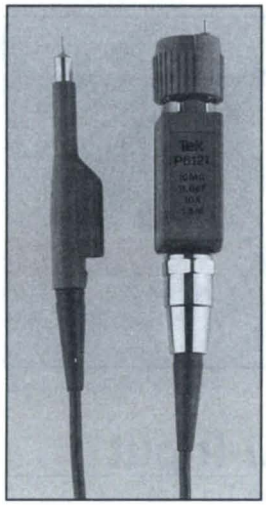
Ruggedized Probes For 1 MΩ Input

- **Improved, Rugged, Replaceable Tip**
- **Hybrid Circuitry for Improved Performance**
- **New, Two-Piece Modularity**
- **UL Listed**

The P6103/P6109 are ruggedized modular passive voltage probes. The modular probe head houses all circuitry, including low frequency compensation. The cable assembly comes with an attached BNC connector.

Both probes feature easily replaceable screw-in probe tips. These probe tips have been specifically engineered to provide improved long-term performance and reliability. Both are compatible with the miniature size probe accessories (see probe accessories page 546).

The P6103 is included with the 2225 oscilloscope. The P6109 is included with the 2245 and 2246 GPS oscilloscopes. Oscilloscopes equipped with readout can be activated by the P6109.



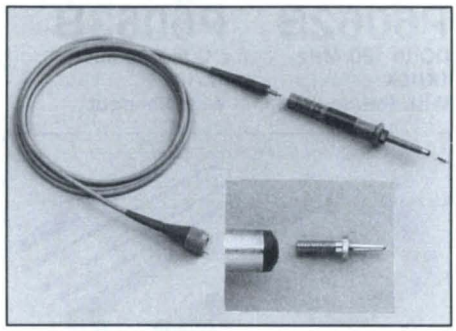
P6121

For 1 MΩ Input

- **Small, Precision Tip**
- **Flexible, Low Mass Cable**
- **Hybrid Circuitry for Improved Performance**
- **UL Listed**

The P6120 probe family features modular construction, easily replaceable parts and hybrid circuitry. These probes are also fully compatible with the wide selection of miniature probe accessories.

The P6122 general purpose probe accommodates oscilloscopes with bandwidths up to 100 MHz. The P6121 with readout capability is specifically designed for the Tektronix 2236 Oscilloscope to provide close tolerance readings when using the 2236 DMM functions.



P6109 (showing modularity)

CHARACTERISTICS

	Length	Attenuation	Loading	Bandwidth	DC Max	Scope C in pF
P6103 Opt 01	1 m	10X	10 MΩ 10.9 pF	50 MHz	500 V	15–35
P6103	2 m	10X	10 MΩ 13.2 pF	50 MHz	500 V	15–35
P6103 Opt 03	3 m	10X	10 MΩ 15.5 pF	50 MHz	500 V	15–30
P6109 Opt 01	1.5 m	10X	10 MΩ 11.8 pF	150 MHz	500 V	15–35
P6109	2 m	10X	10 MΩ 13.2 pF	150 MHz	500 V	13–35
P6109 Opt 03	3 m	10X	10 MΩ 15.5 pF	100 MHz	500 V	15–30
P6121*[1]	1.5 m	10X±0.2%	10 MΩ 11.0 pF	100 MHz	500 V	20–26
P6122	1.5 m	10X	10 MΩ 11.0 pF	100 MHz	500 V	15–35
P6122 Opt 02	2 m	10X	10 MΩ 12.0 pF	100 MHz	500 V	15–35
P6122 Opt 03	3 m	10X	10 MΩ 14.0 pF	90 MHz	500 V	15–35

*[1] *Designed specifically for use with the 2236 to ensure optimum DMM readings.*

ORDERING INFORMATION

P6103 10X, 50 MHz, 2 m
Modular Probe **$35**
Includes: Adjustment tool (F3, 003-1364-01); Retractable hook tip (B3, 013-0107-05); Replaceable probe tip (B27, 131-3723-00); 12-in. Ground lead (196-3120-00); Two each of white, yellow, red and green cable markers; Instruction sheet (070-6156-00).

OPTIONS

Option 01—1 m cable. **+$5**
Option 03—3 m cable. **+$5**

P6109 10X, 150 MHz, 2 m
Modular Probe **$58**
Includes: Same as the P6103; Instruction sheet (070-6157-00).

OPTIONS

Option 01—1.5 m cable. **+$5**
Option 03—3 m cable. **+$5**

P6122 10X, 100 MHz, 1.5 m
Modular Probe **$58**
Includes: (020-0717-00) Adjustment tool (F3, 003-1364-01); Retractable hook tip (B3, 013-0107-05); Probe tip ground cover (B16, 166-0404-01); 8.8-in. Alligator ground lead (G10, 195-1870-00); 3.5-in. Ground lead (G1, 195-6176-00); Alligator clip (A16, 344-0046-00); two silver cable marker bands; Instruction sheet (070-5511-00).

OPTIONS

Option 02—2 m cable. **+$5**
Option 03—3 m cable. **+$5**

P6121 10X, 100 MHz, 1.5 m
Modular Probe **$100**
Includes: Same as the P6122; Instruction sheet (070-5512-00).

OPTIONAL ACCESSORY

Manuals—
(P6121) Order 070-3739-01 **$1.50**
(P6122) Order 070-4431-01 **$3**

For probe accessories see pages 546, 548.

For replaceable subassemblies see page 545.

Instrument compatibility chart is on pages 521-522.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

10X Modular with Readout

NEW P6137
DC to 400 MHz (Compact)

P6130
DC to 250 MHz (Subminiature)

P6131
DC to 300 MHz (Subminiature)

P6133
DC to 150 MHz (Subminiature)

NEW P6133
Option 25 (Compact)

P6136
DC to 350 MHz (Subminiature)

NEW P6136
Option 25 (Compact)

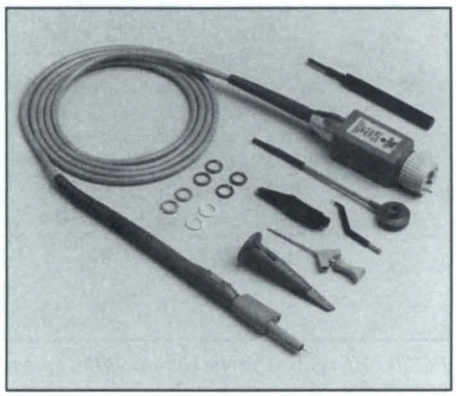
For 1 MΩ Input

- **Subminiature Tip (except P6137 and P6133/P6136 Opt 25) for Precise Probing**
- **Flexible Lightweight Cable**
- **Modular for Low Cost of Ownership**
- **Hybrid Circuitry Performance**
- **UL Listed**

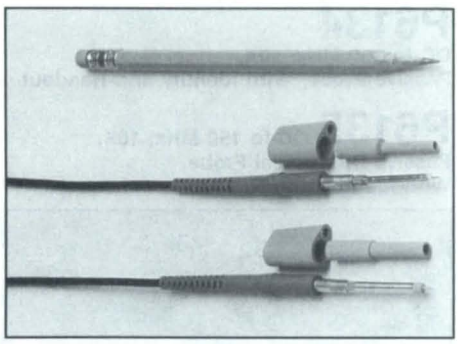
The P6130 probe family features modular construction, hybrid circuitry and smaller probe tips which can easily negotiate dense circuitry or tight spaces. Each probe has 10X attenuation and activates the read-out-encoding circuit of oscilloscopes with the feature.

These probes (except P6137 and P6133/P6136 Option 25) are compatible with the subminiature probe accessories. Full compatibility with the miniature accessories is available when the subminiature-to-miniature probe tip adapter (013-0202-02) is installed over the probe tip. The P6130 general purpose probe can be used with instruments with bandwidths up to 250 MHz. The P6131 is specially designed for the Tektronix 7A42 and older 2465 oscilloscopes. The P6133 is for use with the 2445A. The P6136 and P6137 are specially designed for the 2455A/B, 2465A/B, and 2467/B.

The new P6137 is a high impedance, DC to 400 MHz, 10X, 1.5 meter, passive voltage probe designed specifically for the Tektronix 2400B Series portable oscilloscopes. The P6137 features a larger diameter probe tip, compact size which provides additional tip strength and performance, but is small enough in size to access today's smaller circuitry. (Note: The P6137 tip/hybrid assembly, compact size is not compatible with subminiature accessories, except for the ground collar.) The "Identify" button on the probe head enables the user to utilize special functions on the 2400 Series oscilloscope, such as *Auto Setup, SRQ, Auto Sequencing,* and trace identification.



P6137 shown with typical accessories.



P6133/P6136 Opt. 25 Compact tip (bottom), P6133/P6136 Subminiature (top).

CHARACTERISTICS

	Probe Length	P6130	P6131	P6133*1	P6136*1*2/P6137
Attenuation		10X ±3%	10X ±1%	10X ±1%	10X ±1%
Loading	1.3 m	—	10 MΩ 10.8 pF	10 MΩ 11.4 pF	10 MΩ 10.8 pF
	1.5 m	10 MΩ 12.7 pF	—	—	
	2.0 m	10 MΩ 13.2 pF	10 MΩ 13.5 pF	10 MΩ 12.7 pF	—
	3.0 m	10 MΩ 14.5 pF	10 MΩ 14.5 pF	14.5	—
Bandwidth	1.3 m	—	300 MHz	150 MHz	350 MHz (P6136)
	1.5 m	250 MHz	—	—	400 MHz
	2.0 m	250 MHz	250 MHz	150 MHz	(P6137)
	3.0 m	150 MHz	150 MHz	120 MHz	—
DC Max		500 V	500 V	500 V	500 V
Scope		22xx, 46x, 475, 485,7A15/16/18/26	2430, 2445, 2465, 7A42	2430A/M, 2445/A	2440, 2455A/B, 2465A/B, 2467B

*1 *P6133/P6136 Opt 25 products have same specifications as standard P6133/P6136 subminiature.*
*2 *P6136 will NOT meet 2400B-Series 400 MHz BW.*

ORDERING INFORMATION

P6130 10X, 250 MHz, 2 m Subminiature Probe **$130**
Includes: Adjustment tool (F3, 003-1364-01); Retractable hook tip (C1, 013-0208-01); Circuit board connector (C5, 131-2766-03); 8.8-in. Alligator ground lead (G10, 195-1870-00); 6-in. Microhook ground lead (G5, 195-4104-00); 2-in. Ground lead (G9, 195-4240-00); Probe holder (352-0687-00); Each of white, gray, red and green cable markers; Instruction sheet (070-5513-00).

OPTIONS

Option 01—1.5 m cable. **+$5**
Option 03—3 m cable. **+$15**

P6131 10X, 300 MHz, 1.5 m Modular Probe **$145**
Includes: Same as P6130; Instruction sheet (070-5514-00).

OPTIONS

Option 02—2 m cable. **NC**
Option 03—3 m cable. **NC**

P6133 10X, 150 MHz, 2 m Modular Probe **$115**
Includes: Same as P6130; Instruction sheet (070-5795-00).

OPTIONS

Option 01—1.3 m cable. **+$5**
Option 03—3 m cable. **+$15**
Option 25*3—Compact tip offers increased tip strength, but maintains a smaller profile that still allows probing of dense circuit applications. Option 25 is not compatible with the standard P6133/P6136 "Subminiature" accessories. Similar accessories, for the "Compact" size, are available. Refer to page 548 for additional information on the optional accessories.

P6136 10X, 350 MHz, 1.3 m Modular Probe **+$150**
Includes: Same as the P6130; instruction sheet (070-6025-00).
Option 25*3
Includes same as P6133 Opt 25.

P6137 10X, 400MHz, 1.5m **$160**
Includes: Low inductance ground lead (195-4240-00), Retractable hook tip (013-0107-00), Alligator clip (344-398-00), IC grabber (013-0217-00), 3-in. ground lead (196-3113-00), Adjustment tool (003-1417-00), Instruction sheet (070-6432-00).

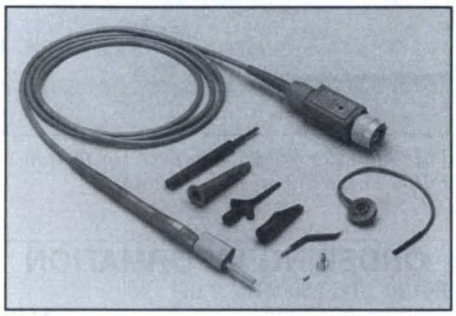
*3 *Contact your local sales office for additional ordering information.*

P6134

DC to 300 MHz, 10X, Passive Probe, With Identify and Readout

P6135 DC to 150 MHz, 10X,

Passive Differential Probe, With Identify and Readout



P6134 shown with typical accessories.

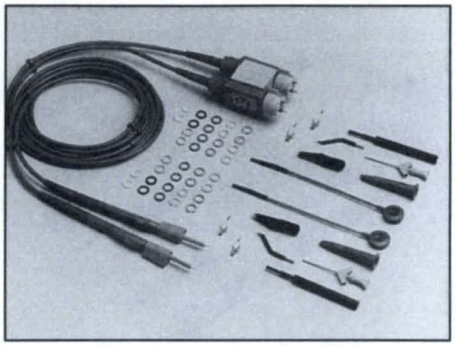
For Use With the *Intelligent* TekProbe™ Interface of the 11000 Series Plug-Ins

- **Identify Button on Each Probe Allows Remote Sequencing of Oscilloscope Programs**
- **Automatic Input Impedance Selection**
- **Activates Readout on 11000 Series Oscilloscopes**
- **Probe Power Comes Through Connector—No Extra Power Supply or Cables Needed**
- **Uses Subminiature Probe Accessories**

The P6134, P6135 and P6231 probes were the first in a line of "intelligent" probes. Through the TekProbe™ interface connector, the probe can (if available on the specific probe) communicate one or more of the following: its type, serial number, attenuation, input impedance, offset scale factor, and other key parameters to and from the host instrument. Power for compatible probes is also supplied through the TekProbe™ interface, eliminating the need for extra cabling and external power supplies. The probe connectors allow easy and positive locking to the test instrument.

An "ID" button is standard with each probe which, when pressed, causes one of several programmable actions to be taken by the mainframe (e.g., autoset, setup recall, automatic measure, SRQ, etc.).

The P6134 and P6135 are passive probes designed for amplifiers with an input impedance of 1 MΩ. The P6135 is a pair of differential probes which are matched for high CMRR when used with the 11A33 Differential Comparator plug-in.



P6135 differential probe shown with typical accessories

CHARACTERISTICS

	P6134	P6135
Attenuation	10X ±1%	10X Adjustable ±3%
Input R	9 MΩ ±0.3%	1 MΩ ±0.32% at dc
Input C	11.3 pF	11.3 pF
Bandwidth	300 MHz	150 MHz
Rise Time		
Input Voltage	500 V (dc + peak ac)	500 V (dc + peak ac)
CMRR	NA	10000:1 dc to 1 kHz derating to 100:1 at 20 MHz

ORDERING INFORMATION

P6134 10X, 300 MHz, 1.5 m Passive Probe **$170**
Includes: Adjustment Tool (F3, 003-1364-01); Retractable hook tip (C1, 013-0208-01); Two circuit board connectors (C5, 131-2766-03); 2-in. Ground lead (G9, 195-4240-00); 6-inch Ground lead (196-3113-00); Miniature alligator clip (A16, 344-0046-00); IC grabber (013-0217-00); Two each of black, white, silver, gray, blue, orange, red, green and yellow cable markers; Instruction manual (070-6029-00).

P6135 Pair of 10X, 150 MHz, 1.5 m Differential Probes **$495**
Includes: Same as the P6134, for each probe; Instruction manual (070-6158-00).

P6231

DC to 1.5 GHz, 10X, Bias/Offset Probe, With Identify and Readout

Refer to Active probes on page 531 for specifications and Ordering Information.

NEW 1103

TekProbe™ Interface Power Supply

1103 TekProbe™ Power Supply

TYPICAL APPLICATIONS

- **Allows Use of P6701/P6702, P6231, and P6203/P6204 on Non-11000 Series Oscilloscopes**

FEATURES

- **Dual TekProbe™ Inputs**
- **Dual BNC Outputs**
- **Dual Voltage On/Off Offset Switches and Potentiometers**

The 1103 Power Supply allows customers to use probes requiring TekProbe™ Interface power with any oscilloscope or digitizer which does not provide TekProbe™ power. The 1103 includes dual TekProbe™ inputs, dual BNC signal outputs, and dual voltage offset on/off switches and potentiometers.

The offset control supplies a voltage, adjustable with the front panel potentiometer. This voltage is used to control the offset of probes such as the P6701/02 optical-to-electrical converters.

CHARACTERISTICS

Output Voltage (±2%)—+15 V @ 300 ma, −15 V @ −300 ma, +5 V @ +300 ma, −5 V −300 ma (ripple ≤5 mV rms).
Line Voltage Ranges—115 V: 87 to 128 V ac; 230 V: 174 to 250 V ac.
Line Frequency—48 to 440 Hz.
Power Consumption—≤35 W.

ORDERING INFORMATION

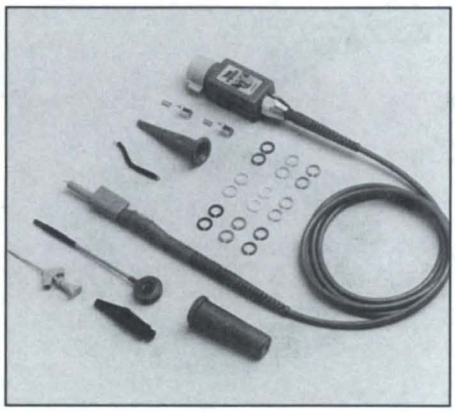
1103 Accessory Power Supply **$350**

INTERNATIONAL POWER PLUG OPTIONS
Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

NEW P6156

DC to 3.5 MHz., 10X, Low Impedance Zo (50 Ω) Probe, With Identify and Readout.



P6156 shown with standard accessories.

TYPICAL APPLICATIONS

- **High-Speed Analog and Digital Device Characterization**
- **Propagation Delays for ECL, EMOS, and GaAs Circuitry**

FEATURES/BENEFITS

- **Low Capacitive Loading at High Frequencies**
- **Interchangeable Attenuator Tip Assemblies (1X, 10X, and 20X; Available as Options);**

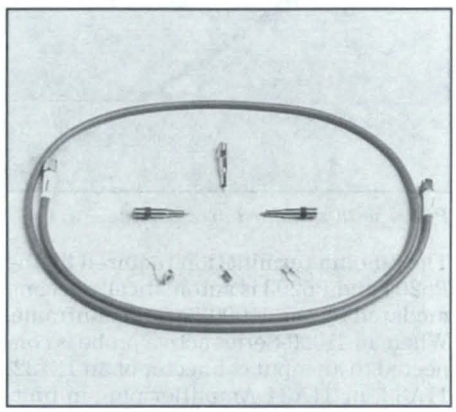
The P6156 is a 3.5 GHz, low impedance (low input R, low input C) Zo (50 Ω) probe and comes standard with a 10X (500 ohm) attenuator tip. Attenuation values of 1X and 20X are available as options to the standard product.

Although primarily designed for the 11A52 and 11A71 plug-ins, the P6156 probes may be used with the other 11000-Series plug-ins, the 11800-Series SD24 and SD26 Sampling-TDR plug-ins, or other 50 ohm input channel amplifiers and oscilloscopes (with the proper adapters).

The 50 ohm termination required by the P6156 is automatically accommodated by the 11000-Series mainframe. When an 11000-Series probe is connected to an input connector of an 11A32, 11A33, or 11A34 Amplifier plug-in unit, the plug-in input impedance is automatically switched to 50 ohm. The 11A52 and 11A71 Amplifier plug-ins have fixed 50 ohm input impedances.

NEW P6150

DC to 9 GHz., 10X Probe, Low Impedance Zo (50 Ω) with 1X Accessory Tip



P6150 shown with standard accessories.

TYPICAL APPLICATIONS

- **High-Speed Device Characterization in Microwave Communication, Signal Processing, and Logic Applications**
- **Propagation Delay on GaAs and ECL Devices**
- **Circuit Board Impedance Testing**

FEATURES/BENEFITS

- **Low Loading at Extremely High Bandwidths**
- **Small Size**
- **Ideal for 50 Ohm Environments**
- **Interchangeable Probe Tips (1X, 10X)**
- **Recommended Probe for 11800/ SD-24 and SD-26 Sampling Plug-Ins**
- **SMA Cable Connectors for Optimum Signal Integrity**

High Quality, Flexible Probe Cable

The P6150 is a very high bandwidth, 10X attenuation, low impedance probe designed for use with the 11800/SD24 and SD26 Sampling TDR. The probe consists of interchangeable, screw-in attenuator tip assemblies (1X and 10X) and an SMA-to-SMA probe cable. An assortment of circuit and grounding attachments are included to optimize attachment to the device under test, while maintaining high signal integrity.

ORDERING INFORMATION

P6156 10X, 3.5 GHz, 1.5 m Low Impedance Probe, Compact Tip **$200**
Includes: Retractable hook tip (013-107-06); Two circuit board connectors; 2-in. Ground lead (195-4240-00); 6 in. ground lead (196-3113-02); Ground collar (343-1003-01); Alligator clip (344-0398-00); SMT Grabber (206-0364-00); Two each cable markers various colors: gray, white, green, red; Probe tip holder (352-0670-00); Instruction sheet (070-6430-00).

OPTIONS

Option 26*[1]—Adds 20X Attenuator **+$55**
Option 27*[1]—Adds 1X Attenuator **+$55**
P6150 10X, 1.0 m, 50 Ω Probe. **$1,250**
Includes: 1X and 10X replaceable probe heads; 1.0 m cable assembly (174-1341-00); 020-1708-00 kit consisting of 20 each grd. clip; 3 each adjustable grd. lead; 10 each electric contact; 2 each probe to circuit board ground connectors; and Instruction sheet (070-7173-00).

*[1] *Contact your local sales office for additional ordering information.*

CHARACTERISTICS

	P6156			P6150	
Attenuation	1X ±3%	10X ±3%	20X ±3%	1X ±2%	10X ±2%
Input R	50Ω ±5%	500Ω ±3%	1000Ω ±3%	50Ω	500Ω
Input C	N/A	≤1 pF	≤1 pF	N/A	<0.15 pF
Bandwidth	≥1.5 GHz	≥3.5 GHz	≥3.5 GHz	≥3.0 GHz	DC to 9 GHz
Rise Time	≤300 ps	≤100 ps	≤100 ps	≤170 ps	<38.8 ps
Max Input Voltage (dc plus peak ac) ± input volts	Scope Max	15 V	22 V	Scope Max	12.5 V
Signal Delay	7.5 ns ±0.05 ns	7.5 ns ±0.05 ns	7.5 ns ±0.05 ns	4.40 ±.1 ns	5.2 ns ±0.1 ns
Length	1.5 m	1.5 m	1.5 m	1 m	1 m

NEW P6204

DC to 1 GHz, 10X, 10-MΩ Active (FET) Probe, With Identify and Readout (Typically 1.1 GHz*)

NEW P6203

DC to 1 GHz, 10X, >10 KΩ Active (Bipolar) Probe, With Identify and Readout.

TYPICAL APPLICATIONS

- **High-Speed Digital and Analog Circuitry, ECL, CMOS, TTL, and GaAs**
- **Amplitude, Aberrations, Signal Delay, Bandwidth and Rise Time Measurements**

FEATURE/BENEFITS

- **High Impedance (10 MΩ, 1.9 pF); Lower Circuit Loading, Better Measurement Accuracy**
- **Compatible with Miniature Size Probe Tip Accessories and Adaptors**
- **Probe Power at the TekProbe™ Interface; No Additional Cables or Supplies Required**
- ***Identify* Button Allows Remote Control of Several Propramable Actions on the Mainframe from the Probe Head**
- **Easily Replaceable Probe Tips**

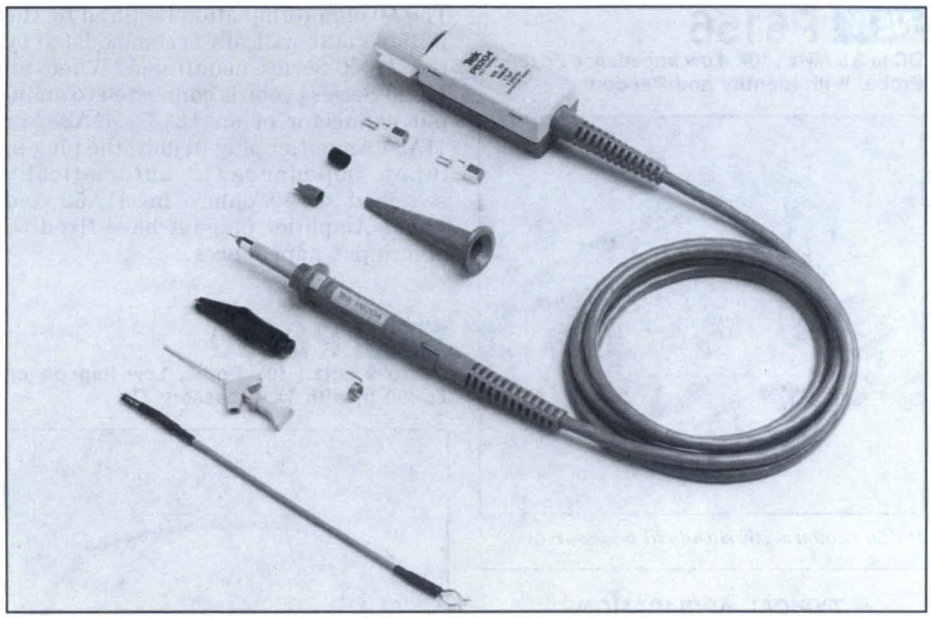
The P6204 and P6203 high-performance Active Probes round out the capabilities of the 11000-Series oscilloscopes and plug-ins.

The P6204 is a 1-GHz, high impedance (high input R, low input C), miniature size, 10X Active (FET) probe intended for use in high speed digital and analog circuitry. The variable dc offset voltage (±10V) is adjustable via mainframe controls, allowing offset of any dc component within the range of the control. This allows signals with dc components to be brought into the probe's dynamic range.

The P6203 is a 10X, 1-GHz, medium impedance (medium input R, low input C), miniature size Active (Bipolar) probe intended for use in testing high speed logic and analog circuitry. The P6203 also provides a variable (±10 V) dc offset function which is controlled via the mainframe.

Although primarily designed for the 11A52 and 11A71 plug-ins the P6204 and P6203 active probes may be used with the other 11000-Series plug-ins.

* *At room temperature.*



P6204 with standard accessories.

The 50-ohm termination required by the P6204 and P6203 is automatically accommodated by the 11000-Series mainframe. When an 11000-Series active probe is connected to an input connector of an 11A32, 11A33, or 11A34 Amplifier plug-in unit, the plug-in input impedance is automaticaly switched to 50 ohms.

The P6204 and P6203 11000-Series Active probes have an *IDENTIFY* button which, when pressed, will cause any one or more of several actions to be taken by the mainframe; these include autoset, recall the next in a series of stored setups, invoke the automatic-measurement function, or issue an SRQ. These actions are selectable via the mainframe Utility Menu.

The P6204 and P6203 Active Probes provide communications (*intelligent* probes) through the TekProbe™ interface connector. The probe can (if available on the specific probe) communicate one or more of the following: it's type, serial number, attenuation ratio, input impedance, offset scale factor, and other key parameters to and from the host instrument. Power for the Active probes is also supplies by through the TekProbe™ interface, eliminating the need for extra cabling and external power supplies.

The P6204 and P6203 may also be used with other oscilloscopes via the NEW 1103 TekProbe™ power supply (see page 528).

CHARACTERISTICS

	P6203	P6204
Attenuation	10X ±1.5%	10X Adjustable ±1.5%
Input R	>10 KΩ	10 MΩ
Input C	2.0 pF (Typically 1.8 pF)	1.9 pF (Typically 1.7 pF)*
Bandwidth	DC - 1.0 GHz	DC - 1.0 GHz (1.1 GHz typical)*
Rise Time	<350 ps (<320 ps typical)	<350 ps P6204 only
Maximum Nondestructive Input Voltage (dc plus peak ac)	40V	400 V
Signal Delay	8.4 ns ±200 ps	8.4 ns ±200 ps
Length	1.5 m	1.5 m
Linear Dynamic Range	−10.0 V ≤(V sig−V offset) ≤+10.0 V	
DC Offset Range	±10 V	±15 V

* *At room temperature.*

ORDERING INFORMATION

11K1P6203 10X, 1 GHz, 1.5 m, Active (Bipolar) Probe, Miniature Size. **$825**
Includes: Retractable hook tip (013-6107-06); 6 in. ground lead (196-3198-00); alligator clip (344-0398-00); SMT Grabber (206-0364-00); electrical insulating sleeve (166-0404-01); ground contact, spring (214-4125-00); 2 probe tip to circuit board adapters; carrying case; instruction sheet (070-6823-00).

P6204 10X, 1 GHz, 1.5 m, Active (FET) Probe, Miniature size. **$1,395**
Includes: Same as P6203; except instruction sheet.

ACTIVE PROBES

Active probes provide high input resistance and low input capacitance without loss of signal. The dynamic range and measurement capability are substantially increased through the voltage offset control.

Since active probes have a selectable 50 ohm output impedance, the distance from the probe tip to the instrument is only limited by the bandwidth limit of the 50 ohm coaxial cables between the probe and instrument. Active probes are used in measurements where high input resistance and low input capacitance is needed and frequencies above 250 MHz are encountered.

Refer to page 530 for information on the P6203 Bipolar and P6204 FET probes for the 11000 Series plug-ins.

ACTIVE PROBE SELECTION GUIDE

Type	Attn	Nominal Length	Loading		Rise Time	Input Limits: Maximum Dc + Pk Ac	Input Limits: Linear Dynamic Range	Input Limits: Dc Offset Range	Read-Out	Price
P6201 FET	1X 10X 100X	6 ft	100 kΩ 1 MΩ 1 MΩ	3 pF 1.5 pF 1.5 pF	0.4 ns	±100 V ±200 V ±200 V	±0.6 V ±6 V ±60 V	±5.6 V ±56 V ±200 V	Yes	$1,280
P6202A FET	10X 100X	2 m	10 MΩ 10 MΩ	2 pF 2 pF	0.7 ns 0.7 ns	±200 V ±200 V	±6 V ±60 V	±55 V ±200 V	Yes No	$735
P6230 Bias/Offset	10X	1.6 m	450Ω	1.3 pF	230 ps	±30 V	±5 V	±5 V	Yes	$420
P6231 Bias/Offset	10X	1.5 m	450Ω	1.6 pF	230 ps	±30 V	±10 V	±5 V	Yes	$410

P6201

DC to 900 MHz, 1X With Readout
Typically 1.1 GHz*

For 50 Ω or 1 MΩ Inputs

- **Unity Gain, Low Input Capacitance**
- **Two Plug-on Attenuator Heads That Maintain Scope Readout Factor**
- **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. Very low input capacitance permits acquisition of high frequency signals with minimum loading of circuits under test while high input resistance minimizes low frequency and dc loading. Plug-on attenuator heads provide higher input resistance and reduced input capacitance. The probe derives its power from the probe power jack on many Tek scopes, or an 1101A Power Supply.

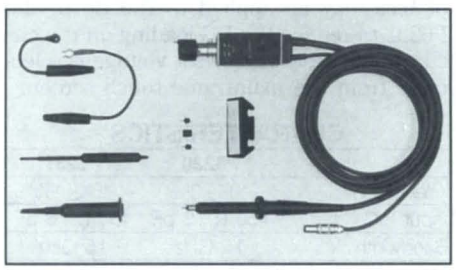
* *At room temperature.*

ORDERING INFORMATION

P6201 1X, 6 ft FET Probe **$1,280**
Includes: Retractable probe tip (D1; (013-0135-00); 10X Attenuator head (010-0376-00); 100X Attenuator head (010-0377-00); 3 Probe tips (D9, 206-0200-00); Probe tip (D2, 103-0164-00); 30 cm (12-in.) Ground lead (G4, 175-0848-02); Ground contact (D5, 131-1302-00); Alligator clip (A16, 344-0046-00); Electrical insulating sleeve (D6, 166-0557-00); Ground contact insulator (D7, 342-0180-00); Carrying case; Instruction manual (070-1306-00).

P6202A

DC to 500 MHz, 10X With Readout



For 50 Ω or 1 MΩ Inputs

- **DC Offset, Small Probe Size**
- **High Input Impedance Through Freq Range**

The low input capacitance of the P6202A 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 dc offset feature offsets any dc component within the range of the control to bring the signal into the dynamic range of the probe.

The P6202A derives its power from the probe power jack on many Tek scopes, or an 1101A Power Supply.

CHARACTERISTICS

	P6201	P6202A
Rise Time	<0.4 ns	<0.7 ns
Bandwidth*1	>900 MHz*3	>500 MHz
Attenuation	×1	×10
Attenuation Accuracy	±3%	±4%
Input Resistance	100 kΩ	10 MΩ
Input Capacitance	3 pF	2 pF
Input R with Attenuator	1 MΩ	10 MΩ*2
Input C with Attenuator	1.5 pF	2 pF*2
Dynamic Range	±0.6 V	±6.0 V
Dynamic Range with Attenuator	±6 V or ±60 V	±60 V*2
DC Offset Range	±5.6 V	±55 V
Noise	300 μV	150 μV
Maximum Input Probe Only	±100 V peak	±200 V peak
Derated above	60 MHz	2 MHz
Derated to— at Frequency	5 V at 500 MHz	20 V at 300 MHz
Maximum Input with Attenuator	200 V peak	200 V peak*2
Derated Above	50 MHz	150 MHz*2
Derate to— at Frequency	5 V at 500 MHz	70 V at 400 MHz*2
AC Coupling −3 dB Low Frequency	10 Hz	16 Hz

*1 *Verified by rise time.*
*2 *Optional accessory.*
*3 *Typically 1.1 GHz at room temperature.*

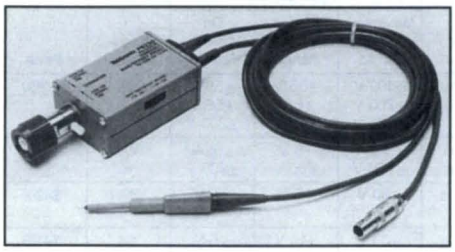
ORDERING INFORMATION

P6202A 10X, 2 m FET Probe **$735**
Includes: Retractable probe tip (E2, 013-009701); Two alligator clips (A16, 344-0046-00); Probe holder (352-0351-00); 7.5 cm (3 in.) Ground (G6, 175-0849-00); Probe adjustment tool (F5, 003-0675-01); Carrying case; 13 cm (6 in.) Ground lead (G8, 175-1017-00); 2 Replaceable probe tips*1; Electrical Insulating sleeve (B16, 166-0404-01); Instruction manual (070-3642-00).
*1 *Available in package of 10 only. Order 206-0230-03 (B26).*

P6202A OPTIONAL ACCESSORIES

10X Attenuator—For total 100X attenuation. Order 010-0384-00 **$80**
AC Coupling Cap—Order 010-0360-00 **$40**

P6230
DC to 1.5 GHz, 10X Bias/Offset With Readout



For 50 Ω or 1 MΩ Inputs

- **Bias/Offset**
- **Internal/External 50 Ω Termination Switch**
- **Low Impedance**
- **For Adjusting Tip "Nulling" Voltage (±5.0 V DC)**
- **Fully Compatible With Tek Subminiature Probe Accessories**
- **UL Listed**

The P6230 is a 1.5 GHz, low-impedance, subminiature, 10X active probe for use with broad-band scopes. A switch on the compensation box allows selection of internal or external 50 ohm termination so the probe may be used with instruments having either 50 ohm or 1 megohm input resistances. A coding pin on the BNC connector activates the readout of instruments with this feature.

The P6230 acts as a standard 500 ohm passive voltage probe with the additional capability of having an adjustable tip *nulling voltage*. This feature reduces the dc-loading effects of the probe when it is used to measure signals whose mid-voltage value is not at zero volts, or in circuits where the termination impedance is not returned to ground level. The Input Bias/Offset Voltage may be adjusted so that the voltage at the probe input resistor is equal to the test signal potential; thus, no current flows through the input resistor.

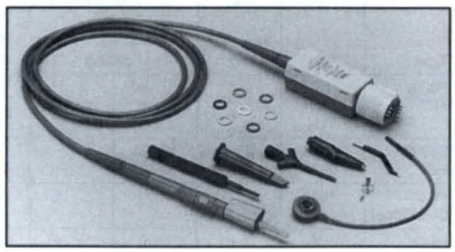
The probe derives its power from the probe power jack on many Tek scopes or the 1101A Power Supply.

The P6230 is compatible with all subminiature probe accessories. With the subminiature-to-miniature probe tip adapter (013-0202-02), all miniature probe accessories on page 548 can be used.

ORDERING INFORMATION

P6230 10X, 1.6 m. Bias/Offset Probe **$420**
Includes: (020-0798-00); Adjustment tool (F3, 003-1364-01); Retractable hook tip (C1, 013-0208-00); Circuit board connector (C5, 131-2766-03); 8.8-in. Alligator ground lead (G10, 195-1870-00); 6-in. Microhook ground lead (G5, 195-4104-00); 2-in. Ground lead (G9, 195-4240-00); Probe holder (352-0687-00); 2 each of white, gray, red and green cable markers; Instruction manual (070-4211-00).

P6231
DC to 1.5 GHz, 10X, Bias/Offset Probe, With Identify and Readout



For 50 Ω Input

- **For Use with the *Intelligent* TekProbe™ Interface of the 11000 Series Plug-ins**
- **Identify Button on Probe Allows Remote Sequencing of Oscilloscope Programs**
- **Probe Power Comes Through Connector**
- **Bias/Offset for Adjusting Tip *Nulling* Voltage (± 5.0 V Dc)**

The P6231 is an active probe designed for amplifiers with an input impedance of 50 ohm, primarily the 11A52 and 11A71 high-frequency amplifiers. Connection of the P6231 into any other 11000 Series amplifier automatically causes the input impedance to be set at 50 ohm. Up to five volts of bias may be applied to the tip of the P6231 to reduce the DC loading on the circuit under test. The offset voltage is selectable from the mainframe touch screen.

CHARACTERISTICS

	P6230	P6231
Attenuation	10X±3%	10X±1%
Input R/C	450 Ω 1.3 pF	450 Ω 1.6 pF
Bandwidth	1.5 GHz	1.5 GHz
Max DC Input Voltage	10 V	10 V
DC Offset Range	±5.0 V	±5.0 V

ORDERING INFORMATION

P6231 10X, Bias/Offset Probe **$410**
Includes: Adjustment tool (F3, 003-1364-01); Retractable hook tip (C1, 013-0208-00); 2 Circuit board connectors (C5, 131-2766-03); 8.8-in. ¼alligator ground lead (G10, 195-1870-00); 6-in. Ground lead (196-3113-00); 2-in. Ground lead (G9, 195-4240-00); Miniature alligator clip (A16, 344-0046-00); IC grabber (013-0217-00); Two each white, black, silver, gray, blue, orange, red, green and yellow cable markers; manual (070-6027-00).

OPTIONAL ACCESSORIES

KLIPKIT—16-pin DIP package accepts the P6230 and P6130 family probes directly. Other probes must use the supplied pins and attach via a retractable hook tip. Included are two DIP clips, and four signal/ground pins. Order 013-0197-00 **$46**

KLIPKIT Signal/Ground Pins—Includes eight signal/ground pins for use with the KLIPKIT. Order 131-3288-02 **$31**

1101A Power Supply

The 1101A Accessory Power Supply provides power for active probes such as the Tektronix P6201, P6202A and P6230 when they are used with oscilloscopes that do not supply probe power.

The 1101A will provide power for up to two probes. Output power features short-circuit protection.

CHARACTERISTICS

Output Voltages—+15 V dc ±2%; −15 V dc ±2%; +5 V dc ±5%.
Output Currents—300 mA each supply (short-circuit protected). +15 V, −15 V supplies: ≤1 mV RMS with 300 mA load.
Ripple—+5 V Supply: ≤5 mV RMS with 300 mA load.
AC Input Voltages—Selectable, 87 to 128 V ac or 174 to 250 V ac.
Line Frequency—48 to 440 Hz.
Power—30 W maximum at 115 V ac.

PHYSICAL CHARACTERISTICS

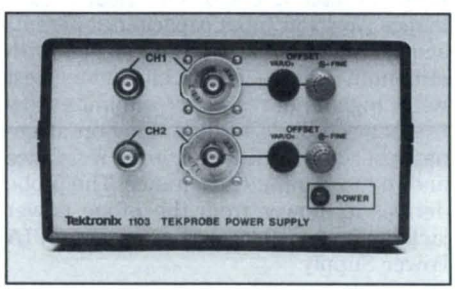
Dimensions	mm	in.
Width	157	6.2
Height	89	3.5
Depth	165	6.5
Weight ≈	**kg**	**lb**
Net	1.7	3.8

ORDERING INFORMATION

1101A Accessory Power Supply **$440**
Includes: Instruction sheet 070-5126-00.

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A4—North American 240 V, 60 Hz.
Option A5—Switzerland 220 V, 50 Hz.



1103 TekProbe™ Interface Power Supply (see page 528).

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

DIFFERENTIAL PROBES

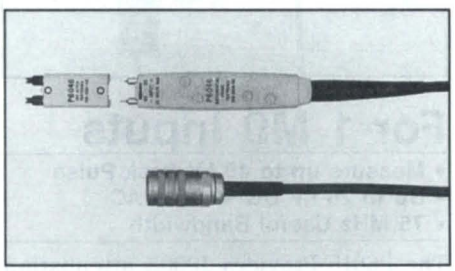
Tek supports four modes of differential measurements: the differential amplifier probe, the matched pair of probes, the isolation amplifier, and the ground interrupt monitor.

The P6046 is a 100 MHz differential amplifier in probe form. It connects into one channel of a standard scope amplifier.

A matched pair of probes (P6055 or P6135) can produce CMRR ratios up to 20,000:1 (P6055) with differential amplifiers. A single 10X probe has accuracy of 1% or less giving a scope-to-probe CMRR of no better than 50:1.

P6046

DC to 100 MHz, 1X Differential



For 50 Ω or 1 MΩ Inputs

- **1000:1 CMRR at 50 MHz (DC-Input Coupled)**
- **500:1 CMRR at 50 MHz (AC-Input Coupled)**
- **±250 V Maximum Voltage with 10X Attenuator**
- **Dual Probe Tips for Greater CMRR at High Frequencies**

The P6046 Differential Probe and P6046 Amplifier Unit provide unique measurement capabilities with all Tektronix oscilloscopes. 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.

CHARACTERISTICS

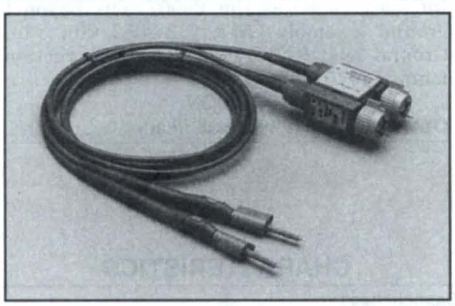
CMRR—With deflection factors of 1 to 20 mV/div: at least 10,000:1 at 50 kHz, 5,000:1 at 1 MHz, and 1,000:1 at 50 MHz (dc coupled).
Common-Mode Linear Dynamic Range—±5 V, ±50 V with 10X attenuator.
Bandwidth—DC to 100 MHz (−3 dB).
Rise Time—3.5 ns or less.
Deflection Factor Range—1 to 200 mV/div in 8 calibrated steps, 1-2-5 sequence, accurate within 3% (with an oscilloscope deflection factor of 10 mV/div).
Input RC—1 MΩ paralleled by 10 pF or less.
Input Coupling—AC or dc, selected by a switch on the probe. Low frequency response ac-coupled is −3 dB at 20 Hz, 2 Hz with 10X attenuator.
Displayed Noise—280 μV or less (tangentially measured).
Maximum Input Voltage—±25 V (dc + peak ac), ±250 V with 10X attenuation, derated with frequency. The P6046 circuitry can be damaged by electrostatic discharge. Please refer to manual for use.
Output Impedance—50 Ω through a BNC-connector. 50 Ω termination supplied with amplifier for use with 1 MΩ systems.
Probe Cable—6 ft long, terminated with special nine-pin connector.

ORDERING INFORMATION

P6046 1X, 6 ft FET Differential Probe With Amplifier and Power Supply **$1,895**
Includes: 50 Ω termination (011-0049-01); Amp and power supply (015-0106-00); 50 Ω Coaxial cable (012-0076-00); Hanger assembly (014-0029-00); Carrying case (016-0111 01); 10X attenuator (010-0361-00); Dual attenuator head (010-0419-00); Swivel probe tip; spring ground contact; Connector test point jack; Instruction manual (070-0756-00).

OPTION

Option 11—Probe Without Amplifier and Power Supply **−$825**
Power Supply With Amplifier—Order 015-0106-00 **$1,000**



P6135 Differential Probe

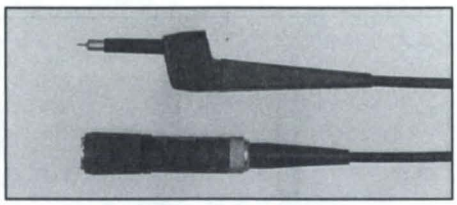
P6135 DC to 150 MHz, 10X

Refer to the P6135 Differential Probe (page 528), which was designed for the 11000 Series differential amplifiers.

The A6902B also provides differential capabilities. See page 543.

P6055

20,000:1 CMRR, 10X With Readout



- **High CMRR**
- **Compact Size**
- **Low Capacitance**
- **DC to 60 MHz**

The P6055 is a miniature, low capacitance, 10X probe designed for use with Tektronix differential amplifiers with nominal input capacitances from 20 to 47 pF. The attenuation ratio is adjustable to compensate for differences in input resistance of the amplifier (the amplifier input resistance must be 1 megohm ±2%). A special locking type readout connector allows use 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. The use of a matched pair of P6055 differential probes provides the best possible system CMRR.

CHARACTERISTICS

CMRR—20,000:1 from dc to 1 kHz derating to 100:1 at 20 MHz.
Attenuation—Adjustable to 10X.
Input Resistance—1 MΩ ±0.5%.
Input Capacitance—≈10 pF when used with instrument that has 20 pF input capacitance; 12.5 pF when used with instrument that has 47 pF input capacitance.
Maximum Useful Bandwidth—60 MHz.
Typical Probe Rise Time—5.8 ns.
Maximum Voltage—500 V (dc + peak ac) from dc to 12 MHz, p-p V derated to 100 V at 70 MHz.

ORDERING INFORMATION

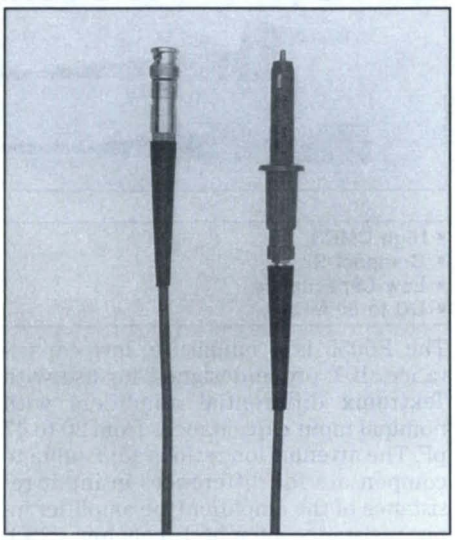
P6055 Matched Pair of 10X, 3.5 ft Differential Probes **$555**
Includes (for each probe): Probe holder (352-0090-00); Adjustment tool (F4, 003-0675-00); Retractable hook tip (B3, 013-0107-05); Two minialligator clips (A16, 344-0046-00); Probe tip ground cover (B16, 166-0404-01); 5-in Ground lead (G7, 175-0124-01); 12-in Ground lead (G7, 175-0125-01); 5-in Ground lead (G2, 175-1256-00); Hook tip (B6, 206-0114-00); Instruction manual (070-1115-00).

OPTION

Option 01—Single probe with accessories **−$260**

P6007

DC to 25 MHz, 100X



For 1 MΩ Inputs

- **1500 V DC**
- **Low Capacitance Loading**

The P6007 is a low input capacitance, high-voltage (1.5 kV) probe. It can be compensated to match all plug-ins and oscilloscopes with nominal input capacitances of 15 to 55 pF and input resistance of one megohm.

ORDERING INFORMATION

P6007 100X, 6 ft High Voltage Probe **$130**

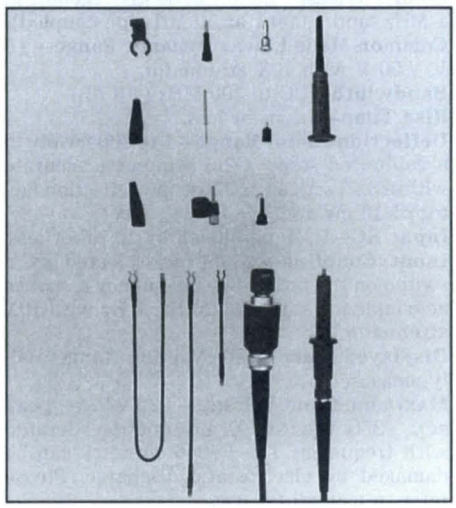
Includes: Retractable hook tip (A1, 013-0071-00); Banana tip (A12, 134 0013-00); 5-in. Ground lead (G7, 175-0124-01); 12-in. Ground lead (G7, 175-0125-01); 0.055-in. Diameter straight tip (206-0015-00); 0.080-in. Diameter spring tip (A4, 206-0060-00); Hook tip (A6, 206-0105-00); Two miniature alligator clips (A16, 344-0046-00); Probe holder (352-0090-00); Instruction manual (070 0388-01).

OPTIONS

Option 01—3.5 ft cable. **+$5**
Option 03—9 ft cable. **+$15**
Option 04—12 ft cable. **+$20**

P6009

DC to 120 MHz, 100X With Readout



For 1 MΩ Inputs

- **1500 V DC**
- **DC to 120 MHz**
- **Low Capacitance—2.5 pF**

The P6009 is a low input capacitance, high-voltage (1.5 kV) probe designed for use with dc to 150 MHz oscilloscopes. The probe can be compensated to match plug-ins and oscilloscopes with nominal input capacitances of 12 to 47 pF and input resistance of one megohm.

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.

ORDERING INFORMATION

P6009 100X, 9 ft High Voltage Probe With Readout **$205**

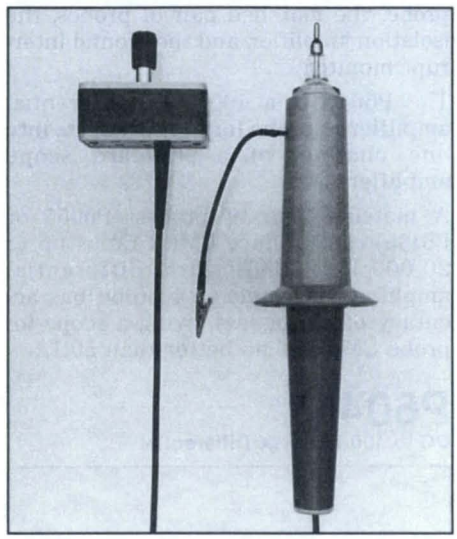
Includes: Same as the P6007 plus Bayonet ground assembly (A17, 013-0052 00); 3-in. Ground lead (G7, 175-0263-01); Instruction manual (070-0401 01).

OPTION

Option 14—9 ft without Readout. **NC**

P6015

40 kV, Peak Pulse, 1000X



For 1 MΩ Inputs

- **Measure up to 40 kV Peak Pulse**
- **Up to 20 kV DC + Peak AC**
- **75 MHz Useful Bandwidth**

The P6015 Provides 1000X attenuation for oscilloscope measurements up to 40 kV peak pulse. Voltage or duty cycle derating is necessary for RF voltages at frequencies over 100 kHz, or at temperatures above 25 °C.

The probe can be compensated for instruments with nominal input capacitance of 12 to 47 pF and input resistance of one megohm.

ORDERING INFORMATION

P6015 1000X, 10 ft High Voltage Probe **$725**

Includes: Carrying case (016-0128-02); High-voltage dielectric fluid (A21, 252-0120-00); Alligator clip (A14, 344-0005-00); Probe holder (352-0056-00); Instruction manual (070-0373-02).

OPTIONS

Option 10—Without freon. Max 13 kV. **NC**
Option 25—25 ft cable (8 MHz B/W). **+$100**
Option 26—25 ft cable without freon. Max 13 kV (8 MHz B/W). **+$100**

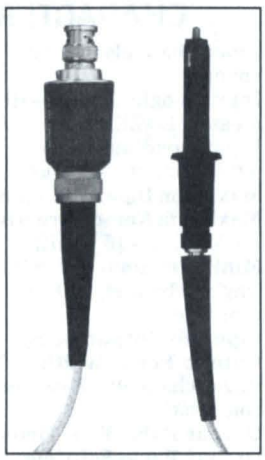
CHARACTERISTICS

	Attenuation	Accuracy	Input Resistance	Input Capacitance 3½ ft	6 ft	9 ft	Probe Rise Time	Aberrations	Bandwidth	Nominal Cable Length (ft)	Maximum DC or RMS Voltage	Derated Above	Scope C in pF
P6007	100X	3%	10 MΩ	2 pF	2.2 pF	2.4 pF	14.0 ns	±3	25 MHz	3½, 6, 9, 12	1.5 kV	200 kHz	15 to 55
P6009	100X	3%	10 MΩ			2.5 pF	2.9 ns	±3	120 MHz	9	1.5 kV	200 kHz	15 to 47
P6015	1000X	Adjustable	100 MΩ	3 pF (10 ft only)			4.0 ns	±5	75 MHz	10	20.0 kV	100 kHz	12 to 47

Above probes compatible with screw-tip accessories. Instrument compatibility chart is on pages 521-522.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

P6008
100 MHz, 10X Environmental



For 1 MΩ Input

- **−50 to +150°C Temperature Range**

The P6008 Environmental Probe operates over −50 to +150 °C for the probe body and cable; the compensation box operates from −15 to +55 °C. It is designed for use with dc to 100 MHz oscilloscopes. The probe can be compensated to match plug-ins and oscilloscopes with nominal input capacitance of 12 to 47 pF and input resistance at one megohm. The P6008 is compatable with the screw-tip accessories.

CHARACTERISTICS

	P6008
Attenuation	10X
Input Resistance	10 MΩ
Input Capacitance	≈7.5 pF with an instrument having 20 pF input capacitance
Bandwidth	DC to 100 MHz
Voltage Rating	600 V dc, ac peak, or dc and ac peak combined. P-p voltage derating is necessary for cw frequencies > 20 MHz. At 40 MHz, the maximum allowable p-p voltage is 300 V
Scope C in pF	12-47

ORDERING INFORMATION

P6008 10X, 6 ft Environmental Probe **$260**

Includes: Retractable hook tip (A2, 013-0071-01); Banana tip (A12, 134-0013-00); 12-in. Ground lead (G7, 175-0125-01); Alligator clip (A15, 344-0045-00); Probe holder (352-0090-00); Instruction sheet (070-1173-00).

Option 01—3.5 ft cable, non-environmental **NC**

P6048
DC to 100 MHz, 10X

For 1 MΩ Input

- **Minimum Loading, 1 pF at 1 kΩ**
- **AC/DC Switch**

The P6048 is a miniature low capacitance probe for use with one megohm 20 pF oscilloscopes. The probe input impedance of one kilohm paralleled by 1 pF is intended for applications where capacitive loading may distort the circuit waveforms. AC or dc coupling switch is available to extend the measurement range.

CHARACTERISTICS

	P6048
Attenuation	10X
Input Resistance	1 kΩ
Input Capacitance	1 pF or less
Maximum Input	DC 20 V; ac 200 V
AC Low Frequency	7 kHz or less
Bandwidth	100 MHz
Typical Probe Rise Time	1.95 ns
Scope C in pF	15-20

ORDERING INFORMATION

P6048 10X, 6 ft Minimum Loading Probe **$225**

Includes: Retractable hook tip (E1, 013-0090-00); 2 Probe tip ground covers (B16, 166-0404-01); Insulating sleeves (D8, 166-0433-00); 5-in. Ground lead (G7, 175-0124-01); 3-in. Ground lead (175-0263-01); Hook tip (G7, 206-0114-00); 2 Miniature alligator clips (A16, 344-0046-00); Probe holder (352-0090-00); Instruction manual (070-0675-01).

P6057
DC to 1.4 GHz, 100X 5000 Ω With Readout

For 50 Ω Input

- **Minimum Loading, 1 pF or Less**
- **<70 ps Probe to Probe Variation**

The P6057 is a miniature low-capacitance probe for use with 50 ohm wide-band oscilloscopes. The BNC connector provides trace identification and CRT readout information when used with instruments having these features. A convenient button on the probe activates this function. This probe can also be used with 50 ohm sampling systems, with the appropriate adapters.

CHARACTERISTICS

	P6057
Rise Time	<250 ps
Input R @ DC	5 kΩ
Input R @ 1 GHz	1500 Ω
Maximum DC + Peak AC	50 V
Derated Above	500 MHz
Maximum Peak @ 1 GHz	21 V
Maximum Peak Pulse	500 V <1 ms

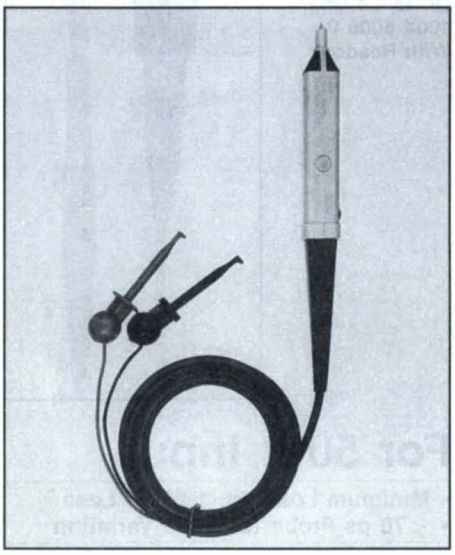
ORDERING INFORMATION

P6057 100X, 6 ft 50 Ω Probe **$195**

Includes: 6-in. Ground lead (G6, 175-0849-01); 3-in. Ground lead (G1, 195-6176-00); Replaceable tip (013-0085-00); Hook tip (206-0114-00); 2 Electrical contacts (B28, 214-0283-00); Alligator clip (344-0046-00); Instruction sheet (070-1224-00); replaceable tip (307-0329-01).

Option 3—9 ft cable **+$15**

P6401 Logic Probe



- **Illuminated Probe Tip Indicates Logic Level**

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 ponts. 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.

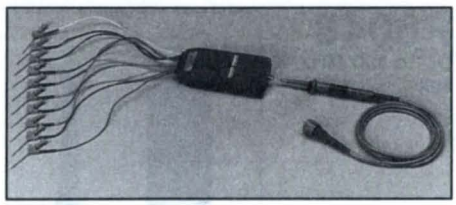
Two bright lights in the probe tip indicate condition of the logic signal.

CHARACTERISTICS

Low State Input Voltage Threshold—+0.7 V ±0.125 V.
High State Input Voltage Threshold—2.175 V ±0.125 V to V cc.
Minimum Recognizable Pulse Width—10 ns.
Minimum Recognizable Strobe Pulse Width—20 ns.
Impedance—≈7.5 kΩ paralleled by ≈6 pF.
Minimum Circuit Resistance for Open Circuit Indication—10 kΩ.
Maximum Nondestructive Strobe Input—±30 V (dc or RMS).
Maximum Nondestructive Input—±150 V (dc or RMS).
Strobe Input Impedance—5.6 kΩ within 20%.

ORDERING INFORMATION

P6401 1.5 m Logic Probe. **$190**
Includes: Probe tip hood (B6, 206-0114-00); Strobe lead (175-0958-01); Strobe lead (175-0958-00); probe tip to 0.025 inch square pin adapter (A10, 206-0137-01); White plug (348-0023-00); Two alligator clips (A16, 344-0046-00); Accessory pouch (016-0537-00); data sheet (062-1693-00).



NEW P6408

TYPICAL APPLICATIONS

- **Troubleshooting Timing Problems Between the MPU and Disk Drive.**
- **Troubleshooting Memory Systems**
- **Used Whenever a Specific Binary Word is Used to Implement a Function**

FEATURES

- **For TTL and TTC-Compatible Logic**
- **Allows Oscilloscope to Trigger on User-Defined Logic States**
- **Non Scope Specific (Can be Used with Any Scope)**
- **17-bits (16 Data Plus Qualifier)**
- **Synchronous or Asychronous Operation**
- **Easy to Use**
- **Simplifies Digital Design and Troubleshooting**

The P6408 is a 16-channel word recognizer/trigger probe for use with analog and digital storage oscilloscopes. The P6408 allows triggering on logic states, rather than on analog levels. The trigger word is manually programmed via 16 miniature DIP switches on the probe pod with HI, LO, and DON'T CARE recognition capabilities.

The P6408 leads are connected to the DUT (Device Under Test) via TEK SMT Grabber Clips (see page 544). The grabber clips allow access to high-density circuitry, with lead spacing down to 50 mils.

The P6408 is an active probe and derives its operating power from the DUT. The P6408 draws a maximum 100 mA from the DUT's 5 V bus. An optional probe power cable is available that allows the P6408 to be powered from any TEK scope (with a probe power connector), 1101A Probe Power Supply, or from a user-furnished +5 V supply.

The P6408 includes a P6109, 10X, passive probe which couples the output of the probe pod to a 1M-ohm trigger input of an oscilloscope. This presents a low C load to the probe pod and delivers a fast rise pulse to the scope's trigger input.

CHARACTERISTICS

Input Channels—16 data channels, 1 qualifier channel.
Input Logic Levels—HI/ONE, +2.0 V or greater; LO/ZERO, +0.7 V or less.
Input Loading—+2.7 V input, 20 μA max; +0.5 V input, −600 μA max.
Maximum Input Voltage Swing—0 V to V cc.
Maximum Non-destructive Input Voltage—−1 V (LO), +15 V (HI).
Minimum Input Pulse Width—10 nS for any single channel; 40 nS for any channel combination.
Input To Output Delay—20 nS max.
Output Pulse Width—10 nS min. for any single channel; 27 nS min. for any channel combination.
Output Pulse Rise Time—10 nS max.
Output Pulse Falltime—10 nS max.
Output Voltage Level—HI/ONE, +200 mV or greater; LO/ZERO, +70 mV or less; (At output of P6109).
Power Requirements—Volts: +5 V ±0.25 V Current: 100 mA max.
Temperature—Nonoperating: −55 to +75 °C (−67 to +167 °F).
Temperature—Operating: −0 to +50 °C (32 to 122 °F).
Net Weight—(Including Accessories): 207 grams (7.2 oz.).

ORDERING INFORMATION

P6408 Word Recognizer/Trigger Probe **$350**
Includes: 2 (10 wide) lead headers (012-0747-01); Pkg. of 20 SMT Grabber Clips (SMG50); P6109 Probe (complete package); Instruction sheet (070-6938-00)
P6407 Word Recognizer Probe
See page 223 for specifications and ordering information. **$455**

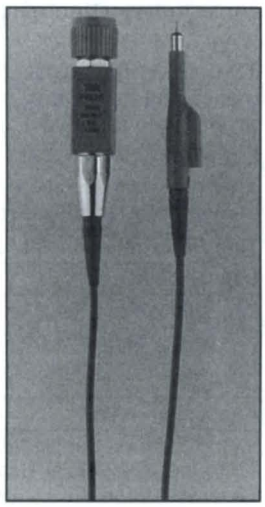
OPTIONAL ACCESSORIES

Probe Power Cable—
Order 174-1342-00. **$50**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

P6125

DC to 250 MHz, 5X Modular, Counter



For 1 MΩ Input

- **Small, Precision Tip**
- **Flexible, Low Mass Cable**
- **Hybrid Circuitry for Improved Performance**
- **UL Listed**

The P6125 is a low capacitance, 5X attenuation passive probe specially designed for dc to 250 MHz digital counter/timers. Five-times attenuation provides an optimum match between the counter input characteristics and the voltage levels of all common logic families. It makes more accurate time interval measurements of high speed logic signals possible with minimum loading of the circuits under test.

CHARACTERISTICS

Length—1.5 m.
Attenuation—5X.
Loading—5 MΩ 20.0 pF.
Bandwidth—250 MHz.
DC Max—250 V.
Scope Capactance—15.33 pF.

ORDERING INFORMATION

P6125 5X, 250 MHz, 1.5 m Modular Probe **$80**
Includes: Same as the P6122; instruction sheet (070-3617-02).

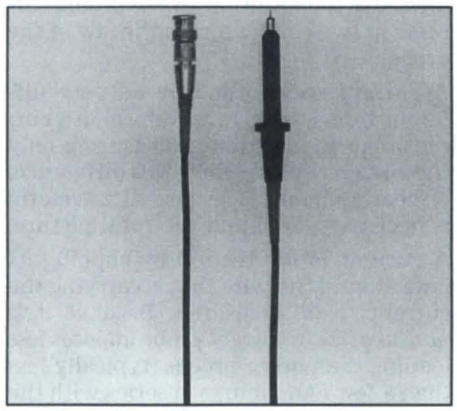
OPTIONAL ACCESSORY

Manual—Order 070-3617-02 **$2**

For probe accessories see pages 546-548.

For replaceable subassemblies, see page 545.

P6420 RF Probe



For 10 MΩ Inputs

- **10 kHz to 1 GHz Bandwidth**
- **DC V Output/RMS of Sine Input**

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 compatible with any DMM with an input resistance of 10 megohms.

CHARACTERISTICS

Voltage Range—0.5 to 25 V RMS (70.7 V p-p).
AC to DC Transfer Ratio Accuracy—0.5 to 5 V RMS ±10% (+15 to +35°C). 5.0 to 25 V RMS ±5% (+15 to +35°C).
Frequency Response—100 kHz to 300 MHz (±0.5 dB). 50 kHz to 500 MHz (±1.5 dB), 10 kHz to 1 GHz (±3.0 dB).
Input Capacitance—≈3.7 pF.
Maximum Input Voltage—42.4 V (peak ac +dc).
Temperature Range—Nonoperating: −55 to +75°C. Operating: +15 to +35°C.
Length—Probe only: 96 mm. Cable Only: 2 m.

ORDERING INFORMATION

P6420 2 m RF Probe **$155**
Includes: Retractable probe tip (E2, 013-0097-01); Two alligator clips (A16, 344-0046-00); Two replaceable*[1] probe tips; electrical insulating sleeve (B16, 166-0404-01); 75 mm (3 in) Ground lead (G6, 175-0849-00); 130 mm (6 in) Ground (G8, 175-1017-00); Probe holder (352-0351-00); BNC female to dual banana adapter (103-0090-00); Data sheet (062-2764-00).

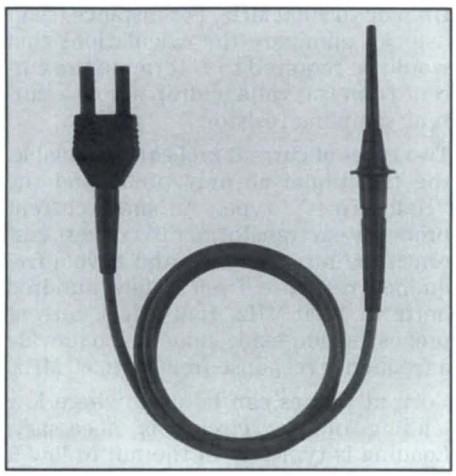
*[1] *Available in packages of ten (order 206-0230-03) or 100 (order 206-0230-04) (B26).*

OPTIONAL ACCESSORIES

Probe Cables—For P6420 (does not change electrical specifications):
(1 m) Order 174-0975-00 **$17**
(2 m) Order 174-0976-00 **$20**
(3 m) Order 174-0977-00 **$22**

P6601/P6602

Temperature Probe



P6602 (shown).

For DMM Input

The P6601 and P6602 are temperature-measuring devices designed to operate with the DM 502A and DM 501A Digital Multimeters (P6601) or with the 2236 Digital Multimeter (P6602). The temperature-sensing element consists of a thin-film platinum resistor on the tip of the probe. Measurements are made by touching the probe tip to the surface whose temperature is in question. The thermal signal is transmitted to the associated digital multimeter through a two-conductor cable.

The probes are totally immersible except in liquids that are not compatible with Dow Corning 308 molding compound (P6601), Polyset 410B molding compound (P6602), BeO, silicone rubber, or epoxy adhesives. The sensor and tip are limited to a maximum of 240°C (230°C for P6602), and the cable is limited to a maximum of 140°C.

ORDERING INFORMATION

P6601 Temperature Probe **$250**
Includes: Instruction manual (070-2620-00)
P6602 1.5 m Temperature Probe **$260**
Includes: Instruction manual (070-4377-00).

TEKTRONIX CURRENT PROBES

Current probes provide a method to measure the current flowing in a circuit from dc to 1000 MHz. For instance, their use can eliminate the calculations that would be required to determine the current from the voltage drop across a current sampling resistor.

Two types of current probes are available, the traditional ac only probe and the "Hall effect" type. Ac only current probes use a transformer to convert current flux into ac signals and have a frequency response from a few hundred hertz to 1000 MHz. Hall effect current probes include semiconductors to provide a frequency response from dc to 50 MHz.

Current probes can be used where low loading of the circuit is necessary. Loading is typically in the mΩ to low Ω 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. A measurement of the current waveform is necessary to obtain the total picture.

A current probe is used by clipping its jaws around the wire that is carrying the current to be measured. Because it is *noninvasive*, a current probe imposes less loading than other probes (typically less than a few nanohenrys in series with the wire at a capacitance of less than 1 pF). Differential current measurements are made by passing the two wires (in correct phase) through the current probe jaws.

The CT-4 increases the high-current measuring capability of most current probes by either 20:1 or 1000:1.

Literature

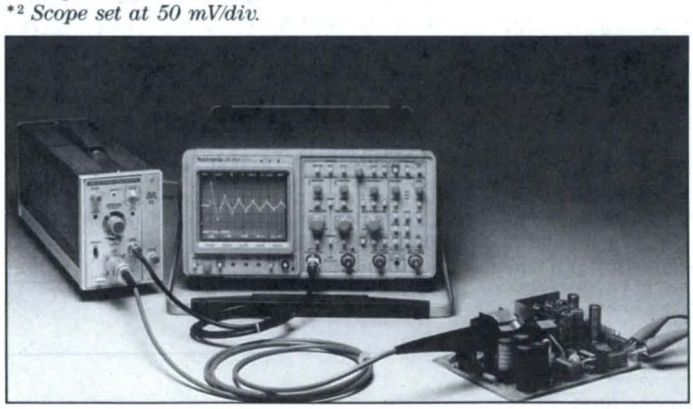
The following literature on current probes is available from Tektronix.

Title/Description	Literature Number
Data Sheets	
P6021/P6022	60W-6647
A6302/AM503	60W-6649
A6303/AM503	60W-6648
CT-1/CT-2	60W-6645
Application Note	
Switching Power Supply Testing Using the 11000 Series Scopes and A6302/A6303 Current Probes	47W-6550

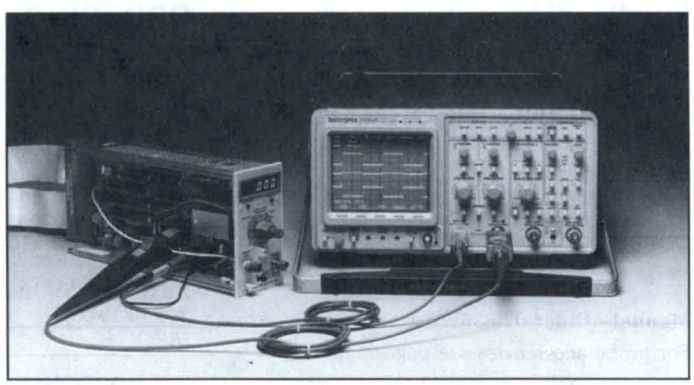
CURRENT PROBE SELECTION GUIDE

Type	Bandwidth	Maximum Current			Derate		Saturation			Prices
	Hz to MHz (−3 dB)	Pulse Peak	DC + pk AC	AC P-P	Below	Above	DC	Amp-S Product	Display Sensitivity Range in Current/Div.	
A6302/AM 503 with CT-4	DC to 50	50 A	20 A	40 A		20 kHz	20 A	100×10^{-6}	1 mA to 5 A*1	$3,185
	0.5 to 20	1 kA		1 kA	20 Hz	1.2 kHz		0.1	20 mA to 5 kA*1	$1,865
A6303/AM 503	DC to 15	500 A	100 A	200 A		20 kHz	100 A	$10{,}000\times10^{-6}$	10 mA to 50 A*1	$2,420
P6021 with Passive Termination	120 to 60	250 A		15 A	300 Hz	5 MHz	0.5 A	500×10^{-6}	20 mA*1 or 100 mA*1	$450
and CT-4	120 to 20	1 kA		1 kA	300 Hz	1.2 kHz	20 A	0.5	400 mA*1 or 100 A	$1,770
P6021 with 134	12 to 20	250 A		15 A	230 Hz	5 MHz	0.5 A	500×10^{-6}	1 mA to 1 A*2	$1,120
and CT-4	25 to 20	1 kA		1 kA	230 Hz	1.2 kHz	20 A	0.5	20 mA to 1 kA*2	$2,440
P6022 with Passive Termination	935 to 120	100 A		6 A	3 kHz	10 MHz	0.2 A	9×10^{-6}	10 mA or 100 mA*1	$495
with 134	100 to 65	100 A		6 A	1.3 kHz	10 MHz	0.2 A	9×10^{-6}	1 mA to 1 A*2	$1,165
CT-1	25 k to 1000	12 A		1.4 A			0.2 A	1×10^{-6}	2.0 mA*1 (5 mV/mA)	$235
CT-2	1.2 k to 200	36 A		7 A			0.2 A	50×10^{-6}	10.00 mA*1 (1 mV/mA)	$210

*1 *Scope set at 10 mV/div.*
*2 *Scope set at 50 mV/div.*



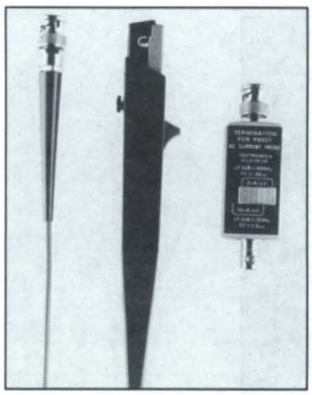
A6302, AM 503, TM 501, and 2430A scope.



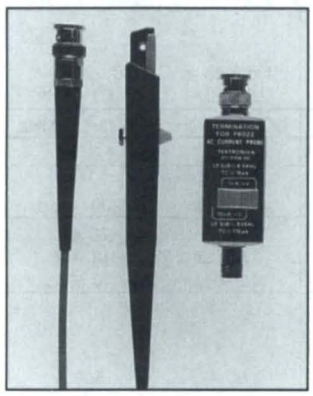
P6021, P6131, and 2430A scope.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

P6021
With Termination



P6022
With Termination



134 Current Probe Amplifier

- **For 1 MΩ Inputs**
- **Clip-on Capability**
- **Shielded Probe Heads**

The P6021 and P6022 Current Probes and 134 Current Probe Amplifier provide versatility in a user-assembled ac current measurement system. Both probes provide accurate current measurements over a wide range of frequencies and are used with real time oscilloscopes. The P6021 and P6022 allow current measurements without breaking the circuit by clipping onto the current carrying conductor. Just open the spring-loaded slide, place the conductor into the slot and release the slide. No electrical connection is required. Shielded probe heads are not grounded when the slides are in their open positions, eliminating accidental grounding of the circuit under test. P6021 and P6022 data sheet (60W-6647) is available.

P6021 Current Probe

For general purpose applications the P6021 provides wide-band performance with excellent low-frequency characteristics. Bandwidth is 120 Hz to 60 MHz. Passive termination is switchable from 2 mA/mV to 10 mA/mV.

P6022 Current Probe

The extra small size of the P6022 makes it ideally suited to measure current in compact semiconductor circuits. Bandwidth is 935 Hz to 120 MHz. Passive termination is switchable from 1 mA/mV to 10 mA/mV.

134 Current Probe Amplifier

The 134 is used to extend the measurement capabilities and sensitivity of the P6021 or P6022 Current Probes. 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 with 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 5 ft Current Probe With Termination **$450**
Includes: 5 in (130 mm) Ground lead (G7, 175-0124-01); 3 in (75 mm) Ground lead (G7, 175-0263-01); Two miniature alligator clips (A15, 344-0045-00); Instruction manual (070-0947-00).

P6022 5 ft Current Probe With Termination **$495**
Includes: Same as the P6021; Instruction manual (070-0948-00).

OPTIONS

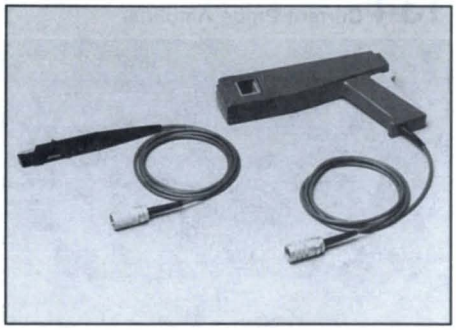
Option 03—9 ft with termination. **+$25**
Option 12—5 ft without termination.
(P6021) **−$40**
(P6022) **−$65**
Option 13—9 ft without termination.
(P6021) **−$40**
(P6022) **−$65**
134 110 V Current Probe Amplifier **$670**
Includes: Hanger assembly (014-0029-00); Cable assembly (012-0104-00); Power supply (015-0058-02); Instruction manual (070-0990-01).

OPTIONAL ACCESSORIES

Carrying Case—For P6021 or P6022, and a 134 Amplifier. Order 016-0087-01 **$30**
Passive Termination—
(P6021) Order 011-0105-00 **$125**
(P6022) Order 011-0106-00 **$150**
Power Supply—
(110 V ac) Order 015-0058-02 **$165**

PERFORMANCE CHARACTERISTICS

	P6021 with Passive Termination		P6022 with Passive Termination		Probe with 134 Amplifier	
					P6021	P6022
Accuracy 3% Sensitivity	2 mA/mV	10 mA/mV	1 mA/mV	10 mA/mV	1 mA to 1 A/div @ 50 mV/div	
Bandwidth Low −3 dB High −3 dB	 450 Hz 60 MHz	 120 Hz 60 MHz	 8.5 kHz 100 MHz	 935 Hz 120 MHz	 12 Hz 38 MHz	 100 Hz 65 MHz
Rise Time	5.8 ns	5.8 ns	2.7 ns	1.7 ns	9.2 ns	5.4 ns
Droop TC	0.35 ms	1.3 ms	18.7 μs	0.17 ms	13 ms	1.6 ms
Maximum AC CW From To	15 A peak (1.2 kHz to 5 MHz)	15 A peak (300 Hz to 5 MHz)	6 A peak (10 kHz to 10 MHz)	6 A peak (3 kHz to 10 MHz)	15 A peak (230 Hz to 5 MHz)	6 A peak (1.3 kHz to 10 MHz)
Maximum Peak Current	250 A	250 A	100 A	100 A	250 A	100 A
Amp/Second Product	500×10^{-6}	500×10^{-6}	9×10^{-6}	9×10^{-6}	500×10^{-6}	9×10^{-6}
Maximum DC	0.5 A	0.5 A	0.2 A	0.2 A	0.5 A	0.2 A
Insertion Z (Ω)	0.03 @ 1 MHz 1.0 @ 60 MHz		0.03 @ 1 MHz 0.2 @ 120 MHz		0.03 @ 1 MHz 1.0 @ 38 MHz	0.03 @ 1 MHz 0.2 @ 65 MHz
Propagation Delay (ns) 5 ft 9 ft	 9 15	 9 15	 9 15	 9 15	 9 15	 9 15
Maximum Voltage (Barewire)	600 V	600 V	600 V	600 V	600 V	600 V
Net Weight	≈1 lb		≈1 lb		≈5 lb	
Maximum Conductor Size	0.15 in. dia		0.1 in. dia		0.15 in dia	0.1 in. dia
Operating Temperature	0 to 50°C		0 to 50°C		0 to 50°C	



A6302 (left) and A6303 (right) shown.

A6302/A6303 Current Probes

- **20 A AC and DC Current Measurements**
- **DC to 50 MHz Bandwidth**
- **Peak Pulse Measurements to 50 A, 1,000 A With the CT-4 Current Probe**
- **AC or DC Coupling**
- **Small Loading—0.1 Ω Insertion Z at 1 MHz, 0.5 Ω at 50 MHz**
- **100 A AC and DC Current Measurements**
- **Peak Pulse Measurement to 500 A**
- **AC or DC Coupling**
- **25x21 mm (1x0.83 in.) Jaw Opening**
- **Minimal Loading—0.02 Ω Insertion at 1 MHz, 0.15 Ω at 15 MHZ**

The A6302 and A6303 Current Probes are designed to be used with the AM 503 Current Probe Amplifier, any TM 500 Power Module and an oscilloscope. Both probes are used to make SCR, power supply, industrial control and motor start-up current measurements. The A6303 is recommended for measuring current in X-ray tubes to ensure compliance with PL 90-602, the Radiation Control for Health and Safety Act of 1968.

The A6302 and A6303 are valuable measurement tools when low loading is important, as when testing high impedance points or with current dependent devices. Both probes make ac or dc coupled current measurements simply by opening the sliding jaws and placing them around the conductor to be measured. For differential or sum measurements, just place properly phased conductors in the probe jaw.

Suggested measurements for the A6302 and A6303 Current Probes include:

- X-ray tube currents
- SCR currents
- Power supply currents
- Motor start-up currents
- Industrial control currents
- Relay currents
- Common-mode rejection of dc and ac currents

CHARACTERISTICS

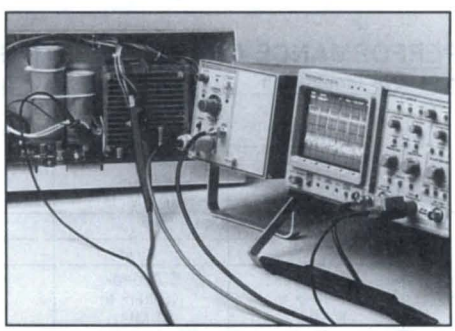
	A6302/AM 503*[1]	A6303/AM 503*[1]
Sensitivity: Scope @ 10 mV/div Accuracy 3%	1 mA/div to 5 A/div	10 mA/div to 50 A/div
Bandwidth	DC to 50 MHz	DC to 15 MHz
Rise Time	7 ns	23 ns
Max AC Current CW	40 A p-p	200 A p-p
Derated Above	20 kHz 2.5 A @ 10 MHz	20 kHz 12 A @ 10 MHz
Maximum Peak Current Not to Exceed A-S Product	50 A	500 A
A-S Product	100×10^{-6}	$10{,}000\times10^{-6}$
Insertion Z	0.1Ω @ 5 MHz 0.5Ω @ 50 MHz	0.02Ω @ 1 MHz 0.15Ω @ 15 MHz
Max Hardware Volts	500 V	700 V
Max Conductor Diameter	0.15 inch	0.83 inch
System Prop Delay	≈30 ns	≈40 ns
Cable Length	2 m	2 m
Tangential Noise	0.3 mA	3 mA
Aberrations	±5%	±5%
Magnetic Susceptibility	250 μA/Gauss	25 mA/Gauss
Operating Temp	0 to +50°C	0 to +50° C

*[1] *A6302/AM 503 or A6303/AM 503 calibrated as a set.*

ORDERING INFORMATION

A6302 2 m Current Probe **$625**
Includes: 5-in (130 mm) Ground lead (G7, 175-0124-01); 3 in (75 mm) Ground lead (G7, 175-0263-01); 2 Miniature alligator clips (A16, 344-0046-00); Instruction manual (070-3905-01).

A6303 2 m Current Probe **$1,180**
Includes: Carrying case (016-0622-00); Instruction manual (070-3906-01).



AM503S (in use).

Data sheets for the A6302 (60W-6649) and A6303 (60W-6648) are available.

AM 503 Current Probe Amplifier

For 50 Ω/1 MΩ

The AM 503 operates in any one of the TM 500 power modules and is connected to the A6302 or A6303 probes through a multipin connector.

It is calibrated in 12 steps; the knob skirt is illuminated to indicate current per division. Bandwidth can be limited to 5 MHz to eliminate unwanted transients. Both ac and dc coupling are provided. AC coupling allows the measurement of low amplitude signals on a high level dc current. A front panel light warns of input currents above 100 A dc with the A6303 or 20 A dc with the A6302. A pushbutton allows degaussing of probe when it is removed from the circuit and locked in operating position.

The output of the A6303/AM 503 can be displayed on any oscilloscope that has at least a 50-MHz bandwidth and a 10 mV sensitivity. The A6302/AM 503 can be used on a 100-MHz oscilloscope with 10 mV sensitivity to display the probe's full bandpass. The AM 503 output can be plugged directly into a 50 ohm recording instrument, or a 50 ohm termination which is supplied.

AM 503S

To achieve optimum performance the current probe and current probe amplifier should be calibrated as a system. The AM503S system provides a fully calibrated system.

ORDERING INFORMATION

AM 503 Current Probe Amplifier **$1,240**
Includes: 50Ω BNC cable (012-0057-01); 50Ω BNC termination (011-0049-01); Instruction manual (070-2052-01).

The AM 503 requires one of the TM 500 Series power modules. See page 419.

AM 503S Current Probe System **$2,120**
Includes: AM 503 Current Probe Amplifier; TM 502A Power Module; A6302 Current Probe; Plug-in tool box (216-0362-02).

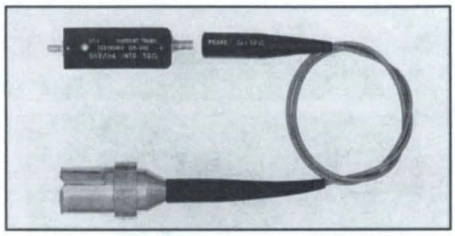
OPTIONS

Option 01—Adds A6303 Current Probe. **+$1,175**

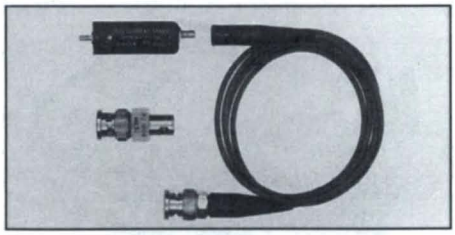
Option 03—Substitute A6303 for A6302. **+$550**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

CT-1 With Probe Cable



CT-2 With Probe Cable



CT-1/CT-2 Current Probes

- **The 1 GHz CT-1 is Used with 50 Ω Systems, or Wide Band Oscilloscopes; Has a Minimum Loading Effect on a 50 Ω Environment**
- **Insulated for Limited Space Applications**

The CT-1 and CT-2 Current Probes are designed for permanent or semipermanent in-circuit installation. Each probe consists of a current transformer, an interconnecting cable and a termination. The current transformers are traversed by a small hole through which a current carrying conductor is passed during circuit assembly. One probe cable can be used to monitor several current transformers that have been wired into a circuit.

A data sheet (60W-6645) for the CT-1 and CT-2 is available.

CHARACTERISTICS

	CT-1	CT-2
Sensitivity	5 mV/mA	1 mV/mA
Accuracy	±3%	±3%
Rise Time	350 ps	500 ps
Frequency Response*1 Low: −3 dB High: −3 dB	 25 kHz 1 GHz	 1.2 kHz 700 MHz
Insertion Impedance at: 10 MHz 100 MHz	 ≈1Ω 2Ω	 0.1Ω 0.5Ω
Capacitive Loading Barewire	1.5 pF for #14	1.8 pF for #16
Maximum Barewire Voltage	1000 V	1000 V
DC Saturation Current: Current to Reduce L/R by X2 Pulse Current Rating*2 Not to Exceed: Amp S Product*2 Maximum CW Current*2 Cable Length Prop Delay Cable Connector	 75 mA 12 A 1×10^{-6} 450 mA 18 inch 3.25 ns GR874	 175 mA 36 A 50×10^{-6} 2.5 A 42 inch 6.1 ns BNC
Operating Temperature	−25 to +65°C	

*1 *System B/W= $\sqrt{\text{probe B/W} + \text{scope B/W}}$.*
*2 *With 50 Ω termination. Values are reduced by a factor of 2 if unterminated.*

The CT-1 Probe Cable (P6040) provides the connection between the CT-1 current transformer and a GR scope input. This cable can also be used with other test point connectors such as Amphenol Series 27 Sub-Minax or Sealectro Sub-Miniature RF connectors.

The CT-2 Probe Cable (P6041) is used to connect the CT-2 current transformer with a BNC oscilloscope input. A 50 Ω termination is used to terminate the cable at the high impedance input of an oscilloscope.

ORDERING INFORMATION

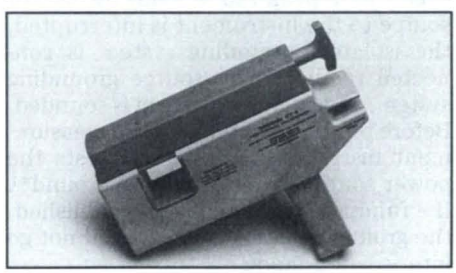
CT-1 Current Probe, Current Transformer and Probe Cable **$235**
Includes: Instruction manual (070-0375-01).

OPTION

Option 09—Current Transformer only. **−$90**
P6040—Probe Cable only. **$105**
CT-2 Current Probe, Current Transformer, Probe Cable, Termination **$210**
Includes: 50 Ω termination (011-0049-01); instruction manual (070 0406-01).

OPTION

Option 09—Current Transformer only. **−$60**
P6041—Probe Cable only. **$70**



CT-4 Current Probe

- **Continuous Currents Up to 1000 A Peak**
- **1.5 Inch Diameter Conductors**
- **Measurements on Bare Conductors to 3000 V**
- **Nullifies DC Effects to 300 A with DC Bucking Coil**
- **Pulsed Currents to 1 kA**

The CT-4 is a clip-on high current transformer that extends the measurement capability of the P6021 and A6302 clip-on current probes. Maximum low frequency performance is obtained using the A6302/AM 503. Pulse current to 1,000 amps may be measured using the P6021 and passive termination, provided the 0.5 A-s rating is not exceeded. The P6021 and 134 may be used for measurements at normal line frequency and above. (The P6022 and A6303 are not compatible with the CT-4.)

The CT-4 has receptacles for current probes 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. Insulated core and shield assemblies allow measurements on bare wires to 3000 V, and to 10 kV RMS with a high voltage bushing.

A dc bucking coil assembly allows up to 300 A of dc to be nullified (derates to 1 MHz B/W). This is very useful for measuring ac signals on top of a dc voltage level.

CHARACTERISTICS

The following are characteristics of the CT-4 using either the A6302/AM 503 or P6021/134 combinations.

Rise Time—≈17.5 ns.
Insertion Impedance—≈ ≤20 μΩ at 60 Hz and 30 mΩ at 1 MHz.
Current Display Range—20 mA/div to 100 A/div with A6302/AM 503, and 20 mA/div to 20 A/div with P6021/134 (20:1 step down ratio); 1 A/div to 5 kA/div with A6302/AM 503, 1 A/div to 1 kA/div with P6021/134, (1000:1 step down ratio).
Maximum Current—Up to 1,000 A peak.
Accuracy—±4% when less than 20 A dc current present.
Maximum Voltage of Circuit Test—3000 V (barewire). 10 kV RMS with high voltage bushing.
Maximum DC Bucking Current—300 mA to buck out 300 A dc (using dc bucking coil).

CURRENT MEASUREMENT COMBINATIONS*1

Product	Bandwidth	A-s Product	Maximum Current RMS	Maximum Current Peak Pulse
CT-4/A6302/AM 503	0.5 Hz to 20 MHz	0.1	700 A	1 kA
CT-4/P6021/134	25 Hz to 20 MHz	0.5	700 A	1 kA
CT-4/P6021/Term	120 Hz to 20 MHz	0.5	700 A	1 kA

*1 *Maximum Current—RMS: 700 A. Peak Pulse: 1 kA.*

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	57	2.3
Height	241	9.5
Depth	266	10.5
Weight ≈	**kg**	**lb**
Net	1.8	4.0

ORDERING INFORMATION

CT-4 Current Probe With DC Bucking Coil **$1,320**
Includes: Carrying case (016-0191-03); 12-in wide, 4 ft long High voltage bushing (015-0194-00); DC bucking coil (015-0190-00); Instruction manual (070-6478-00).

Floating Measurement Techniques

The industries' need for oscilloscope measurements referenced to voltage levels above/below ground potential has long been recognized. The need to reject signals represents another closely allied measurement requirement. These needs often lead users to employ practices which may distort the waveform measurement or are unsafe. Tektronix offers three safe techniques to solve these measurement problems.

Isolation Amplifiers

The A6902B is a voltage isolation amplifier used to connect the circuit under test and the oscilloscope. Signals are coupled across an insulating barrier to the oscilloscope. The isolator provides complete insulation from the signal, no access to dangerous voltages, and complete usability of all oscilloscope functions.

Differential Techniques

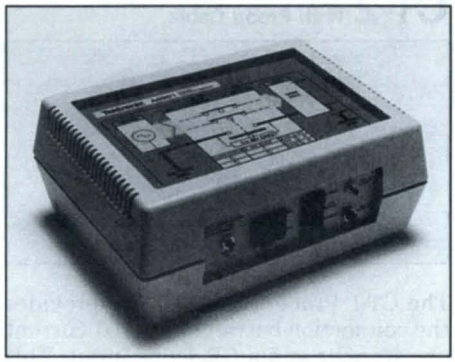
The most popular solution for a floating measurement is the A minus B quasi-differential technique. Most general-purpose dual-trace oscilloscopes have an Add Mode in which two channels can be electrically subtracted, giving a display of the difference signal. This technique limits the common-mode dynamic range and the CMRR to approximately 100:1. Also, examination of low-level signals in the presence of high common-mode voltages can be difficult.

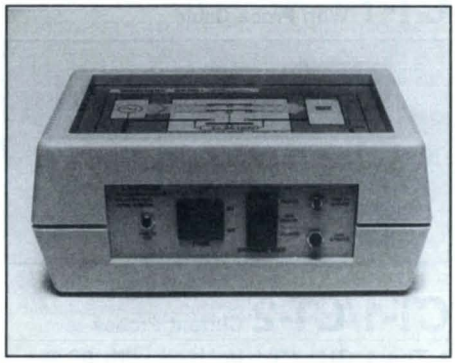
True differential amplifiers like the 7A13 are designed specifically to have good rejection of the common-mode signal and display only the difference signal. Common-mode dynamic range is improved but there are bandwidth and floating capability limitations.

Using both A6902B channels as differential input to a 7A13, 7A22 or oscilloscope provides an extra measure of common-mode performance. The isolator probes' common leads are tied together and the signal leads are then used as plus and minus differential inputs to test the circuit. This technique provides the protection of the isolator as well as the combined CMRR capabilities of the isolator and amplifier.

Indirect Grounding

The A6901 Ground Isolation Monitor is an indirect grounding device which connects between the power mains and the test instruments, allowing monitored floating measurements. As specified in safety standards, the grounding circuit to the test instrument need not be completed until the available voltage or current exceeds a prescribed amount (40 V peak or 28 V RMS). When this amount is exceeded the power to the instrument is interrupted, a protective ground is reestablished, and an audible alarm is sounded. The A6901 also verifies the existence of a functional ground in the power source.





A6901

- **Permits Elevation of Test Instrument Chassis to 40 V Peak (28 V RMS)**
- **Aids in Circuit Analysis or Circumventing Ground Loop Noise Problems**
- **UL and VDE Safety Certification**

The A6901 is placed between a measurement instrument and its power source and acts as an indirect grounding device, allowing floating measurements to be made with operator protection.

The A6901 monitors the voltage on the isolated system. When the voltage exceeds 40 V peak (28 V RMS) the power source to the instrument is interrupted, the isolated grounding system is connected to the power source grounding system, and an audible alarm is sounded. Before power is supplied to the measurement instrument, the A6901 tests the power source for a functional ground*[1]. If a functional ground is not established, the ground isolation monitor will not go into isolated mode.

Applications for the A6901 include elevating a test instrument chassis to logic reference voltages for more accurate logic level measurements, and isolating a test instrument chassis from common-mode voltages present on ground systems to eliminate undesirable noise from signal measurements. The A6901 also can be used to test power outlets for proper wiring.

*[1] *If the A6901 is used in conjunction with a GFI (Ground Fault Indicator), consult the GFI manual for compatibility information.*

CHARACTERISTICS

ELECTRICAL

Trip Voltage (DC)—40 V peak (28 V RMS) or + and −40 V (within 5%).
Trip Current—0.5 mA, 3.5 to 5 mA selectable.
Neutral-to-Ground Continuity—Between 3 and 10 V RMS (8.5 and 28.3 V p-p), 50 Hz.
DC Voltage Trip Delay—<20 ms.
Line Voltage Ranges—90 to 128 V RMS, 180 to 250 V RMS.
Line Frequency Range—48 to 66 Hz.
Maximum Power Consumption (No External Load)—12 W at 115 V, 60 Hz.
Load Power—500 W maximum.

ENVIRONMENTAL

Temperature—Operating: −15 to +55° C (5 to 131° F). Nonoperating: −62 to +85° C (−80 to +185° F). Meets MIL-T-28800B, Class 3.
Altitude—Operating: To 4600 m (15,000 ft). Nonoperating: To 15 000 m (50,000 ft). Exceeds MIL-T-28800B, Class 3.
Humidity—Exceeds MIL-T-28800B, Class 3.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	87	3.4
Width	206	8.1
Depth	153	6.0
Weights ≈	**kg**	**lb**
Net (w/o accessories)	1.4	3.0
Shipping	2.3	5.0

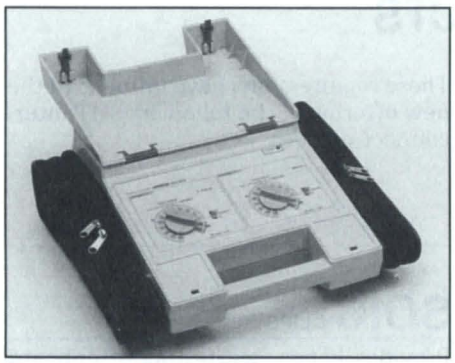
ORDERING INFORMATION

A6901 Ground Isolation Monitor **$760**
Includes: Operator manual (070-3618-00).

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.
Option A2—UK 240 V, 50 Hz.
Option A3—Australian 240 V, 50 Hz.
Option A5—Switzerland 220 V, 50 Hz.
(North American 240 V not available. Neutral not grounded in 240 V North American Systems.)

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.



A6902B

For 50 Ω or 1 MΩ Inputs

- **Two Independently Isolated Channels**
- **High Voltage/High CMRR**
- **UL Certified to 3000 V/Channel (6000 V Maximum Channel Differential)*1**
- **DC to 20 MHz Bandwidth**

A dual-channel, optical- and transformer-coupled voltage isolator, the A6902B allows safely grounded test instruments to make floating measurements at high sensitivity levels in the presence of large common mode signals.

The A6902B acts as a buffer between the test instrument and the system under test and extends the range of the test instrument to 3000 V (dc plus peak ac) with the larger industrial probe (option 02 or 09) and to 500 V (dc plus peak ac) with the smaller signal probe. Both probes are quickly interchangeable at the cable connectors, and can be stored in convenient, removable side pouches.

Designed for use with any dual-channel oscilloscope, the A6902B permits simultaneous observation of two signals at two different points in the same circuit; or signals in two different circuits without respect to common lead voltages. The two channels can be combined to function as an input to a differential amplifier.

Separate, calibrated controls for volts per division on each channel allow precise floating measurements. The plastic case and external controls protect the user during control settings and other operations. Other than probe tip connections, the user is never in close proximity to hazardous voltages.

CHARACTERISTICS

ELECTRICAL

Deflection Factor—Probe Tip Sensitivity: 20 mV/div to 500 V/div in 1-2-5 sequence with oscilloscope set to 10 mV/div. Accuracy: ≤ ±5% of indicated V/div switch setting.

Frequency Response Bandwidth—DC coupled (to −3 dB point) is ≥ 20 MHz. AC coupled (to lower −3 dB point) is ≤ 5 Hz to ≥ 20 MHz. (50 to 500 V/div not specified).

Transient Response—Rise time: 17.5 ns.

Maximum Working Voltage

Small Probe (500 V)—Probe Center Tip to Earth Ground: 500 V (dc + peak ac). Probe Center Tip to Probe Common: 500 V (dc + peak ac) to 3 MHz. See Figure 2 for voltage derating above 3 MHz. Probe Common to Earth Ground: 500 V (dc + peak ac) to 6 MHz. See Figure 2 for voltage derating above 6 MHz.

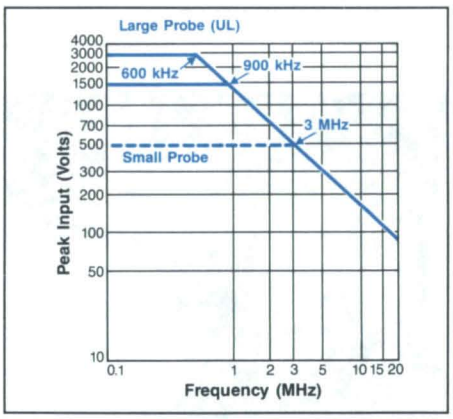


Figure 1. Maximum working voltage between probe input and probe common (all temperatures).

Large Probe (DC Coupled)—Probe Center Tip to Earth Ground: UL 3000 V. Probe Center Tip to Probe Common: UL 3000 V (dc + peak ac) to 450 kHz. See Figure 1 for voltage derating above 900 kHz. Probe Common to Earth Ground: UL 3000 V (dc + peak ac) to 250 kHz. See Figure 2 for voltage derating above 250 kHz.

Large Probe (AC Coupled)—Probe Center Tip to Earth Ground: 500 V (dc + peak ac).

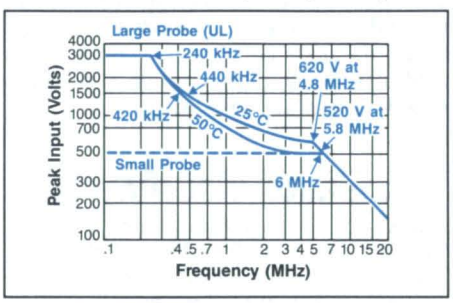


Figure 2. Maximum working voltage between probe common and earth ground.

Maximum Input dV/dt—100 V/ns.

Input Impedance—Resistance: 10 MΩ ±3%. Capacitance: ≈19 pF with either probe.

Output Impedance—50 Ω ±5%.

Output Drive—4 V p-p into 1 MΩ.

Common-Mode Capacitance—100 pF from probe common to earth ground.

Maximum Common to Ground Slew Rate—500 V/μs.

Tangential Noise—≤20 mV. DC Drift With Temperature: ≤10 mV/°C (0.1 div/° C) at output. Range of Output DC Level: At least +5 div from center screen.

Channel Isolation—Maximum Voltage: Using two 3,000 V UL probes is 6000 V (dc + peak ac) UL. Using two 500 V probes is 1000 V (dc +peak ac).

Delay—51 ns ±3 ns (large probe), 52 ns ±3 ns (small probe), from probe input to instrument input. CH 1, CH 2 delay difference is ≤4 ns.

Common Lead Signal Feedthrough—−106 dB from probe input to output BNC to 500 Hz.

See Figure 3 for derating above 500 Hz.

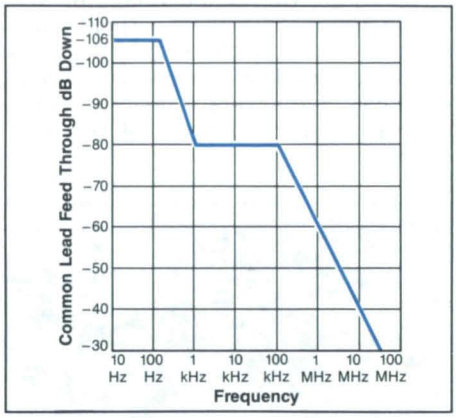


Figure 3. Common lead feedthrough characteristics.

POWER REQUIREMENTS

Line Voltage Ranges—Low: 90 to 132 V. High: 180 to 250 V.

Line Frequency Range—48 to 440 Hz.

Maximum Power Consumption—24 W at 115 V, 60 Hz.

ENVIRONMENTAL

Temperature—Operating: 0 to +50°C. Nonoperating: −55 to +75°C.

Altitude—Operating: To 4500 m (15,000 ft). Nonoperating: To 15 000 m (50,000 ft).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	136	5.4
Width	394	15.5
Depth	344	13.5
Weight ≈	**kg**	**lb**
Net w/Accessories	6.2	13.7
Shipping	8.0	17.7

ORDERING INFORMATION

A6902B Voltage Isolator (500 V Max) **$1,980**

Includes: Two 500 V isolation probes (010-0411-15); Right angle power cord (161-0117-00); 72 in (183 cm), 50 Ω output cables (012-0204-00); Operator manual (070-5614-00).

OPTIONS

Option 02*2—Add two large probes. (010-0409-01) **+$580**

Option 09*2—Add two large probes plus two 4 mm banana adapters. **+$670**

INTERNATIONAL POWER PLUG OPTIONS

Option A1—Universal Euro 220 V, 50 Hz.

Option A2—UK 240 V, 50 Hz.

Option A3—Australian 240 V, 50 Hz.

Option A4—North American 240 V, 60 Hz.

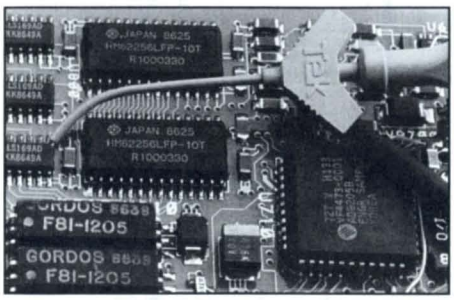
Option A5—Switzerland 220 V, 50 Hz.

*1 *When ordered with option 02 or 09.*

*2 *Extends range to 3,000 volt per channel.*

SURFACE MOUNT DEVICE INTERCONNECTS

A rapidly growing area in Electronic Circuit Boards (ECB) is the incorporation of Surface Mount Technology (SMT). Increased circuit density, increased product reliability, and lower assembly costs are among the many benefits of this new technological trend. Troubleshooting and device interconnection however, have become more difficult due to decreased device size, tighter lead spacing, and increased ECB densities. These requirements have influenced the new offering of the following SMT interconnect devices.



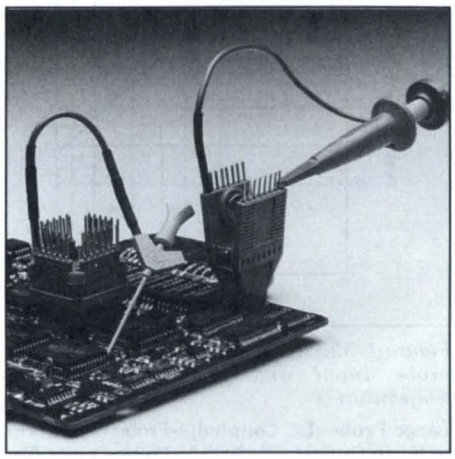
SMT grabber clip

SMT GRABBER CLIPS

The SMT grabber clip is an interface device for attachment of logic and analog probes to today's SMD's, DIP's, and discrete components. The SMT Grabber is capable of attaching to components with maximum lead diameters of 0.095'' and stackable on lead centers of 0.050''. Dual sided 0.025'' lead contacts allow this grabber to be used in multiple signal insertion/acquisition.

ORDERING INFORMATION

SMG50—SMT Grabber Clips **$89**
Includes: 20 SMT Grabber Clips.
SMGK51—SMT Grabber w/Leads **$25**
Includes: 4 SMT Grabbers; 3 Electrical Leads.
SMGK52—SMT Grabber w/Adapters **$55**
Includes: 5 SMT Grabbers; 3 Electrical Leads; 1 Dual Lead Adapter; 1 Flex Tip Adapter.



PLCC Quad Clip (left) and SOIC Clip (right).

PLCC QUAD CLIPS™

The Snap-Ring design allows for quick and easy interconnection to Plastic Leaded Chip Carriers (PLCC) with ''J'' leads on 0.050'' centers. Test contacts are gold plated beryllium copper which provide low contact resistance.

ORDERING INFORMATION

SMQK1—PLCC Engineering Kit*1
Includes: 1 each of 20,28,44,52,68 Pin PLCC Clips plus 4 SMT Grabbers, 8 Electrical Leads w/ (0.025'') Square Pin Connectors.
SMQ20—PLCC Twin Pack*1
Includes: 2 each 20 Pin PLCC Clips; 2 each SMT Grabbers; 4 Electrical Leads
SMQ28—PLCC Twin Pack*1
Includes: 2 each 28 Pin PLCC Clips; 2 each SMT Grabbers; 4 Electrical Leads.
SMQ44—PLCC Twin Pack*1
Includes: 2 each 44 Pin PLCC clips; 2 each SMT Grabbers; 4 Electrical Leads.
SMQ52—PLCC Twin Pack*1
Includes: 2 each 52 Pin PLCC Clips; 2 each SMT Grabbers; 4 Electrical Leads.
SMQ68—PLCC Twin Pack*1
Includes: 2 each 68 Pin PLCC Clips; 2 each SMT Grabbers; 4 Electrical Leads.

*1 *Contact your local sales office.*

SOIC CLIPS™

Provides hands-free testing of onboard Small Outline Integrated Circuits (SOIC). These clips are compatible with gull wing and ''J'' leads on 0.050'' centers. Features gold plated beryllium copper contacts with glass-filled nylon insulation. Upper contact pins: 0.64 mm (0.025 in.) square pins.

ORDERING INFORMATION

SMCK1—SOIC Engineering Kit*1
Includes: 1 each of 8,14,16,20,24 Pin SOIC Clips plus 4 SMT Grabbers, 8 Electrical Leads w/ (0.025'') Square Pin Connectors.
SMC8—SOIC Twin Pack*1
Includes: 2 each 8 Pin SOIC Clips; 2 each SMT Grabbers; 4 electrical Leads.
SMC14—SOIC Twin Pack*1
Includes: 2 each 14 Pin SOIC Clips; 2 each SMT Grabbers; 4 Electrical Leads.
SMC16—SOIC Twin Pack*1
Includes: 2 each 16 Pin SOIC Clips; 2 each SMT Grabbers; 4 Electrical Leads.
SMC20—SOIC Twin Pack*1
Includes: 2 each 20 Pin SOIC Clips; 2 each SMT Grabbers; 4 Electrical Leads.
SMC24—SOIC Twin Pack*1
Includes: 2 each 24 Pin SOIC clips; 2 each SMT Grabbers; 4 Electrical Leads.

*1 *Contact your local sales office.*

MODULAR PROBE REPLACEMENT SUBASSEMBLIES

Probe	Length (m)	Connector/Comp Box		Probe Cable		Probe Head		Probe Tip/Hybrid Tip	
P6101A	1	103-0189-00	$20.00	174-0975-00	$17.00	206-0223-02	$20.00	206-0191-03*1	$21.00
	2	103-0189-00	$20.00	174-0976-00	$20.00	206-0223-02	$20.00	206-0191-03*1	$21.00
	3	103-0189-00	$20.00	174-0977-00	$22.00	206-0223-02	$20.00	206-0191-03*1	$21.00
P6102A	2	206-0352-00	$45.00	174-0976-00	$20.00	206-0302-00	$22.00	206-0338-01*2	$29.00
P6103*5	1	NA		174-0394-00	$18.00	206-0365-01	$25.00	131-3723-01*7	$13.50
	2	NA		174-0395-00	$20.00	206-0361-02*4		131-3723-01*7	$13.50
	3	NA		174-0396-00	$22.00	206-0367-01	$25.00	131-3723-01*7	$13.50
P6104A	1	206-0332-00	$53.00	174-0975-00	$17.00	206-0303-00	$20.00	206-0336-01*2	$31.00
P6105A	1	206-0331-00	$60.00	174-0975-00	$17.00	206-0328-00	$24.00	206-0336-01*2	$31.00
	2	206-0334-00	$60.00	174-0976-00	$20.00	206-0301-00	$22.00	206-0337-01*2	$31.00
	3	206-0320-02	$60.00	174-0977-00	$22.00	206-0302-00	$22.00	206-0338-01*2	$29.00
P6106A	1	206-0313-01	$85.00	174-0975-00	$17.00	206-0328-00	$24.00	206-0336-01*2	$31.00
	2	206-0319-01	$95.00	174-0976-00	$20.00	206-0301-00	$22.00	206-0337-01*2	$31.00
	3	206-0320-01	$90.00	174-0977-00	$22.00	206-0302-00	$22.00	206-0338-01*2	$29.00
P6107A	2	206-0247-02	$70.00	174-0976-00	$20.00	206-0217-02	$22.00	206-0339-02*2*4	
P6108A	1	206-0332-01	$45.00	174-0975-00	$17.00	206-0303-00	$20.00	206-0336-01*2	$31.00
	2	206-0318-02	$50.00	174-0976-00	$20.00	206-0304-00	$20.00	206-0337-01*2	$31.00
	3	206-0333-00	$45.00	174-0977-00	$22.00	206-0305-00	$20.00	206-0338-01*2	$29.00
P6109*5	1.5	NA		174-0714-00	$18.00	206-0372-01	$35.00	131-3723-01*7	$13.50
	2	NA		174-0715-00	$21.00	206-0360-01	$35.00	131-3723-01*7	$13.50
	3	NA		174-0393-00	$23.00	206-0366-01	$35.00	131-3723-01*7	$13.50
P6121	1.5	206-0311-00	$60.00	174-0967-00	$17.00	206-0323-00	$25.00	206-0341-01*2	$36.00
P6122	1.5	206-0312-00	$50.00	174-0967-00	$17.00	206-0324-00	$21.00	206-0342-01*2	$31.00
	2	206-0318-00	$50.00	174-0968-00	$19.00	206-0325-00	$21.00	206-0343-01*2	$31.00
	3	206-0318-01	$50.00	174-0969-00	$21.00	206-0326-00	$21.00	206-0344-01*2	$31.00
P6125	1.5	206-0335-00	$45.00	174-0967-00	$17.00	206-0256-02	$35.00	131-2509-04*1	$50.00
P6130*6	1.5	206-0313-00	$85.00	174-0970-00	$22.00	206-0270-10	$12.00	206-0270-10*3	$12.00
	2	206-0319-00	$85.00	174-0971-00	$26.00	206-0270-12	$12.00	206-0270-12*3	$12.00
	3	206-0320-00	$85.00	174-0972-00	$31.00	206-0270-11	$12.00	206-0270-11*3	$12.00
P6131*6	1.3	206-0314-00	$90.00	174-0973-00	$22.00	206-0265-10	$12.00	206-0265-10*3	$12.00
	2	206-0321-00	$90.00	174-0971-00	$26.00	206-0265-12	$12.75	206-0265-12*3	$12.75
	3	206-0322-00	$90.00	174-0972-00	$31.00	206-0265-11	$12.75	206-0265-11*3	$12.75
P6133*6	1.3	206-0349-00	$70.00	174-0973-00	$22.00	206-0265-10	$12.00	206-0265-10*3	$12.00
	2	206-0350-00	$70.00	174-0971-00	$26.00	206-0265-12	$12.75	206-0265-12*3	$12.75
	3	206-0351-00	$70.00	174-0972-00	$31.00	206-0265-11	$12 75	206-0265-11*3	$12.75
P6134	1.5	206-0363-00	$90.00	174-0245-01*4		206-0265-13	$12.75	206-0265-13	$12.75
P6135	1.5	206-0368-00	$95.00	174-0707-00	$85.00	NA		206-0369-00	$18.00
P6136*6	1.3	206-0359-00	$95.00	174-0978-00	$24.00	206-0265-10	$12.00	206-0265-10	$12.00
P6137	1.5	206-0389-00*4		174-1081-03*4		NA		206-0378-00	$9.78
P6148A	2	206-0288-02	$65.00	174-0976-00	$20.00	206-0217-02	$22.00	206-0339-03*2*4	$25.00
P6149A	2	206-0255-02	$65.00	174-0976-00	$20.00	206-0217-02	$22.00	206-0339-03*2*4	$25.00
P6156	1.5 10X	NA		NA		NA		206-0380-00*4	
Option 26	adds 20X tip	NA		NA		NA		206-0381-00*4	
Option 27	adds 1X tip	NA		NA		NA		206-0379-00*4	
P6203	1.5	NA		N/A		206-0391-00	$150.00	131-4280-00	$3.50
P6204	1.5	NA		N/A		206-0390-00*4		131-4280-00	$3.50

*1 *Probe tips in packages of ten.*
*2 *Probe hybrid tip assemblies in packages of five.*
*3 *Probe hybrid tip assembly in quantities of one.*
*4 *Contact your local Sales Engineer for information.*
*5 *Probe sleeve cover for compensation adjustment is P/N 200-3342-00.*
*6 *Probe body shield for P6130, P6131, P6133, and P6136 is P/N 204-0925-01.*
*7 *Package of 5 tips.*

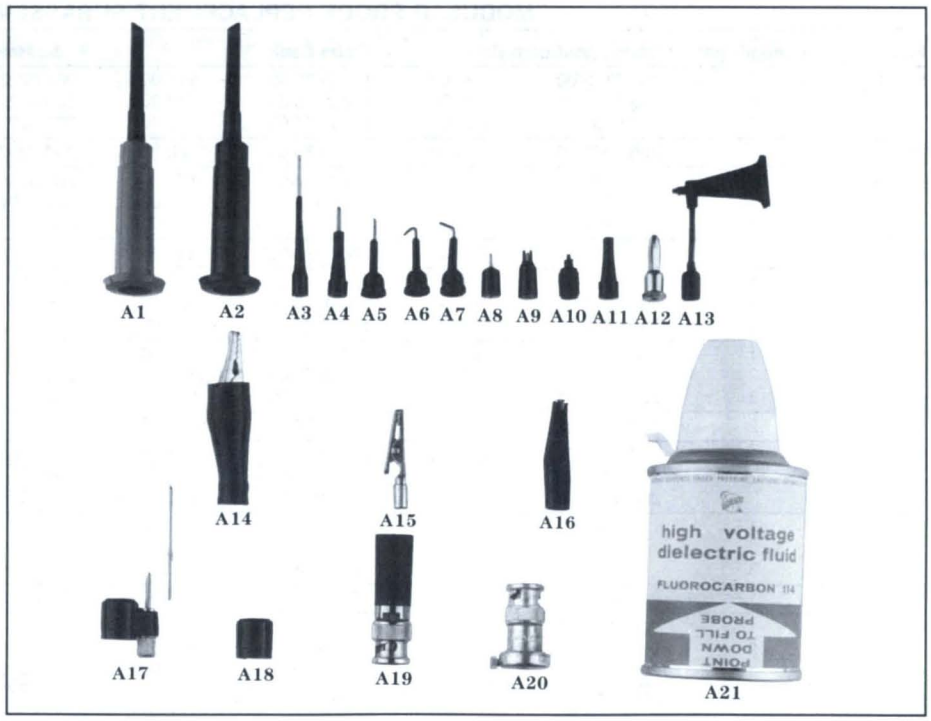
P6006, P6007, P6008, P6009, P6028 and P6060 probes that have #6-32 screw tips.

Code	Description	Part No.	Price
A1	Retractable hook tip	013-0071-00	$4.50
A2	Retractable hook for P6008 environmental	013-0071-01	$5.00
A3	Calibration tip (0.063 in dia)	206-0100-00	$13.00
A4	Spring tip (0.08 in dia)	206-0060-00	$3.10
A5	Long straight tip (0.032 in dia)	206-0104-00	$1.50
A6	Hook tip	206-0105-00	$1.75
A7	Right angle hook tip	206-0185-00	$2.00
A8	Straight tip (0.055 in dia)	206-0015-00	$1.75
A9	IC test tip	206-0203-00	$2.00
A10	Ground lead adapter (0.025 in square pin closing)	206-0137-01	$4.00
A11	Spring tip (accepts 0.065 in dia pin)	206-0061-00	$2.30
	(accepts 0.068 in dia pin)	206-0168-00	$3.75
A12	Banana tip	134-0013-00	$1.50
A13	Pin tip (accepts 0.025 in IBM SLT pin)	206-0134-03	$6.00
A14	Alligator clip, P6015 only*1	344-0005-00	$5.25
A15	Alligator clip	344-0045-00	$1.00
A16	Miniature alligator clip	344-0046-00	$2.50
A17	Bayonet ground assembly	013-0052-00	$11.00
A18	Insulating ground cover for P6009	166-0428-00	$1.55
A19	Probe screw tip to BNC adapter	013-0054-00	$16.75
A20	Probe screw tip to BNC adapter for P6028	013-0056-00	$22.00
A21	High voltage dielectric fluid 3 oz; P6015	252-0120-00	$6.75

P6053B, P6055, P6056, P6057, P6062B, P6063B, P610X Family, P612X Family, P6148, P6149A, and P6202A miniature tip probes.

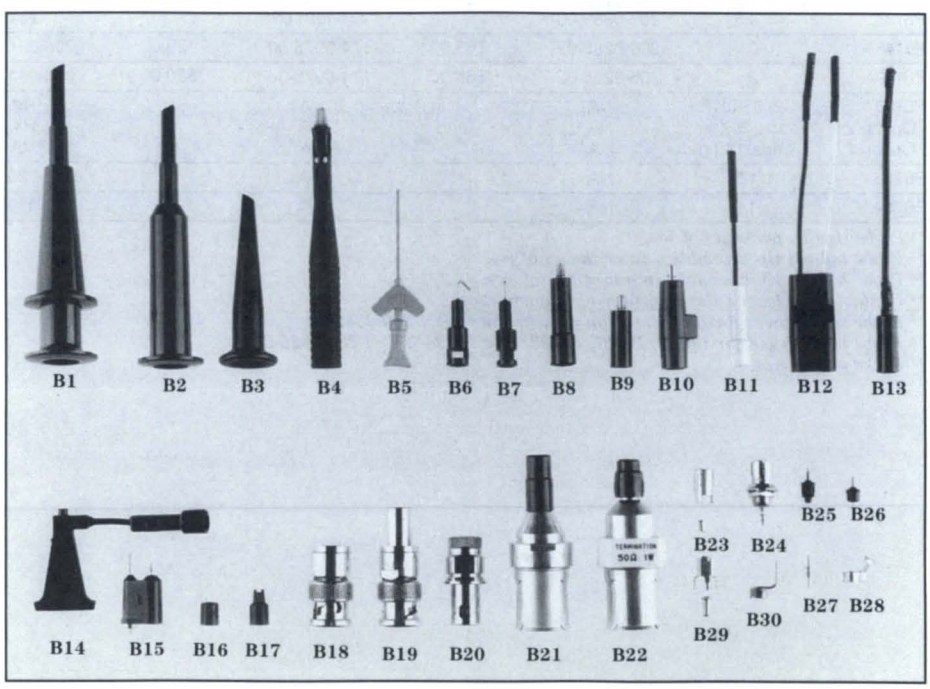
Code	Description	Part No.	Price
B1	Retractable hook tip (except P612X)	013-0105-00	$9.75
B2	Retractable hook tip (for P6202A and P6420)	013-0097-01	$11.50
B3	Retractable hook tip (for all except P6202A and P6420)	013-0107-06	$3.50
B4	IC grabber	013-0191-00	$8.25
B5	SMT Grabber Clip (used with adapters B11 and B12) Order	SMG 050	$89.00
	Single Clip	206-0364-00	$4.90
B6	Hook tip	206-0114-00	$3.75
B7	Straight tip	206-0114-01	$3.75
B8	Screw tip (#6-32)	103-0051-01	$5.50
B9	Screw tip (#6-32 for P6202A and P6420)	103-0051-00	$5.50
B10	Screw tip with ground connection (#6-32)	103-0131-00	$11.00
B11	Flexible tip (accepts B5 retractable hook)	103-0177-01	$8.25
B12	Dual lead adapter (accepts B5 retractable hook)	015-0325-00	$19.25
B13	Flexible tip for 0.025 in square pin	206-0193-00	$9.50
B14	Pin tip (accepts 0.025 in IBM SLT pin)	206-0209-00	$4.75
B15	Bayonet ground assembly	013-0085-00	$9.75
B16	Insulating ground cover	166-0404-01	$1.50
B17	IC test ground cover Package of 10	015-0201-04	$7.50
	Package of 100	015-0201-05	$25.00
B18	Miniature probe tip to BNC adapter	013-0084-01	$9.75
B19	Miniature probe tip to BNC adapter (for all except P6202A)	013-0084-02	$12.00
B20	Miniature probe tip to BNC female adapter	103-0096-00	$14.00
B21	Miniature probe tip to GR adapter	017-0076-00	$80.00
B22	Miniature probe tip to GR 50 Ω termination adapter	017-0088-00	$75.00

*1 *# 10-32 screw tip.*



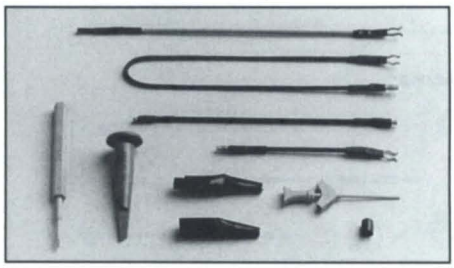
B23	Circuit board test point		
	Outer case	131-1436-00	$6.25
	Inner connector (need to order both for one test point)	136-0333-00	$.55
B24	Chassis mount test jack	131-0258-00	$3.15
B25	Replaceable probe tip (for all except P6202A/P6420/ and P610X "A" versions*1 probes)		
	Package of 10	206-0191-03	$21.00
B26	Replaceable probe tip (for P6202A/P6420)		
	Package of 10	206-0230-03	$22.00
B27	Replaceable probe tip (for P6103/P6109)		
	Package of 5	131-3723-01	$13.50
B28	Electrical ground contact	214-0283-00	$1.25
B29	Circuit board test point,		
	Package of 25	131-4353-00	$60.00
B30	Electrical contact ground	214-4125-00	$2.50

*1 For "A" versions, refer to page 545, Modular Probe Replacement Subassemblies.



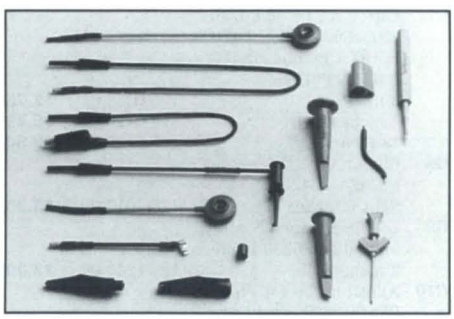
To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

NEW ACCESSORY PACKS/ CONVERSION KIT



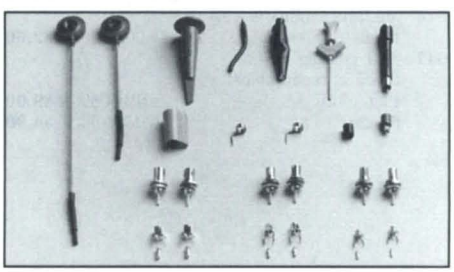
ACCESSORY PACK/MINIATURE PROBE TIPS

Includes: Plastic screwdriver 003-1364-01; Retractable tip 013-0107-06; Ground cover 166-0404-01; 6 in. Ground lead 196-3198-00; 5 in. Ground lead 175-0124-01; 12 in. Ground lead 175-0125-01; 3 in. Ground lead 175-0263-01; IC Grabber Probe tip 206-0364-00; Alligator clip for 0.025 connector 344-0398-00; Alligator clip for #6-32 thread 344-0046-00. Order 020-1724-00. **$29.50**



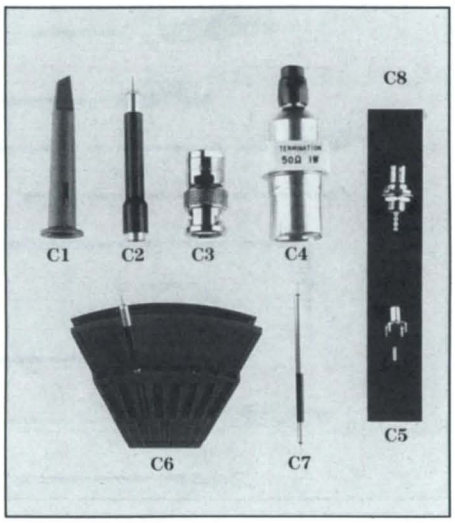
ACCESSORY PACK/P613X/P612X PROBES

Includes: Plastic screwdriver 003-1364-01; Retractable hook tip 013-0107-06; Retractable hook tip 013-0208-01; Probe tip insulator 166-0404-01; Ground lead (Z) 195-4240-00; 3 in. Ground lead 196-3113-03; 6 in. Ground lead 196-3113-02; 12.8 in. Ground lead 195-1870-01; 8.8 in. Ground lead 195-1870-02; 3.5 in. Ground lead 195-6176-01; Probe tip IC grabber 206-0364-00; Ground collar 343-1003-01; Alligator clip for 0.025 in. connector 344-0398-00; Alligator clip for #6-32 thread 344-0046-00. Order 020-1725-00. **$59.50**



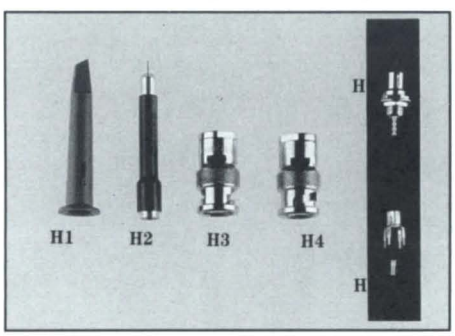
ENGINEERING PACK/SIGNAL ACQUISITION TIP SIZE CONVERSION

Includes: Retractable tip 013-0107-06; Probe adapter 013-0202-02; IC test probe tip 015-0201-06; Test jack connector 131-0258-00; Ckt. Bd. to probe tip (pkg) 131-2766-03; Probe to ckt. connector 131-4209-00; Chassis mount connector (compact) 131-4210-00; Probe to ckt. connector 131-4341-00; Probe to ckt. socket 136-0962-00; Probe to ckt. socket 136-0989-00; Tip ground cover 166-0404-01; Ground lead (Z) 195-4240-00; 12 in. Ground lead 196-3113-02; 6 in. Ground lead 196-3113-03; Probe tip IC grabber 206-0364-00; Ground collar 343-1003-01; Alligator clip for 0.025 in. connector 344-0398-00. Order 020-1726-00. **$99.95**



P613X Family and P6230 subminiature tip probes.

Code	Description	Part No.	Price
C1	Retractable hook tip	013-0208-02	$3
C2	Subminiature-to-miniature probe tip adapter (allows use of miniature probe tip accessories)	013-0202-02	$5.00
C3	Subminiature probe tip to BNC adapter	013-0195-00	$9.75
C4	Subminiature probe tip to GR 50Ω termination adapter	017-0520-00	$70.00
C5	Circuit board test points Outer shell (pkg of 100)	131-2766-01	$50.00
	Inner connector (pkg of 100)	136-0352-02	$25.00
C6	KLIPKIT (includes two 16-pin DIP clips and four signal/ground pins)	013-0197-00	$46.00
C7	Signal/ground pins for KLIP-KIT (includes eight pins)	131-3288-02	$31.00
C8	Chassis mount test jack	131-4210-00	$5.25

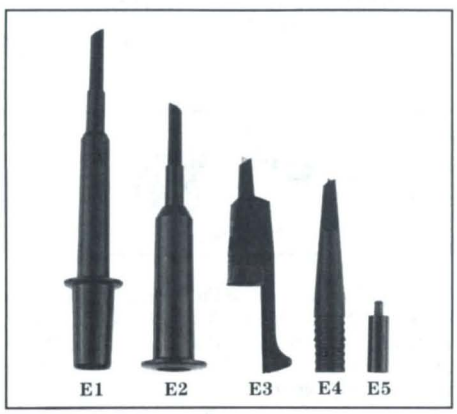


P6137, P6133 Opt 25, and P6156 compact tip probes.

Code	Description	Part No.	Price
H1	Retractable compact hook tip	013-0107-06	$3.50
H2	Subminiature-to-miniature probe tip adapter (allows use of miniature probe tip accessories)	013-0202-02	$5.00
H3	Compact probe tip to BNC adapter	013-0226-00	$10.00
H4	Compact probe tip to BNC 50Ω Termination Adapter	013-0227-00	$60.00
H5	Circuit board test points (pkg of 100)	131-4244-00	$100.00
H6	Chassis mount test jack	131-4210-00	$5.25

P6201 Probes

Code	Description	Part No.	Price
D1	Retractable hook tip	013-0135-00	$8.25
D2	Probe tip to miniature probe tip adapter	103-0164-00	$11.25
D3	Probe tip to BNC adapter	013-0145-00	$25.00
D4	Probe tip to GR 50Ω termination adapter	017-0094-00	$90.00
D5	Ground contact	131-1302-00	$1.25
D6	Insulating ground cover	166-0557-00	$1.50
D7	Ground contact insulator	342-0180-00	$1.75
D8	Ground lead insulator	166-0433-00	$1.25
D9	Replaceable probe tip	206-0200-00	$1.50

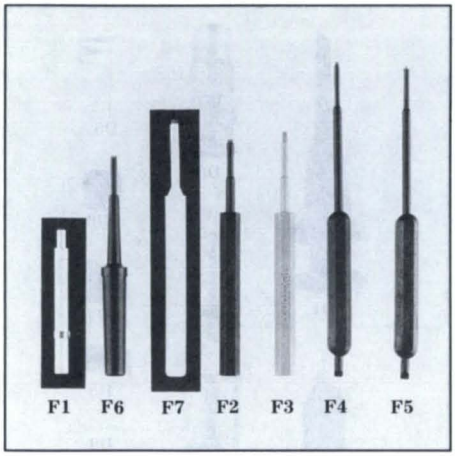


Other Probes

Code	Description	Part No.	Price
E1	Retractable hook tip (for P6010/P6048)	013-0090-00	$7.50
E2	Retractable hook tip (for S-3A/P6202A/P6420)	013-0097-01	$11.50
E3	Retractable hook tip (for 7A11/P6401)	013-0106-00	$19.00
E4	Retractable hook tip (for 211/212/213/214/221 scope probes)	013-0107-02	$3.50
E5	Screw tip (#6-32 for P6045/P6046/P6202A/ 7A11/S-3A)	103-0051-00	$5.50

Cable Marker Sets (not pictured)

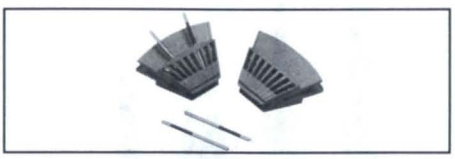
Description	Part No.	Price
For $^{1}/_{8}$ in dia cable (P6053B/ P6062B/P6063B/P6075)	016-0130-00	$8.50
For $^{3}/_{16}$ in dia cable	016-0127-00	$8.50
For All modular cables (P610XA/P612X/P613X/ P6230 families)	016-0633-00	$4.25



Probe Tools

Code	Description	Part No.	Price
F1	Tip extractor for miniature probes (except for P610X "A" version and P612X family probes)	003-0825-00	$1.75
F2	Adjustment tool metal blade (except P6055/P6202A)	003-1364-00	$1.50
F3	Adjustment tool plastic blade (except P6055/P6202A)	003-1364-01	$.70
F4	Adjustment tool P6055	003-0675-00	$2.60
F5	Adjustment tool P6202A	003-0675-01	$2.50
F6	Adjustment tool P610X, P610XA, P612X, P613X	003-1433-01*1	
F7	Adjustment tool P6134, P6135, P6137	003-1417-00	$1.50

KLIPKIT



The P6130/P6131/P6133/P6136/P6230 are used directly, other probes must use the supplied pins and attach via a retractable hook tip. Up to 16-pin DIP can be connected. Four supplied pins make signals accessible at the top of the KLIPKIT, or invert the pins for pin signal connection to a common connection strap inside the clip. Two IC clips, 4 signal ground pins and information sheet includes.

KLIPKIT 013-0197-00. **$46.00**

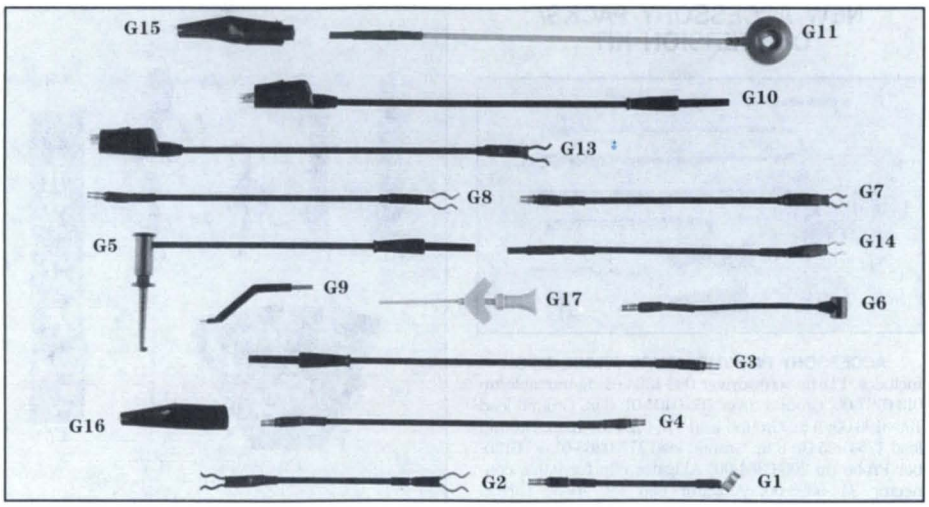
IC CLIP

16-Pin DIP—Clothes pin style, 003-0709-00. **$15.50**

24-Pin DIP—Clothes pin style, 003-0823-00. **$34.00**

40-Pin DIP—Clothes pin style, 003-0801-00. **$50.00**

*1 *Contact your local sales office.*



Ground Leads

Code	Description	Part No.	Price
G1	Probe tip clip-on lead for all miniature size probe tips		
	3 inches	195-6176-00	$6.00
G2	Clip-on interconnect for P6055 6 inches	175-1256-00	$5.25
G3	Lead for P612X/P613X/ P6230 families 12 inches	195-1870-01	$7.50
G4	Screw-in lead for P6054/ P6075/P6201 probes		
	3 inches	175-0848-00	$4.00
	5 inches	175-0848-01	$2.80
	12 inches	175-0848-02	$3.20
G5	Microhook for P612X/P613X/ P6230 families		
	6 inches	195-4104-00	$10.00
G6	Probe tip cap lead for all miniature size probe tips		
	3 inches	175-0849-00	$7.75
	6 inches	175-0849-01	$7.75
G7	Clip-on for P6048/P6053B/ P6055/P6062B/P6063B/P600X/ P610XA families/P6125/ P6148A/P6149		
	3 inches	175-0263-01	$2.75
	5 inches	175-0124-01	$2.45
	12 inches	175-0125-01	$2.80
G8	Clip-on for P6202A/P6420/ S-3A 6 inches	175-1017-00	$5.25
G9	Low impedance contact for P613X/P6230 families		
	2 inches	195-4240-00	$2.50
G10	Alligator clip for P612X/ P613X/P6230 families		
	8 inches	195-1870-00	$7.50
G11	Slip on ground lead for P6134/P6135/P6231		
	6 inches	196-3113-02	$18.00
	3 inches	196-3113-03	$18.00
G13	P6103, P6109 ground leads		
	12 inches	196-3121-00	$3.10
	5 inches	196-3120-00	$3.10
G14	P6203 ground lead (6 in.)	196-3198-00	$4.90
G15	Alligator clip for 0.025 in receptacles	344-0398-00	$3.15
G16	Miniature alligator clip for 6-32 threads	344-0046-00	$2.50
G17	SMT grabber clip for 0.025 in receptables;		
	Pkg. of 20	SMG050	$89.00
	Single	206-0364-00	$4.90

INSTRUMENT CARTS

THE TEKTRONIX SCOPE-MOBILE® CART FAMILY AT WORK.

Tektronix SCOPE-MOBLE® Carts provide the quality and versatility needed by many test instrument users.

Tek carts free up your valuable table space and make sharing equipment between work benches easy while getting you closer to your device under test. They are designed for easy integration into your instrument systems. OEM pricing is available for most models. Whatever your requirements, Tek has a cart to fit your needs.

INSTRUMENT/CART COMPATIBILITY

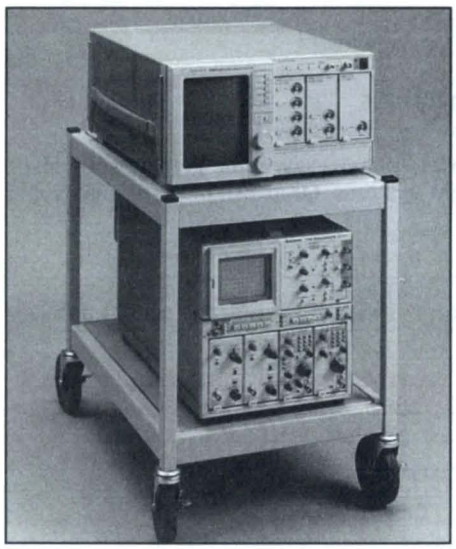
	K212	K213	K213 Shelf	K217	K217S	318/206	K501
Terminals/Copiers/Monitors/Plotters							
4000 Series						✓	
4611/4612						✓	
4631/4632						✓	
4634/4635						✓	
4644						✓	
4660 Series						✓	
4695						✓	
4900						✓	
4926/4970						✓	
606B/608/620	x		x				
650 HR Series (Cabinet)				✓	x	x	
670 Series				✓	x	x	
Television/Spectrum Analyzers/Cable Testers							
1410R Series				✓	x	x	
1420 Series	✓		x				
1430/1440				✓	x	x	
1450/1470 Series				✓	x	x	
1480 Series Cabinet	✓		x			x	
1480 Series Rackmount				✓	x	x	
1500 Series	✓						
1720/1730	✓		x				
1740/1750 Series	✓		x				
1910 (Cabinet)				✓	x	x	
2710				✓	x		
2754/55				✓	x	x	
380	✓		x				
490 Series	✓						x
528A	✓		x				
R140 Series				✓	x	x	
R520 Series				✓	x	x	
OF150 Series	✓						
OF235 Series	✓						

	K212	K213	K213 Shelf	K217	K217S	K318/206	K501
Logic Analyzers							
1240/1241	x	x	x				x
308/318/338	x		x				
DAS 9100					✓	x	
DAS 9200					✓		
Curve Tracers							
370				✓	x	x	
576/577		x		✓		x	
Oscilloscopes/Digitizers/Controllers							
11000 Series					✓	x	
2200/2300/2400 Series	✓	x	x				✓
305/314/336	x		x				
390AD				✓	x	x	
400 Series	✓	x	x	x			
4041	✓		✓				
530/540/550/560 Series (Cabinet)		✓				x	
530/540/550/560 Series (Rackmount)				✓	x	x	
7000/5000 Series (Cabinet)		✓				x	
7000/5000 Series (Rackmount)				✓	x	x	
7612D/7912H				✓	x	x	
7D20T	✓		✓				
T900 Series	✓	x					
TM 5000/TM 500 Series							
TM 5003/TM 503/TM 504	x	x	✓			x	
TM 5006/TM 506/TM 515				✓	x	x	

✓—**Recommended** x—**Compatible**

LOAD CAPACITY/WEIGHTS

	K212		K213		K217		K217S		K318/206		K501	
Load Capacity	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
Top Tray	36	80	34	75	45	100	45	100	45	100	23	50
Base	45	100	11	25	45	100	45	100	45	100		
Hanging Shelf (Option 22)	18	40	18	40	—	—	18	40	—	—		
Total	99	220	77	170	95	200	90	200	90	200	23	50
Weights ≈												
Net	9	20	26	57	20	43	21	45	14	30	.8	1.8
Shipping	13	28	34	75	26	57	27	60	17	38	1.0	2.2
Dimensions: See dimensional drawings												
Page	551		552		552		552		550		550	
Prices	$350		$625		$510		$625		$375/$250		$75	



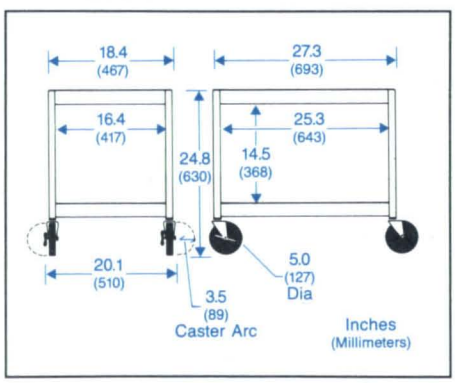
Model 206

Model 206 Utility Cart

Typical Applications: General purpose use and on-site mobility of general instruments, computer peripherals, laboratory and office use.

Features include a plastic laminate on both surfaces and brakes on front casters.

CHARACTERISTICS



206 Utility Cart

ORDERING INFORMATION

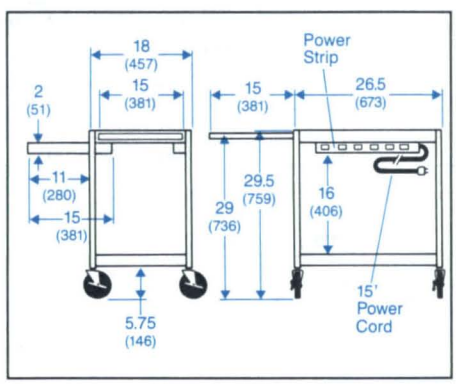
206 Light Gray Finish **$250**
Includes: Instruction sheet (062-1408-02).

K318 Utility Cart

NEW K318 Utility Cart

The K318 is a general purpose Utility Cart that can be used to provide on-site mobility or to store equipment, in addition to providing a platform for PC-type instrument controllers like the PEP 301. A front drawer is provided for convenient storage of cables, probes, and other small items. It can also be utilized as a shelf to hold the PEP 301 or other PC compatible keyboard. A slide out shelf on the side provides additional surface work area. Conveniently located on the back of the cart is a four-outlet power strip.

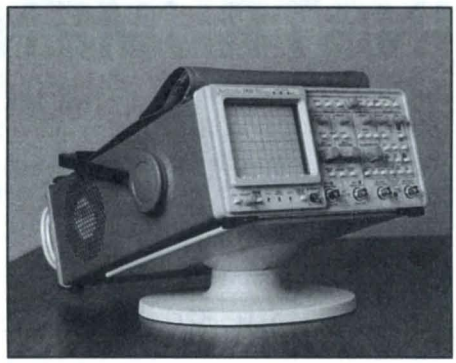
CHARACTERISTICS



K318

ORDERING INFORMATION

K318 Light Gray. **$375**
Includes: Instruction Sheet (070-7229-00)



K501

NEW K501 Tek-Tilt™ Pedestal

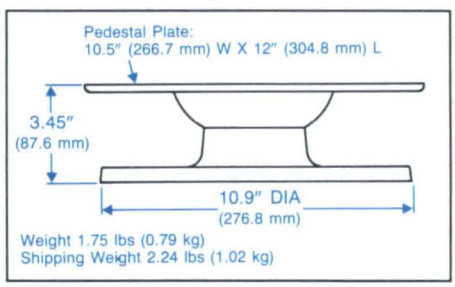
The K501 Tek-Tilt™ Pedestal is a compact, swivel base designed for portable type instruments used in a bench top environment. The K501 Tek-Tilt pedestal rotates 360 degrees in the X axis and tilts 30 degrees in the Y axis.

The swivel base has been designed to allow repositioning of screen height, angle, and eye-to-screen distance to realize optimal comfort and reduction of stress. Swivel and tilt adjustments are made via the tension adjustment located in the middle of the swivel base.

The K501 is adaptable to all Tektronix portable-type instruments by using 3M Dual-Lock™ strips positioned on the four corners of the swivel base. Rubber feet located on the bottom of the 10.9 inch base provide a stable platform.

K501 Data Sheet 56-W-5077 is available.

CHARACTERISTICS



K501 Tek-Tilt™ Pedestal

ORDERING INFORMATION

K501—Tek-Tilt™ Pedestal **$75**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

K212

K212 Portable Instrument Cart

Typical Applications: On-site mobility of all portable instruments in medical facilities, labs, computer rooms, manufacturing areas, and other work areas.

The K212 provides a stable yet mobile platform for all Tek portable oscilloscopes and most other portable instruments. Tilting top tray large locking front casters, and wide track base are standard features.

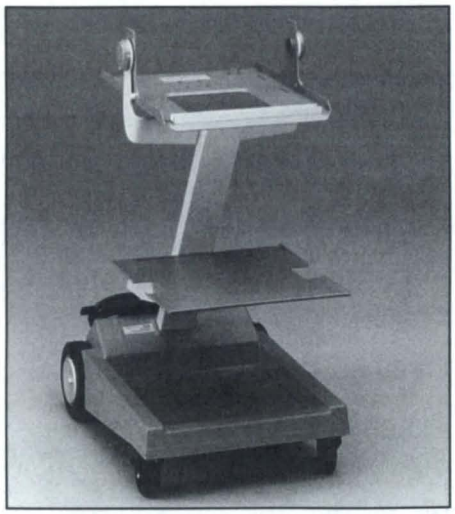
Option 10 adds a four-outlet power strip, with circuit breaker, to the cart base.

Option 12 adds a second tray to accommodate peripherals, such as the HC100 color plotter, for portable scopes. This tray will support other peripherals (less than 40 lbs.) that will fit on a 14.0 inch (depth) by 16 inch (width) base. A slot in back of the tray allows for paper to be fed to the printer from the bottom shelf.

Option 22 combines the four-outlet power strip option and the second shelf option into one option.

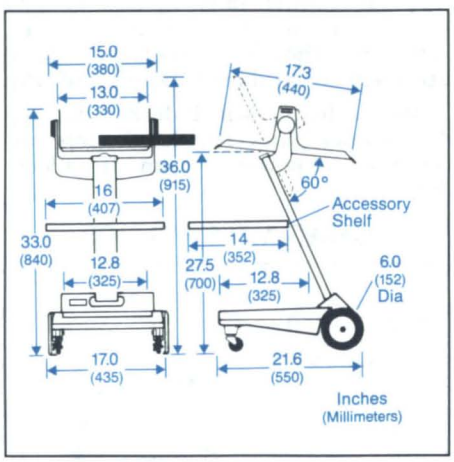
The K212 is compatible with all Tek Portable Instruments, as well as other types of portable instruments. Some assembly is required, using common tools.

K212 Data Sheet 56-W-5835-1 is available.



K212 with Option 22

CHARACTERISTICS

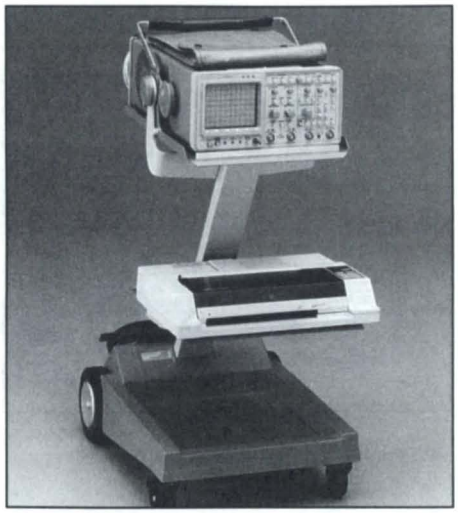


Construction—Base of thermoset polyester. Column top of tray and second tray made of high-strength aluminum.
Color—Base and trays are Tek blue. Column and yoke are silver gray.

ORDERING INFORMATION

K212 Portable Instrument Cart Includes: Two 1 in.×5 ft securing straps (346-0049-04); retaining bar (650-1881-00); two $^3/_{16}$ in. bolts; $^3/_{16}$ in. Hex key; instruction sheet (070-5554-00).	**$350**
Option 10—Add four-outlet power strip	**+$75**
Option 12—Add second tray	**+$75**
Option 22—Combine options 10 and 12	**+$140**

Special terms, conditions and discounts are available to qualified OEMs on the K212 and K217 carts. Contact your local Tektronix Sales Office.



K212 Option 22 with HC100 and 2440

K213 Lab Instrument Cart

Typical Applications: On-site mobility of 5000 and 7000 Series Oscilloscopes in laboratory and manufacturing environments.

Standard features include tilting top tray, brakes on all casters, lockable drawer in the base, four-outlet power strip, 7000 Series scope lock-down bar, mounting hardware for TM 500 equipment and older scopes, a hanging shelf and a securing strap.

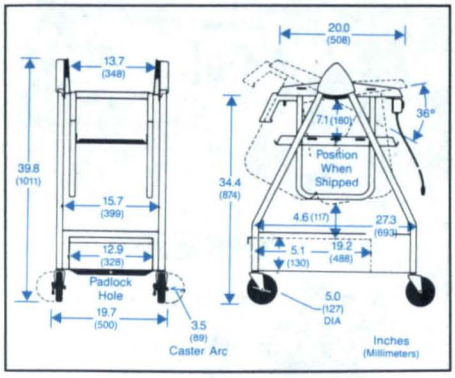
The hanging shelves are supported underneath, tilt with the top tray, and are large enough to carry a TM 504 system or other small-to-medium sized test instruments. Slots in the shelves allow instruments to be secured with straps.

Option 10 provides a sliding drawer for use with the 7854 keyboard. The keyboard drawer mounts underneath the top tray and reduces available hanging shelf space by approximately three inches.

Option 12 provides a storage cabinet for unused 5000 or 7000 Series plug-ins. The storage cabinet mounts on or under a shelf. Up to two storage cabinets can be installed at one time.

K213 Data Sheet 56-W-7131 is available.

CHARACTERISTICS



Color—Tek blue with silver-gray legs.

ORDERING INFORMATION

K213 Lab Instrument Cart **$625**
Includes: Securing strap, 1½×42 in. (346-0136-01); shelf (436-0132-01); miscellaneous mounting adapters; four outlet, 115 V ac power strip; instruction sheet.

OPTIONS

Option 05—Delete Power Strip. **NC**
Option 10—7854 Keyboard Drawer. **+$195**
Option 12—5000/7000 Series Plug-in Storage Cabinet. **+$140**
Option 22—Combines Options 10/12. **+$295**

OPTIONAL ACCESSORIES (Fits K213 and Model 3 Carts)

Securing Straps—Black nylon web, for use on top tray, shelves, or base.
(1½×42 in.) Order 346-0136-01 **$32**
(1½×57 in.) Order 346-0156-01 **$32**
Extra Shelf—Mounts below top tray. Order 436-0132-01 **$65**
7854 Keyboard Drawer Kit—Mounts under top tray. Order 436-0197-00 **$215**
Plug-In Storage Cabinet Kit—Mounts on or under hanging shelves. Does not include shelf. Order 436-0196-00 **$155**
Retaining Bar—Prevents sliding of portable scope on top tray or shelf when secured by straps. Mounting hardware included. Order 650-1881-00 **$12**

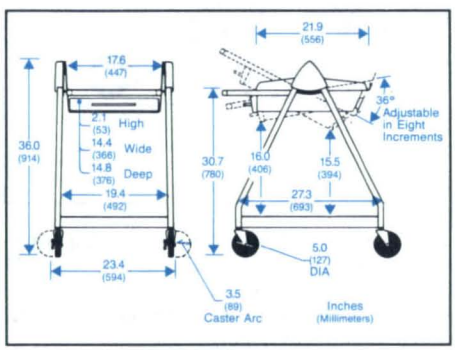
K217

K217 Rack Instrument Cart

Typical Applications: On-site mobility of most rackmountable or rack-width instruments. The ears of rackmountable instruments extend over the sides of tray.

Standard features include a tilting top tray, storage drawer under the top tray, a four outlet power strip, and front locking casters.

CHARACTERISTICS



Color—Tek blue with silver-gray legs.

ORDERING INFORMATION

K217 Rack Instrument Cart **$510**
Includes: Instruction sheet (070-5653-00).
Option 01—Brown Finish **NC**

OPTIONAL ACCESSORIES (Fits K217 and 206 Carts)

Securing Strap—Nylon webbed, 1½×53 inch to secure instruments to top tray. Blue for K217.
Order 346-0070-01. **$80**
Brown for K217 Option 01.
Order 346-0070-03 **$80**

Special terms, conditions and discounts are available to qualified OEMs on the K212 and K217 carts. Contact your local Tek Sales Office.

K217S

NEW K217S

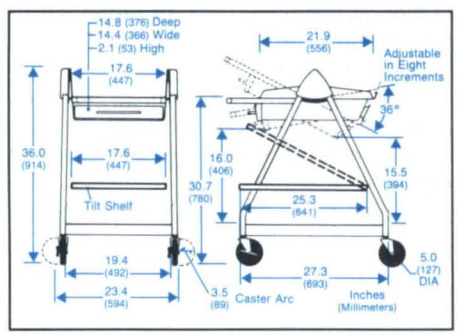
Rack Instrument Cart

The K217S is a rugged version of the K217 and is designed to support the Tektronix 11000 Series Instruments and other rack width instruments. A four-outlet power strip is standard on the K217S. A second shelf is provided that tilts with the top tray of the cart, which can be used to hold portable-type scopes or instruments that do not exceed 40 lbs.

The tilting shelf size is 641×447 mm (25.3×17.6 in.) and holds 100 lbs. The tilting second tray is 508×345 mm (20×14.8 in.) and holds 40 lbs.

The bottom shelf (non-tiltable) is 693×493 mm (27.3×19.4 in.) and holds 100 lbs.

CHARACTERISTICS



ORDERING INFORMATION

K217S Rack Instrument Cart **$625**

OTHER ACCESSORIES

TEST LEADS

Test Lead, Black, 4 ft (T2)	012-0425-00	$13.25
Test Lead, Red, 4 ft (T1)	012-0426-00	$24.00
Test Lead, Black, 4 ft (T1)	012-0426-01	$24.00
Test Lead set includes: 012-0425-00, 012-0426-00, 013-0107-05	012-0427-00	$30.00

50 OHM AIR LINE

The 200 mm, 50 ohm 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 ohm Air Line	017-0084-00	$220.00

PATCH CORDS

BNC to BNC, 18 in.		
Red	012-0087-00	$16.25
Black	012-0086-00	$8.25
BNC to banana plug-jack, 18 in. red	012-0091-00	$8.25
18 in. black	012-0090-00	$8.25
Banana plug-jack to banana plug-jack 18 in. red	012-0031-00	$10.25
18 in. black	012-0039-00	$11.50
Pin-jack to pin-jack, 0.08 in. dia-pin 8 in. red	012-0179-00	$4.25
18 in. red	012-0180-00	$4.55
8 in. black	012-0181-00	$4.50
18 in. black	012-0182-00	$5.50

COAXIAL CABLES

BNC

50 ohm, 42 in.	012-0057-01	$19.25
75 ohm, 42 in.	012-0074-00	$19.75
93 ohm, 42 in.	012-0075-00	$33.00
50 ohm, 18 in.	012-0076-00	$18.25
50 ohm, 18 in. male to female	012-0104-00	$27.00
50 ohm ±1% Precision, 36 in.	012-0482-00	$29.00
BSM female to BNC male, 10 in. RG58	012-0128-00	$26.00
BSM female to BNC male, 18 in. RG58	012-0127-00	$32.00

COAXIAL GR 50 OHM

10 ns, RG58A/U	017-0501-00	$140.00
5 ns, RG213/U	017-0502-00	$205.00
1 ns, RG58A/U*1	017-0503-00	$95.00
2 ns, RG58A/U	017-0505-00	$185.00
5 ns, RG58A/U	017-0512-00	$140.00
10 in. RG213/U	017-0513-00	$95.00
20 in. RG213/U	017-0515-00	$115.00

*1 *Connector on one end only.*

COAXIAL N 50 OHM

N Connectors, 6 ft	012-0114-00	$29.00

COAXIAL SMA (3 mm) 50 OHM

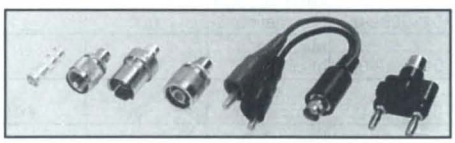
2 ns, male to female	015-1005-00	$120.00
5 ns, male to female	015-1006-00	$185.00
Semirigid, 500 ps, 4.5 in. (male only)	015-1015-00	$30.00
Semirigid, 750 ps	015-1017-00	$46.00
Semirigid, 1 ns	015-1019-00	$150.00

BNC ADAPTER KIT—AK01

Includes: 50 ohm Feed-through Termination 011-0049-01; 50 ohm, 10X Attenuator 011-0059-02; 50 ohm, 5X Attenuator 011-0060-02; 50 ohm, 6 dB Attenuator 011-0069-02; 50 ohm coax cable, 42 in. (2 each) 012-0057-01; GR to BNC female adapter 017-0063-00; BNC female to BNC female adapter 103-0028-00; BNC male to BNC male adapter 103-0029-00; BNC "T" 103-0030-00; BNC Elbow male to female 103-0031-00.
Order AK01. $375

COAXIAL BNC

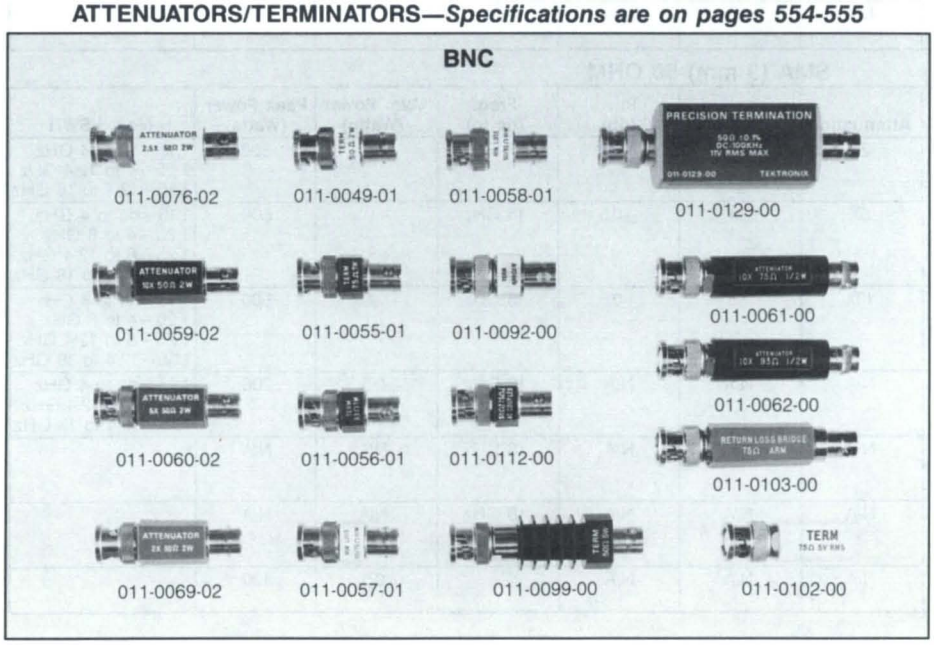
BNC Male to GR	017-0064-00	$100.00
BNC Male to UIIF Female	103-0032-00	$6.50
BNC Male to Binding Post	103-0033-00	$6.50
BNC Male to Dual Binding Post	103-0035-00	$18.25
BNC Male to N Female	103-0058-00	$9.25



BNC Female to Clip Leads	013-0076-00	$40.00
BNC Female to GR	017-0063-00	$55.00
BNC Female to UIIF Male	103-0015-00	$6.00
BNC Female to BSM Male	103-0036-00	$18.00
BNC Female to N Male	103-0045-00	$8.50
BNC Female to Dual Banana	103-0090-00	$10.00
BNC Female to EZ Ball	013-0076-01	$23.00

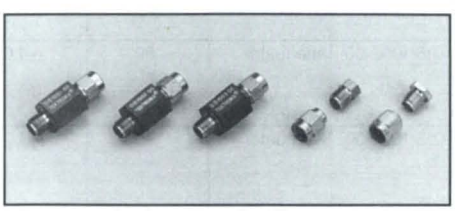
ATTENUATORS/TERMINATORS—*Specifications are on pages 554-555*

BNC

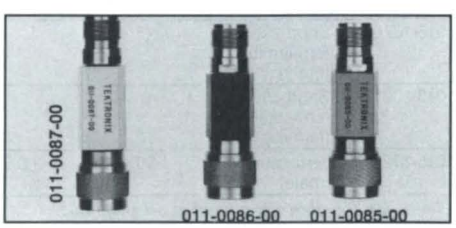


GR

SMA



N



BNC 50, 75, and 93 OHM

	Type	Impedance (Ohms)	Z-Tol. (Ohms)	Attenuation	Atten.(db)	Tol. (db)	Freq. (dc to)	Avg. Power (Watts)	Peak Power (Watts)	Max. VSWR
011-0049-01	Feed-through termination	50	±1	NA	NA	NA	1 GHz	2	300	1.2 from dc to 1 GHz
011-0059-02	Attenuator	50	±1	10X	20	±0.4 dc to 1 GHz ±0.6 1-2 GHz	2 GHz	2	500	1.1→dc to 1 GHz 1.2→1 to 2 GHz
011-0060-02	Attenuator	50	±1	5X	14	±0.4 dc to 1 GHz ±0.6 1-2 GHz	2 GHz	2	500	1.1→dc to 1 GHz 1.2→1 to 2 GHz
011-0069-02	Attenuator	50	±1	2X	6	±0.3 dc to 1 GHz ±0.5 1-2 GHz	2 GHz	2	500	1.1→dc to 1 GHz 1.2→1 to 2 GHz
011-0076-02	Attenuator	50	±1	2.5X	8	±0.3 dc to 1 GHz ±0.5 1-2 GHz	2 GHz	2	500	1.1→dc to 1 GHz 1.2→1 to 2 GHz
011-0099-00	Feed through termination	50	±0.5	NA	NA	NA	200 MHz	5		1.1→dc to 100 MHz 1.2→100 to 200 MHz
011-0055-01	Feed through termination	75	±1	NA	NA	NA	100 MHz	1	300	1.1 from dc to 100 MHz
011-0056-01	Feed through termination	93	±1	NA	NA	NA	100 MHz	1	300	1.1 from dc to 100 MHz
011-0057-01	Min. loss attenuator	50-75		2.3X	7.2	±0.5	100 MHz	½		1.1 from dc to 100 MHz
011-0058-01	Min. loss attenuator	50-93		2.3X	7.2	±0.5	100 MHz	1.2		1.1 from dc to 100 MHz
011-0061-00	Attenuator	75		10X	20			½		
011-0062-00	Attenuator	93		10X	20			½		
011-0092-00	Feed through termination	600	±1	NA	NA	NA	1 MHz	1		
011-0112-00	Min. loss attenuator	75-50						2		(ac coupled)
011-0129-00	Feed-through termination	50	±0.5	NA	NA	NA				
011-0102-00	Coax termination	75	±0.5	NA	NA	NA		½		
011-0103-00*[1]	Return loss bridge	75	±0.5	NA	NA	NA				

*[1] *011-0103-00 red color body; 011-0103-01 green color body; 011-0103-02 white color body.*

GR 50 OHM

	Type	Impedance (Ohms)	Z-Tol. (Ohms)	Attenuation	Atten.(db)	Tol. (db)	Freq. (dc to)	Avg. Power (Watts)	Peak Power (Watts)	Max. VSWR
017-0078-00	Attenuator	50	±0.5	10X	20	±1.5%→dc ±2% to 1 GHz ±5% to 2 GHz	4 GHz	1	1000	1.1→dc to 1 GHz 1.1→1 2 GHz 1.2→to 4 GHz
017-0079-00	Attenuator	50	±0.5	5X	14	same	4 GHz	1	1000	same
017-0080-00	Attenuator	50	±0.5	2X	6	same	4 GHz	1	1000	same
017-0081-00	Termination end-line	50	±0.5	N/A		same	4 GHz	1	1000	same

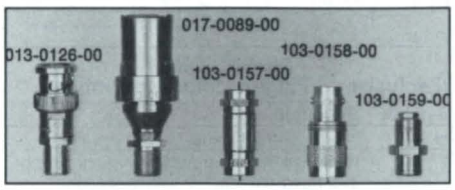
SMA (3 mm) 50 OHM

	Type	Impedance (Ohms)	Z-Tol. (Ohms)	Attenuation	Atten.(db)	Tol. (db)	Freq. (dc to)	Avg. Power (Watts)	Peak Power (Watts)	Max. VSWR
015-1001-00	Attenuator	50	±1.0	2X	6	±0.3	18 GHz	1	500	1.15→dc to 4 GHz 1.25→4 to 12.4 GHz 1.35→12.4 to 18 GHz
015-1002-00	Attenuator	50	±1.0	5X	14	±0.5	18 GHz	1	500	1.15→dc to 4 GHz 1.20→4 to 8 GHz 1.25→8 to 12.4 GHz 1.35→12.4 to 18 GHz
015-1003-00	Attenuator	50	±1.0	10X	20	±0.5	18 GHz	2	500	1.15→dc to 4 GHz 1.20→4 to 8 GHz 1.25→8 to 12.4 GHz 1.35→12.4 to 18 GHz
015-1004-00	Termination (female)	50	±0.5	N/A	N/A	N/A	18 GHz	0.5	200	1.05→dc to 4 GHz 1.10→4 to 12.4 GHz 1.15→12.4 to 18 GHz
015-1020-00	Short-circuit termination (male)	0		N/A	N/A	N/A	18 GHz	N/A	N/A	
015-1021-00	Short-circuit termination (female)	0		N/A	N/A	N/A	18 GHz	N/A	N/A	
015-1022-00	Termination (male)	50	±0.5	N/A	N/A	N/A		0.5	100	

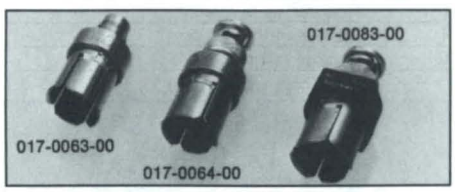
Photos for the above are located on page 553.

N CONNECTOR 50 OHM

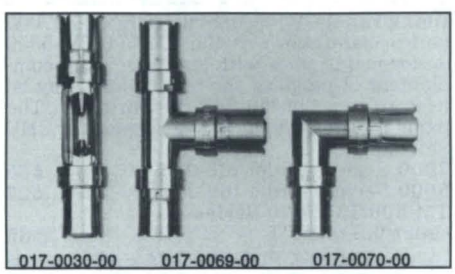
	Type	Impedance (Ohms)	Z-Tol. (Ohms)	Attenuation	Atten.(db)	Tol. (db)	Freq. (dc to)	Avg. Power (Watts)	Peak Power (Watts)	Max. VSWR
011-0085-00	Attenuator	50		3X	10	±0.5	12.4 GHz	2	300	1.2→DC to ≥4 GHz 1.3→4 to ≥8 GHz 1.4→8 to ≥12.4 GHz
011-0086-00	Attenuator	50		10X	20	±1	12.4 GHz	2	300	1.4 from DC to 12.4 GHz
011-0087-00	Attenuator	50		10X	20	±1	12.4 GHz	2	300	1.4 from DC to 12.4 GHz



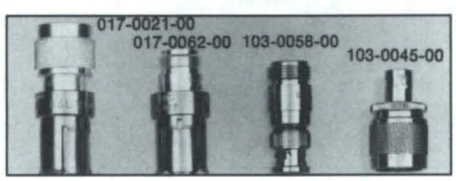
Female to BNC Male	013-0126-00	$19.00
"F" Female to GR	017-0089-00	$55.00
"F" Male to "F" Male	103-0157-00	$7.50
"F" Male to BNC Female	103-0158-00	$5.00
Female	103-0159-00	$7.50



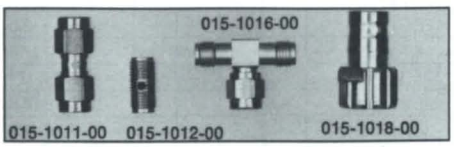
GR to BNC Female	017-0063-00	$55.00
GR to BNC Male	017-0064-00	$100.00
50 Ω termination, thru-line (GR to BNC Male)	017-0083-00	$100.00



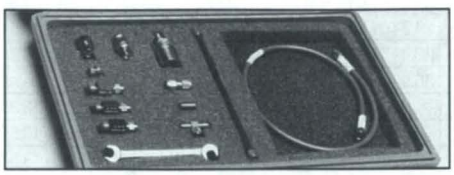
GR Insertion Unit	017-0030-00	$95.00
GR T	017-0069-00	$200.00
GR Elbow	017-0070-00	$165.00



N Male to GR	017-0021-00	$80.00
N Female to GR	017-0062-00	$70.00
N Male to BNC Female	103-0045-00	$8.50
N Female to BNC Male	103-0058-00	$9.25



SMA Male to Male	015-1011-00	$27.00
SMA Female to Female	015-1012-00	$11.00
SMA T	015-1016-00	$41.00
SMA Male to BNC Female	015-1018-00	$10.25



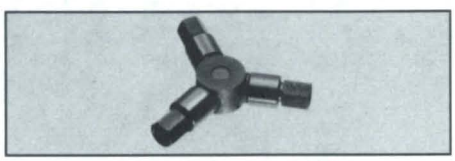
SMA ADAPTER KIT AK02

Includes: 4.5 in. Semirigid cable w/male connectors 015-0015-00; 1 m, flexible, 50 ohm cable w/male connectors 174-1341-00; 2X Atten. 015-1001-00; 5X Atten. 015-1002-00; 10X Atten. 015-1003-00; GR to SMA female adapter 015-1008-00; SMA male to SMA male adapter 015-1011-00; SMA female to SMA female adapter 015-1012-00; SMA "T" 015-1016-00; SMA male to BNC female 015-1018-00; 50 ohm Termination 015-1022-00; SMA female to BNC male adapter. Order AK02. **$945**

ACCESSORY HOUSING

Accessory housing without electrical components is useful for applications requiring special circuitry.

Accessory Housing 011-0081-00 $55.00



50 Ω POWER DIVIDERS

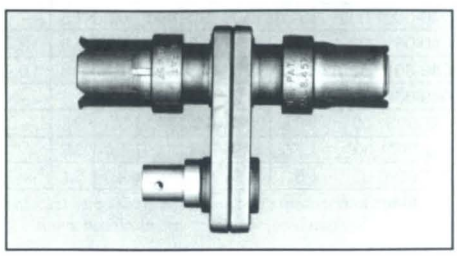
Designed for use in broad-band 50 Ω systems where the mismatch introduced by ordinary "Tee" connectors is undesirable. Load isolation is nominally 6 dB while the voltage attenuation ratio is nominally 2X (input to either load arm, other load arm terminated in a standard 50 Ω termination). Maximum VSWR on the 015-1014-00 is 1.50 from dc to 12.00 GHz and 1.90 from 12.01 to 18.00 GHz.

SMA Male connectors	015-1014-00	$270.00
GR connectors	017-0082-00	$800.00

50 Ω COUPLING CAPACITORS

The coupling capacitor is a short length of coaxial line with a disk capacitor (4700 pF ±20%) in series with the inner conductor. High frequencies are transmitted with small reflection, but dc and low frequencies are blocked. Voltage rating is 200 V (015-1013-00), 500 V (017-0028-00).

SMA connectors	015-1013-00	$230.00
GR connectors	017-0028-00	$125.00



CT-3 SIGNAL PICKOFF

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.

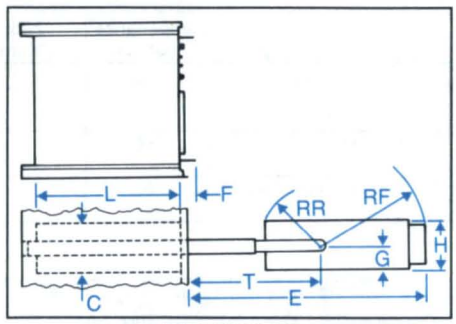
Sensitivity—10% of the voltage under test, into a 50 Ω load.
Decay Time Constant—4.5 μs at 0 dc current.
Rise Time—<0.4 ns.
Frequency Response—50 kHz to 875 MHz at 0 dc current.
Insertion Impedance—With 50 Ω termination is 1 Ω shunted by 4.5 μH, 2 Ω shunted by 4.5 μH without a 50 Ω termination.
VSWR—<1.2 at 1.5 GHz.
Voltage Rating—AT 0 V dc is 25 V RMS. 1 kV pulse peak. The V's product is 100 V μs. If exceeded, the L/R decay will decay rapidly toward zero.

Order 017-0061-00 $210.00

MOUNTING ACCESSORIES

	H		L		F		G		E		RF		RR		T		C	
Product	**in.**	**cm**	**in.**	**cm**	**in.**	**cm**	**in.**	**cm**	**in.**	**cm**	**in.**	**cm**	**in.**	**cm**	**in.**	**cm**	**in.**	**cm**
R485*[1]	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
R5100 R5400*[1]	5.3	13.5	19.0	48.3	1.1	2.8	1.8	4.6	24.6	62.5	—	—	—	—	—	—	5.3	13.5
R5223	7.0	17.8	20.8	52.9	1.3	3.3	—	—	—	—	—	—	—	—	—	—	7.0	17.8
R7103	7.0	17.8	27.7	70.4	1.5	3.8	—	—	29.0	73.7	—	—	—	—	—	—	7.0	17.8
R7704*[1]	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*[1] R7603*[1] R7613*[1] R7623*[1]	5.3	13.5	22.3	56.6	2.0	5.1	—	—	25.2	64.0	—	—	—	—	—	—	5.3	13.5
R7844*[1]	7.0	17.8	24.8	63.0	2.3	5.8	1.75	4.4	—	—	—	—	—	—	—	—	7.0	17.8
R7903*[1]	5.3	13.5	22.8	57.9	2.3	5.8	—	—	25.3	64.3	—	—	—	—	—	—	5.3	17.
R7912*	5.3	13.5	26.9	68.3	1.8	4.6	—	—	26.9	68.3	—	—	—	—	—	—	5.3	13.5
7912AD	7.0	17.8	26.0	66.0	1.95	5.0	—	—	30.7	78.0	—	—	—	—	—	—	6.9	17.5
RTM506	5.25	1	18.9	48.0	1.82	4.7	—	—	—	—	—	—	—	—	—	—	5.25	13.3
016-0015-00	5.1	13.0	16.3	41.4	1.8	4.5	—	—	—	—	—	—	—	—	—	—	—	—
016-0115-05	5.3	13.5	16.3	41.4	0.3	0.8	—	—	—	—	—	—	—	—	—	—	5.3	13.5
016-0466-00	5.1	13.0	16.3	41.4	1.8	4.5	—	—	—	—	—	—	—	—	—	—	—	—
016-0468-00	5.2	13.3	14.9	37.8	2.0	5.1	—	—	—	—	—	—	—	—	—	—	—	—
016-0675-00*[1]	8.8	22.4	19.7	50.1	1.5	3.9	3.5	8.9	24.3	61.6	—	—	11.9	30.1	13.3	33.8	8.5	21.6
016-0676-00*[1]	7.0	17.8	19.7	50.1	1.9	4.8	3.5	8.9	24.3	61.6	11.1	28.2	11.2	28.4	13.3	33.8	6.9	17.5
016-0691-01*[1]	7.0	17.8	18.3	46.5	1.5	3.9	3.5	8.9	20.4	51.9	11.8	30.0	—	—	9.5	24.1	6.6	16.7
040-0551-01	14.0	35.6	22.4	56.9	0.6	1.5	—	—	30.9	78.5	—	—	—	—	—	—	—	—
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	—	—	—	—	—	—	—	—	—	—	5.3	13.5
040-0616-02	5.3	13.5	16.5	41.9	1.1	2.8	1.8	4.6	24.6	62.5	—	—	—	—	—	—	5.25	13.3
040-0617-02	5.3	13.5	16.5	41.9	1.1	2.8	1.8	4.6	24.6	62.5	—	—	—	—	—	—	5.3	13.5
040-0624-01	5.25	13.3	18.3	46.5	0.7	1.8	—	—	—	—	—	—	—	—	—	—	5.3	13.5
437-0031-00	8.8	22.4	9.5	24.1	0.3	0.8	—	—	—	—	—	—	—	—	—	—	5.25	13.3
437-0071-00	7.0	17.8	13.4	34.0	1.4	3.6	—	—	—	—	—	—	—	—	—	—	7.1	18.0
437-0126-03	5.3	13.5	22.3	56.6	2.0	5.1	—	—	25.2	64.0	—	—	—	—	—	—	6.6	16.8

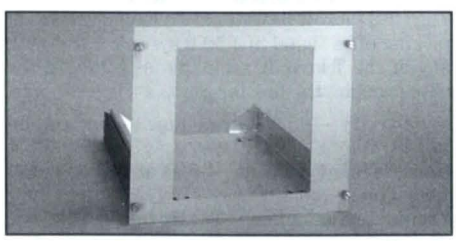
*[1] *These instruments mount with sliding tracks to a standard 19-inch wide rack. Rear support for sliding tracks is required, such as an enclosed rack.*



DIMENSIONS
(Exclusive of Plug-In Units and Probes)

Symbol	Definition
H	Height of front panel
L	Rack front to rearmost permanent fixture excluding cables
F	Back of front panel to foremost protrusion
G	Bottom of front panel to horizontal plane of rotation
E	Maximum forward clearance with instrument out and horizontal
RF	Front radius of rotation
RR	Rear radius of rotation
T	Rack front to pivot point
C	Cabinet height

RACK ADAPTERS



For rackmounting 7000 Series oscilloscopes in a standard 19 in. wide rack. Rack adapter includes slide-out assemblies. 7000 Series mask finish is light gray.

7704A/7104/7834/7854—Rack height is 15.75 in., rack depth is 21.38 in., shipping weight is ≈41 lb. Order 040-0611-01 **$525**

455/465M—Includes cradle mount, rack height 7 in., rack depth 18.75 in. Order 040-0825-01 **$565**

2445A/2465A—Order 016-0691-01*[1]

2335—Order 016-0468-00 **$390**

2213A/2215A/2235—Order 016-0466-00 **$145**

2236—Order 016-0015-00 **$230**

464/466—Order 016-0676-00 **$480**

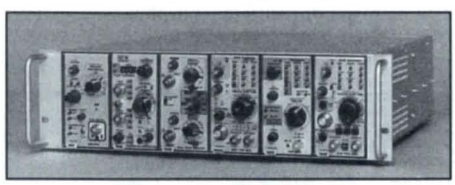
485—Order 016-0558-00 **$530**

434—Order 016-0272-00 **$300**

468—Order 016-0675-00 **$670**

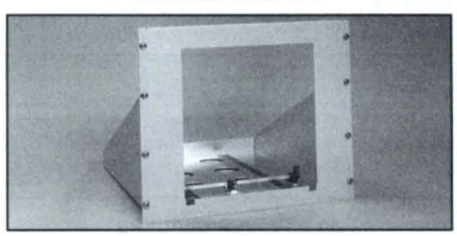
*[1] *Contact your local Sales Office.*

STORAGE CABINETS



7000 Series Plug-In Units—Holds 6 plug-in units, for mounting in a 19 in. rack, 5.25 in. high. Order 437-0126-03 **$1,055**

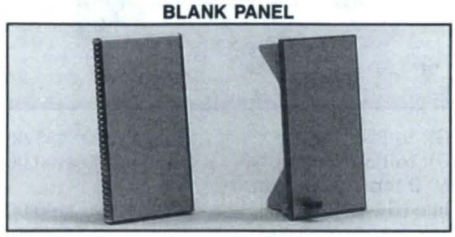
CRADLE MOUNTS



For rackmounting 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. 7000 Series mask finish is light gray.

7704A—Rack height is 22 in. shipping weight is ≈16 lb. Order 040-0560-00 **$535**

BLANK PANEL



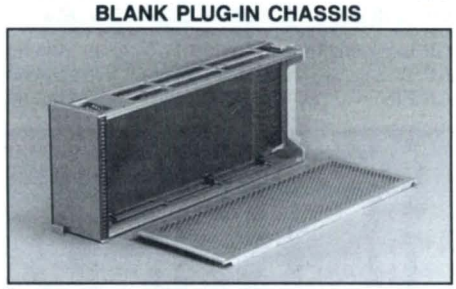
Blank Panel—When operating the 5000/7000 Series mainframes or the TM 500/TM 5000 Series mainframes with less than a full complement of plug-ins, the blank panel may be used to cover an unused compartment. The panel for the 7000 Series is also good for EMC Shielding.

7000 Series—Order 016-0155-00 **$60**

5000 Series—Order 016-0452-00 **$27**

TM 500/TM 5000 Series—Order 016-0195-03 **$35**

BLANK PLUG-IN CHASSIS



Blank Plug-In Chassis—Available for all Tektronix mainframes. The 11000 Series provides a blank plug-in only. 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.

11000 Series—Order 016-0829-00 **$95**

7000 Series—Order 040-0553-03 **$175**

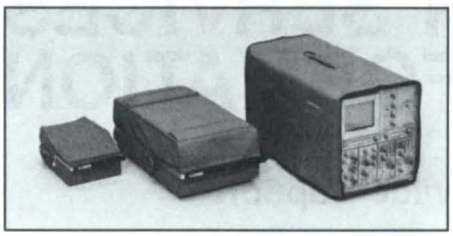
5000 Series—Order 040-0818-03 **$140**

TM 500 Series—Order 040-0652-05 **$135**

560 Series—Order 040-0245-00 **$180**

Minimum acceptable order is $25.00.

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 500/5000/7000 Series have clear vinyl frontal areas.

PROTECTIVE COVERS

Instrument	Part Number	Price
200 Series	016-0512-00	$18.50
323/324/1401A/ 1401A-1/1501	016-0112-00	*1
314/335	016-0612-00	$75.00
326	016-0532-00	$49.00
453A/454A/491	016-0074-01	$18.00
434/464/466	016-0365-00	$27.00
465/465B/475/485	016-0554-00	$19.25
5000 Series	016-0544-00	$18.00
7300/7400/7600 Series	016-0192-01	$20.00
7704A/7900	016-0531-00	$15.00

*1 *Contact your local sales office.*

PLUG-IN UNIT CARRYING CASES

3-Wide—For 7L14/7L5 Option 25/ 7D20/7L18. Order 016-0626-00 $390.00

2-Wide—For 7L12/7L5. Order 016-0625-00 $330.00

CRT MESH FILTERS

The mesh filter improves display contrast for oscilloscope viewing under high ambient light conditions. 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 EMC filter. Installed on the instrument, the metal frame of the filter is grounded, providing effective filtering of the EMC spectrum.

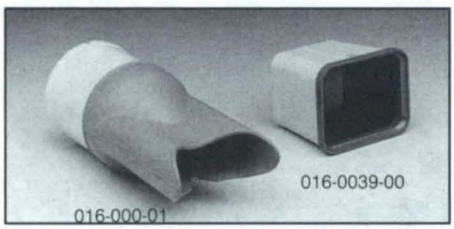
Instrument*1	Part Number	Price
314/326/335	378-0063-00	$23.00
432/434	378-0682-00	$65.00
422/491/453A/454A/485	378-0648-00	$60.00
465/465B/475/ 464/466/434	378-0726-01	$90.00
7400/7603	378-0696-00	$70.00
7100/7500/7700/ 7800/7900 Series/ 7613/7623/7633	378-0603-00	$75.00

*1 *For both cabinet & rackmount instruments.*

VIEWING ACCESSORIES

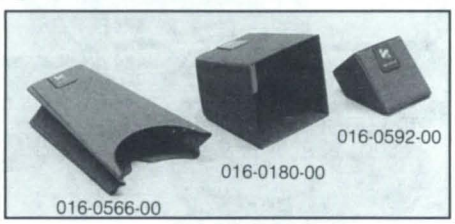
The viewing accessories normally mount on the oscilloscope graticule cover. Some may fit camera-mounting bezels. If you intend using a camera on your oscilloscope, check with your Tek Sales Engineer for bezel-viewer compatibility.

Folding Viewing Hoods—
(576) Order 016-0259-00 $25.00
(577/5000/7000 Series)
Order 016-0260-00 $27.00
(326/314/335/SC 502/SC 503/SC 504)
Not pictured. Order 016-0297-00 $2.10



Polarized Viewers—For Tek older 5-inch oscilloscopes. The viewers reduce troublesome reflections and glare under high ambient light conditions.
(Rectangular)—Order 016-0039-00 $95.00

Viewing Hood—For Tek older 5-inch round oscilloscopes. Includes molded rubber eyepiece & separate tubular light shield. Order 016-0001-01 $200.00



Collapsible Viewing Hoods—For oscilloscopes with rectangular CRTs. Blue vinyl, folds flat for storage.
(422/453A/454A/485/491)
Order 016-0274-00 $19.00
(464/466/455/465/465B/475/ 2200 Series/2445A/2465A)
Order 016-0592-00 $15.00

Folding Binocular Viewing Hoods—
(434/455/464/466/465B/475/475A/ 2200 Series) Order 016-0566-00 $21.00
(422/453A/454A/485/491)
Order 016-0082-0 $21.00

Polarized Collapsible Viewing Hoods—To reduce reflections and glare under high ambient light.
(432/434/455/465/465B/475/464/466 /2200 Series/2445A/2455A/2465A)
Order 016-0180-00 $60.00

Viewing Hoods—Molded gray polystyrene with polyurethane eyepiece.
(576) Order 016-0153-00 $55.00
(5000/7000 Series/601/602/603/ 604/528/577) Order 016-0154 00 $43.00

CATHODE-RAY TUBE LIGHT FILTERS

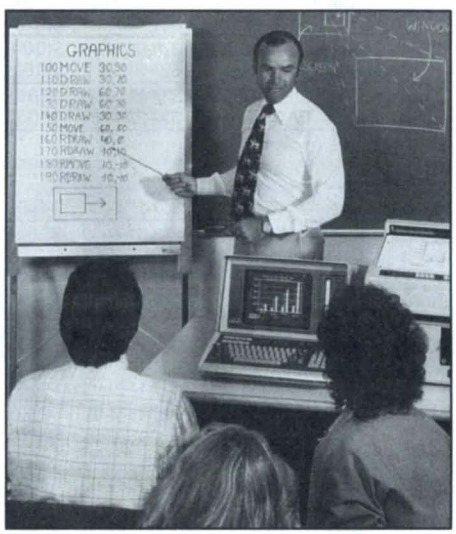
Instrument*1	Color	Part Number	Price
200 Series	Blue	378-0691-00	$2.30
314/335	Blue	378-2016-01	$1.85
434	Blue	378-0678-01	$2.30
455/465M	Blue	337-2122-00	$6.00
465/465B/ 475, 464/466	Blue	337-1674-00	$7.25
	Clear	337-1674-01	$6.50
	Smoke-gray filter	337-1674-07	$6.50
540/550 Series 565/575	Smoke-gray*2	378-0567-00	$14.25
	Green	378-0568-00	$14.25
	Blue	378-0569-00	$11.50
	Amber	378-0570-00	$14.25
576	Blue*2	378-0616-00	$6.00
603/604	Clear (603*2)	337-1440-00	$3.75
	Green	337-1440-01	$3.75
	Amber	337-1440-02	$3.50
	Blue	337-1440-03	$3.50
	Gray	337-1440-04	$4.50
	Graticule (8×10 div)	331-0303-00	$15.00
605/606/ 607	Blue	337-1674-00	$7.25
	Graticule	337-1674-10	$10.00
	Clear Shield	337-1674-13	$13.50
	Gray*2	337-1674-06	$5.00
	Graticule (8×10 div)	331-0391-00	$9.00
608	Amber	378-0704-00	$10.00
	Graticule*2	337-2126-02	$10.00
2200 Series	Blue*2	337-2775-00	$3.80
	Clear TV Graticule	337-2775-01	$1.95
2300 Series	Blue Implosion Shield*2	337-2760-00	$1.65
	Clear Implosion Shield*2	337-2781-00	$4.40
2400 Series	Blue*2	378-0199-03	$3.00
	Clear Implosion Shield*2	378-0208-00	$1.50
5100 & 5400 Series (except 5441)	Clear	337-1440-00	$3.75
	Green	337-1440-01	$3.75
	Amber	337-1440-02	$3.50
	Blue	337-1440-03	$3.50
	Gray	337-1440-04	$4.50
5441	Clear*2	337-1674-01	$6.50
	Gray	337-1674-06	$5.00
	Graticule (8×10 div)	331-0391-00	$9.00
7603	Blue	378-0684-00	$7.00
	Amber	378-0684-01	$7.00
	Gray	378-0684-02	$7.00
	Green	378-0684-03	$10.00
	Spectrum Analyzer Graticule	337-1439-01	$9.75
	Blue Implosion Shield*2	337-1700-01	$6.00
	Clear Implosion Shield	337-1700-04	$5.50
7613/762 3/7623A/ 7633	Spectrum Analyzer Graticule	378-0625-07	$14.50
	Green (UV)	378-0625-08	$5.00
7844/7313	Blue*2	378-0625-00	$6.50
7700 Series/ 7613/ 7623/7100 Series/ 7900 Series	Amber	378-0625-01	$9.50
	Gray	378-0625-02	$6.75
	Green	378-0625-03	$5.00
	Gray TV Graticule NTSC	378-0625-06	$12.00
	Clear Shield Spectrum Analyzer Graticule	337-1159-02	$9.75

*1 *For both cabinet and rackmount instruments unless rackmount version is listed.*

*2 *Standard filter supplied with instrument.*

CUSTOMER SERVICES AND INFORMATION

Tektronix Means . . . Fast, Flexible Worldwide Support

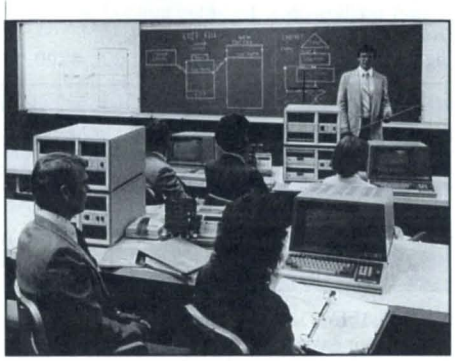


The people behind the product are friendly and ready to help you.

Get sales information and assistance to evaluate and order the products you want.

Ask for a Customer Service Representative the first time you contact Tektronix. The CSR can give you information on products and the names of the Sales Engineers assigned to serve your product interest. Tektronix Sales Engineers will respond to your technical and business inquiries.

Sales Engineers can give you information on dozens of products, so that you can select the one model best suited to your present and future applications, and will be happy to arrange a demonstration of that product.



Your Customer Service Representative or Sales Engineer can provide you with information on prices, terms, delivery dates, shipping estimates and best means of shipping.

Customer-site installations are thorough.

Tektronix provides on-site installations for most computer graphics products and most Tek-configured systems for computer graphics, semiconductor test, microprocessor development, and acquisition/processing. The Tektronix service specialist will make sure your equipment is set up properly with all functions operating to specifications, and will walk you through the basics of its performance.

Technical Assistance Services.

When you need technical assistance to supplement your own resources, Tektronix can arrange the services of an application engineer skilled in meeting your needs. For more information, see the Total Solution Section.

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Training and assistance gets users up to speed, fast.

Your Tektronix product is most useful to you when you're thoroughly familiar with it.

Tektronix offers formal classes and self-study aides. Ask your Sales Engineer for details about Customer Training.

Operation and Application Workshops

Tektronix instruments and programmable instrument systems represent the upper limits of productivity potential. Tektronix has designed workshops to help enhance your understanding of the capabilities of your equipment.

Customer Training Workshops naturally complement the Tektronix commitment to help you achieve optimum utilization of your equipment—A commitment that begins with engineering excellence and continues through training—helping you to develop new and more productive applications fast!

These fast-paced courses combine classroom lectures with supervised, hands-on laboratory sessions. Participants receive manuals and workbooks containing detailed course notes and lab exercises.

If you are interested in registering for one of these workshops or would like more information on a particular workshop, call instrument group customer training at 1-800-835-9433, Ext. 430, or write:

Tektronix, Inc.
IG Customer Training
P.O. Box 4600 M/S 94-953
Beaverton, Oregon 97076-4600

For your convenience, Tektronix also offers private workshops conducted at your company. Call us for more information.

Tektronix Service and Support

At Tektronix, we provide you with a total service solution by anticipating your service needs, offering a variety of services, and placing your best interest first. We do not compromise when it comes to servicing your products. Our goal is to maximize your uptime, quickly correct product malfunctions, and make it easy for you to request service.

No one can match our expertise or service experience. As the manufacturer of the products we service, we know what it takes to keep your Tektronix product operating efficiently. Additionally, we pride ourselves on being able to quickly diagnose problems and repair products correctly—the first time.

With over 40 years of engineering expertise, you can count on us for fast, reliable and responsive service and a worldwide network of field offices.

No matter what your service need, we most likely have an offering or service plan to match.

Warranty Coverage

Every new serialized Tektronix product is warranted against defects. Depending on the product, this warranty period ranges from three months to three years.

Warranty-Plus Service Plans Offered Worldwide

At the time you purchase or lease a Tektronix product, you can choose to add a *Warranty-Plus* Service Plan. The most efficient way to purchase service, for a one-time fee you receive up to five years of service coverage (includes the warranty period).

Depending on the product, plan, or country you are located in, you can receive access to our toll-free hotline, scheduled calibrations, software and hardware updates, remedial and preventive maintenance checks.

Annual Support Agreements

After your warranty or *Warranty-Plus* Service Plan expires, you can obtain a one-year maintenance agreement. Available for both on-site or Service Center Service, you can choose from a variety of plans to help keep your product operating at an optimum and help hold down your service costs.

Our Disk Drive Team, like the other components of our service and support organization, are committed to service excellence.

Additional Services

Other service offerings include: Time and Material, Firm Price, Training, and Installation. Please contact your local Tektronix field office international subsidiary (listed on pages 568-570) or our U.S. Telemarketing Center (1-800-635-6100) for more information on service offerings.

Module Repair Service

The supplier of current, ready-to-install modules for domestic and international field offices, the Module Repair Service uses state-of-the-art diagnostic, test, and repair equipment to quickly analyze and repair exhange modules. If requested, we can provide you with same day service. For an additional charge, the latest design modifications and enhancements can be incorporated into your repaired module. Module Repair Service is also available to self-service customers.

Disk Drive Repair

We know you can't afford slow service which is why our Disk Drive Repair Team can rapidly repair your 5¼ 20 to 200 megabyte Winchester disk drives which include selected models of Maxtor, Micropolis and Seagate drives. Our servo writers, class 100 clean room, 180-day warranty, and competitive prices mean that you get an exceptional value for your service dollars.

Replacement Parts

Our Replacement Parts organization can provide you with components of equal or improved quality for over 5,000 Tektronix products. Our computerized warehouse and adjoining distribution center is considered one of the most sophisticated delivery systems in the world. In addition, no one can match our inventory of spare modules, assemblies, circuit boards, and other essential components for Tektronix products.

Long-Term Support

We continue to support your products through the years. Our Long-Term Support Program is designed to provide per-call service for up to nine years after a product has been removed from the Tektronix catalog. Obsolete products can be serviced if the necessary parts are available. Please call your local Tektronix field office or international subsidiary for availability.

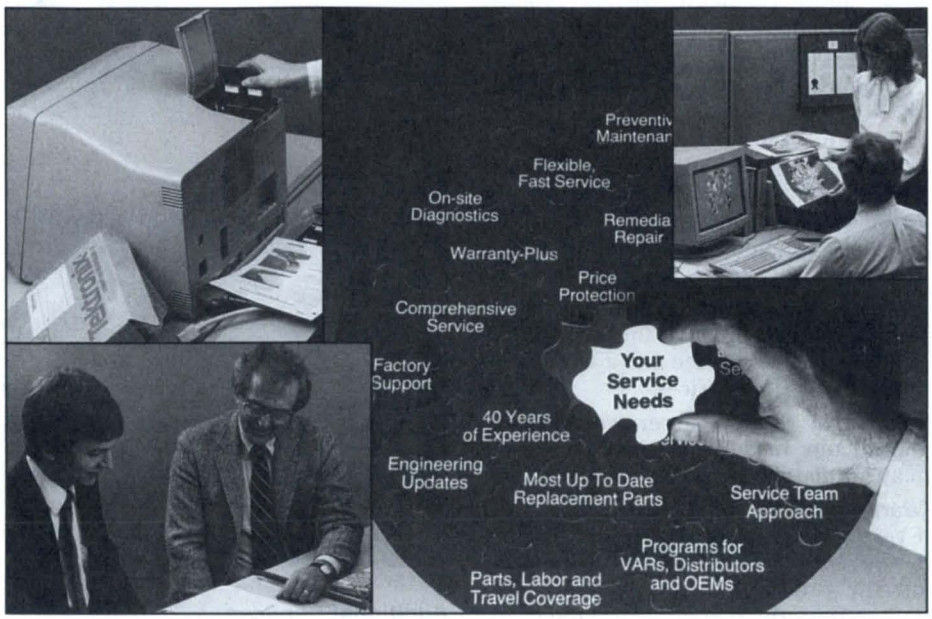
DESIGN AND GRAPHICS SYSTEMS SERVICE AND SUPPORT

At Tektronix, we provide you with a Total Service Solution worldwide. Our service offerings are designed not only to complement your products but, to save you time and money by maximizing your uptime, quickly correcting product malfunctions, and making your best interest ours.

To meet your needs, we have a variety of service offerings including Comprehensive and *Warranty-Plus* Service Plans, annual maintenance agreements, and per-call service.

With over 40 years of engineering and service experience, we know how to maintain your Tektronix Computer Graphics system, Microcomputer/Software Development product, Intelligent Graphic workstation, and Artificial Intelligence system.

Because designing, manufacturing and servicing high-technology products is our only business, we have the resources and the dedication to provide you with both unmatched service and continued support.



WORLDWIDE SERVICE TO COMPLEMENT YOUR NEW PRODUCT PURCHASE

Comprehensive *Warranty-Plus* Service Options

We have packaged all the service you need to keep your product operating efficiently into one service offering—Comprehensive Service. For one price, you can receive up to three years of coverage (including product's warranty period) which includes:

- On-site Hardware Maintenance.
- Software and/or firmware Update Service
- Access to the Customer Support Center hotline.*
- Preventive maintenance checks as required.
- Required engineering updates.
- Parts, labor and travel coverage.

With Comprehensive Service, obtaining assistance could not be simpler. Just pick up the phone and call our Customer Support Center,* Monday through Friday, 6 a.m. to 6 p.m. PST. Within an hour, either a Technical Support Specialist will have called you back and begun discussing your system problem or a Customer Service Representative from one of our field offices will have contacted you to coordinate an on-site call.

Ordered as an option at the time you purchase a product, this service is available for select instrument display products. For a listing of the products covered by Comprehensive Service, please check with your local Tektronix field office.

Warranty-Plus Service Options

Not all products require comprehensive coverage; for those products that do not, we offer standard *Warranty-Plus* Service Plans. Available for one, two or three years (includes product's warranty period), these plans provide you with worry-free maintenance coverage which includes priority service ahead of per-call time-and-material requests, preventive maintenance checks, remedial service, required engineering updates, parts, labor and travel.

Because you pay only one price at the time of product purchase for coverage which continues for up to three years, *Warranty-Plus* Service is the most cost effective way to keep your product operating efficiently.

Installation

Do it right from the start. Have Tektronix install, configure, and integrate your new product, add-on or upgrade. Orderable at the time of product purchase or any time afterwards, installation ensures that when we leave, your product or system is ready to perform.

Firmware Subscription and Software Supscription Services

As a subscriber to either our Firmware or Software Subscription Services, you will receive a new version of either software or firmware when one is released. These updates usually include new product features and design improvements.

Tektronix Service: Your total service solution.
Service options to complement your new products.

*Comprehensive Service includes access to the Customer Support Center, on-site hardware maintenance and either software or firmware updates. Access to the Customer Support Center cannot be ordered separately.

*[1]*Comprehensive Service includes access to the Customer Support Center,* on-site hardware maintenance and either software or firmware updates. Access to the Customer Support Center cannot be ordered separately.*

When you do not require on-site hardware maintenance for a product eligible for Comprehensive coverage, you can order option E9 which provides you with subscription service and Customer Support Center support.

AFTER PRODUCT PURCHASE

Customer-Site Support Agreements

With a Customer-Site Support Agreement, you can say good-bye to additional charges and unbudgeted expenses. All you pay is a Basic Annual Charge (BAC). Depending on whether you get a Comprehensive Service Customer-Site Support Agreement or a standard Customer-Site Support Agreement, you receive:

- Priority service ahead of per-call time and material requests.
- Preventive maintenance checks and remedial service.
- Engineering updates
- Parts, labor and travel coverage.
- Access to the Customer Support Center (Comprehensive Service).*
- Enrollment in Software and/or Firmware Update Service (Comprehensive Service).

Products currently covered under a product warranty, comprehensive lease, Customer-Site Support Agreement, Comprehensive or *Warranty-Plus* Service option are automatically eligible for coverage without inspection. All other products must undergo a product inspection before they can be covered by a Customer-Site Support Agreement.

Per-Call Service

Whether you need to install a new Tektronix product, have a product serviced or perform a preventive maintenance check, we are as near as your phone. Just give one of our worldwide field offices a call.

For a reasonable price (time, materials, travel), we will visit your site, diagnose, service and clean your product. And all on-site repairs are covered by a 90-day Service Warranty.

Response Times

Customers who have either a *Warranty-Plus* Service Plan or a Customer-Site Support Agreement can expect the following response times:

US Response Times

Zone	Mileage	Work Hours*[1]
1-5	0-75	within 8
6&7	76-150	within 16
8-10	151+	within 24

*[1] *8:00 a.m. to 5:00 p.m., Monday through Friday, excluding Tektronix holidays.*

* International Coverage

While Tektronix Service is available worldwide, offerings, response times, the use of U.S. toll-free telephone numbers, and turnaround may differ from those provided in the U.S. Please contact your International field office or approved Distributor for more information. International Field Offices are listed on pages 568-570.

Coverage Exclusions

Service coverage under a *Warranty-Plus* Service Plan or Customer-Site Support Agreement will not be honored if the product failure was caused by the misuse, inadequate care or maintenance of the product such as repairs attempted by non-Tektronix personnel, improper use or connection to incompatible equipment, and modification or integration that make it more difficult to service a product.

Worldwide network of Field Offices

To learn more about our on-site service offerings, please contact one of our field offices listed on the back of this catalog or contact our US Telemarketing Center toll-free: 1-800-835-6100.

INSTRUMENTATION, TEST SYSTEMS, TELEVISION, SPECTRUM ANALYZERS, AND COMMUNICATIONS PRODUCTS

Calibration and Repair Services

Our calibration and repair services provide the full spectrum of support for your Tek instrument. To maintain warranty-like coverage, choose *Warranty-Plus* with the calibration and repair option to suit your needs.

Beyond the Warranty or *Warranty-Plus* periods, Tektronix continues to support your equipment with a wide selection of Support Agreements, Per-Incident Calibration and Repair, and Special Services.

Warranty-Plus

One good purchase deserves another. At the time you purchase or lease a Tek product you can choose to add a warranty-like extension plan. A small, one-time-only fee at the time of product purchase covers your costs for the life of the agreement. You can save money immediately by limiting your future service costs at the time you purchase or lease a Tek product.

Warranty Plus plans provide the most cost-effective long-term service available. And some *Warranty-Plus* plans are even less than one Firm-Price calibration and repair. It is another way Tek service keeps your costs down and your instruments up. Refer to the *Warranty-Plus* tables on these two pages for instrumentation and Test Systems product coverage.

Warranty-Plus Conditions International *Warranty-Plus* Options

Warranty-Plus is available in most countries, but service is only provided in the country where the product and plan are purchased. Response and turnaround times may be different than those provided in the United States. Please consult the Tektronix subsidiary or approved distributor in your country.

Response and Turnaround Times

Warranty-Plus assures that your Instrumentation and Test Systems products receive top priority response. Contact your local Service Center for turnaround times that meet your business needs.

Customer Responsibilities

When products need servicing under M-Option coverage, it is the customer's responsibility to deliver or ship them to a designated Tektronix Service Center. Shipping charges to Tektronix must be paid by the customer. Return shipping is paid by Tektronix.

When Test Systems products need service under Q-Option on-site coverage, it is the customers responsibility to contact a designated Tektronix service office providing system/product type, serial number and description of malfunction.

Coverage Exclusions

Warranty-Plus Service must be purchased in the country where it will be applies. Warranty-Plus Service purchased in the United States is only valid within the United States.

Service under a *Warranty-Plus* Agreement does not apply if the failure is caused by misuse or inadequate care or maintenance, such as:

(a) Abuse or cannibalization of products.
(b) Damage from repair attempts by non-Tektronix personnel.
(c) Improper use or connection to incompatible equipment.
(d) Modification or integration that increases time or difficulty in servicing your product.

Firm Price Calibration and Repair Services for Instrumentation Products

Tektronix-backed service for your instrumentation products does not stop with the Warranty and *Warranty-Plus* programs. As the bar chart illustrates, Tektronix provides the fullest possible range of Calibration and Repair services. Three Calibration levels provide a wide range of services including: On-Site Cal Verifications, overnight service, free pick up and delivery, wet washes, cosmetic services test data and traceability to national standards (NBS in the United States). Whatever your calibration needs, Tek service has a package to fit.

M-OPTIONS
SERVICE CENTER SUPPORT
COMBINED WARRANTY & WARRANTY-PLUS COVERAGE*

Warranty-Plus Option	Year 1	Year 2	Year 3	Year 4	Year 5
M1	Repair coverage	Repair coverage (1) CAL	Repair coverage (1) CAL		
M2	Repair coverage	Repair coverage	Repair coverage	Repair coverage	Repair coverage
M3	Repair coverage	Repair coverage (1) CAL	Repair coverage (1) CAL	Repair coverage (1) CAL	Repair coverage CAL
M4	Repair coverage (1) CAL	Repair coverage (2) CAL	Repair coverage (2) CAL		
M5	Repair coverage (1) CAL	Repair coverage (2) CAL	Repair coverage (2) CAL	Repair coverage (2) CAL	Repair coverage (2) CAL
M9	Repair coverage	Repair coverage	Repair coverage		

** Applicable in the United States and selected international operations. See your local sales or service representative for details.*

Our repair offerings start at the basic repair level for one designated failure. For instruments with more extensive repairs, Tek offers additional service levels ranging from a single repair, to complete refurbishing.

Tek also offers combined services of calibration and repair. These make it efficient and economical for you to let us handle both tasks at one time.

Agreements

Calibration and Repair Services For Instrumentation Products.

For the most cost effective management of maintenance beyond the Warranty and *Warranty-Plus* periods, Tek Service offers Support Agreements. A Support Agreement provides long term, planned care for your equipment at a lower price.

With a Support Agreement, you know the costs up front, can pre-schedule calibrations, and cover most repair needs. Compared with per incident service, the overall savings of a Support Agreement are significant, and it provides even faster turnaround times.

Special Services

You can also purchase extra services not provided by our other calibration or repair coverage. These activities include Time and Material service, Calibrations and Repair of obsolete products, Probe Repair, and Instrument Wash. We will inspect the product and quote a price for the work before performing any servicing.

For the phone number of the Tektronix Service Center nearest you, consult the listings in the back of this catalog.

Test Systems On-Site Support

On-Site service provides fast and convenient support for Instrumentation Test System products. A variety of service plans are available ranging from On-Site Per-Incident Repair to full On-Site Repair and Calibration Agreements.

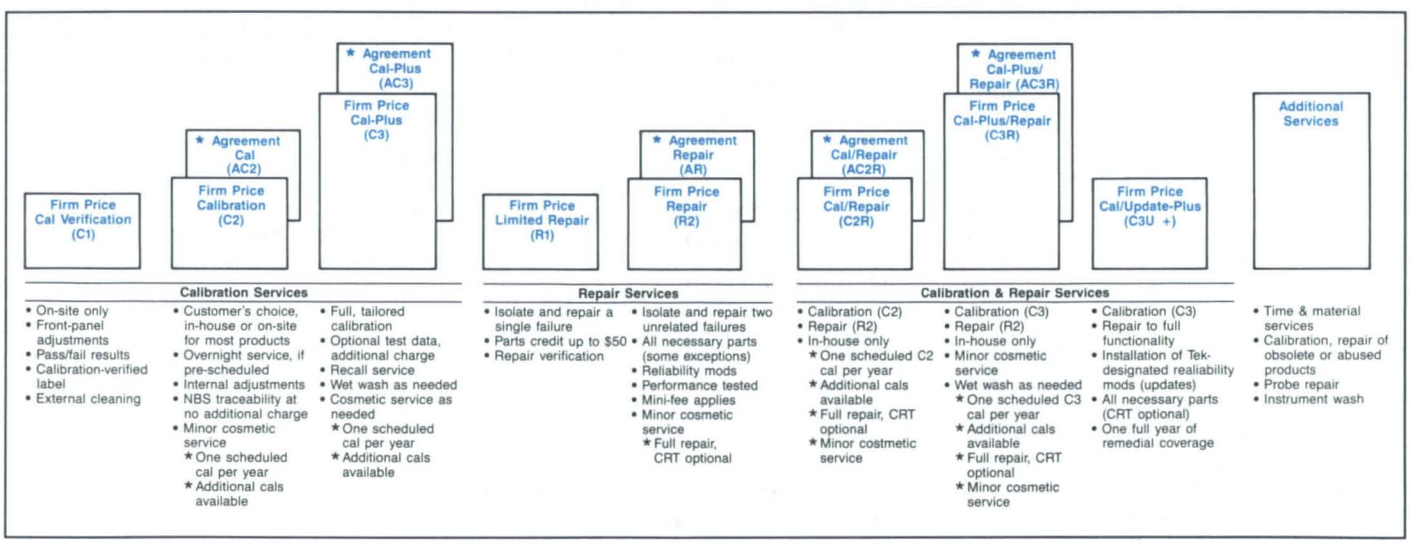
Test Systems *Warranty-Plus* On-Site Service

To make service more convenient customers may purchase our more popular service packages at the time of system purchase. Q0 option provides US customers with system/product installation and integration to assure optimum performance and accuracy. Q1 provides one full year of On-Site Warranty/Remedial support including one On-Site Cal and Performance Test. Q2 provides two full years of On-Site Warranty/Remedial support including two On-Site Calibration and performance test. Q3 provides three full years of On-Site Warranty/Remedial support including three On-Site Cal and Performance Tests. On-Site *Warranty-Plus* ensures maximum uptime and performance for your Tektronix Test Systems.

Q OPTIONS
ON-SITE SUPPORT

Warranty-Plus Option	Combined Warranty and *Warranty-Plus* Coverage Year 1	Year 2	Year 3
Q0	On-Site Installation		
Q1	On-Site Repair (1) On-Site Cal		
Q2	On-Site Repair (1) On-Site Cal	On-Site Repair (1) On-Site Cal	
Q3	On-Site Repair (1) On-Site Cal	On-Site Repair (1) On-Site Cal	On-Site Repair (1) On-Site Cal

* *Applicable in the United States and selected international operations. See your local sales or service representative for more details.*



Customer Service Training Offerings

- **Service Training Classes**
- **Technology Concept Classes**
- **Operational Instrumentation Training**
- **Self-Study Packages**
  - **Video Tapes**
  - **Audio Tapes**
  - **Packages**
- **Training Documentation**
  - **Training Guides**
  - **Service Manuals**

Service Training Classes

Professional training provides your technicians the same opportunity to learn the latest maintenance techniques in identical courses used to train Tektronix technicians. We emphasize the "How to Fix" philosophy.

Our formal classroom training is intensive, with lectures and hands-on labs. Tektronix service instructors sharpen your skills in troubleshooting, isolating faults, and repairing Tektronix products. You learn factory-approved preventive maintenance procedures for long product life and maximum uptime.

On-site custom training is available. We have the flexibility within our programs to provide training at your location, enabling you to save costly travel expenses. By tailoring the class presentations and materials to your exact needs, you receive maximum value for your training investment.

Technology Concept Classes

We offer professional development in contemporary concepts technology. Our training focuses upon state-of-the-art developments in the areas of Logic Analysis, Microprocessor Development Labs, Digitizing Oscilloscopes, Computer Graphics, and Spectrum Analysis.

These seminars are offered on a scheduled basis at various locations throughout the United States and may be conducted at your location if you desire. Use these seminars to enhance the professional development of your engineers and technicians in the instrumentation world.

Operational Instrumentation Training

To get the most from your Tektronix products, register in one of the various operational instrumentation training seminars offered by Tektronix Service Training. Our seminar/workshops combine classroom lecture with hands-on labs that emphasize "How to Use" philosophy. These sessions can be conducted at your location to satisfy your requirements. Multiple product offerings are available, if you request. This high-quality training increases your productivity and provides you with "Ease of Use" necessary to grow in your personal development.

Self-Study Packages

Study on the job or at home. Our self-study video/audio tapes and training packages include exercises to help you quickly develop skills in logical diagnosis and repair.

Tektronix Service Training packages provide interactive, hands-on instruction for comprehension of troubleshooting and repair techniques at your own bench. Our tapes are quality products that introduce basic concepts to novice technicians and advanced multimedia packages for experienced service specialists. Build your own library of relevant training tapes and materials. Training packages are the next best thing to being in class.

Training Documentation

Tektronix Service Training develops the complete program for your training needs. In addition to formal training, we can provide a complete instructor package consisting of: class outline; lesson plan; instructor guide; student workbook; lab exercises; and visual projections. Service manuals, created by the Service Training group, can be developed to satisfy your specific needs. Our professional technical writers develop materials which emphasize the "How to Fix" techniques used by the Tektronix service specialist.

Our training programs have been used by various branches of the Armed Services with high acclaim. Join the team of professional training offered by Tektronix Service Training.

Call Tektronix Today

Formal classroom training is available at the Tektronix Training Facilities in Beaverton, Oregon, as well as in Atlanta, GA; Boston, MA; Chicago, IL; Dallas, TX; Denver, CO; Irvine, CA; and Santa Clara, CA.

To register for the formal training classes or information on other training services, call:

1 (800) 835-9433 ext. WR1407

or write:
Tektronix, Inc.
Walker Road Industrial Park
P.O. Box 4600 M/S 94-925
Beaverton, Oregon 97076

Check the Specifications. You'll Find Long Product Life Designed-In.

Reliability Standards Second to None

Tek products are engineered for high reliability. Components and assembled products of every prototype and preproduction model are subjected to "accelerated-life" reliability tests in our Labs. If any fall short of Tek Standards, changes are made. Manufactured products are thoroughly tested before they're fitted in custom-designed, lab-tested shipping cartons.

Product Specifications to Meet Your Environment

In Tek's Environmental Labs, field conditions are taken to extremes. Shock, vibration, high humidity, electromagnetic radiation, electrostatic discharge, power line surge, high/low temperature, and altitude tests are conducted.

The specification limits for humidity, vibration, shock, and transportation are intended to be beyond what is expected in use. Operation at these extremes may cause minor physical deterioration but should not cause electrical performance to deteriorate outside specifications. Continual use at the specified limits of temperature and altitude should not cause significant short-term deterioration. Higher temperature will reduce long-term reliability. The EMC test is completely nondestructive.

GENERAL TERMS OF SALE

Credit and Payment Terms

Tektronix, Inc. offers many different terms of sale in order to meet varied purchasing objectives and to assist in financial planning. Credit accommodations must be arranged with Tek's Credit Department. Orders and requests for credit accommodations should be placed with your local Tek Sales Office, listed on the inside back cover.

If, in the judgement of Tektronix, the financial condition or payment record of the Buyer at any time does not justify shipment of order on the payment terms requested, Tektronix may refuse to ship unless it receives payment in advance, or at its option, payment upon delivery of equipment. Businesses established for six months or less may not meet minimum requirements for extended and/or installment terms of sale.

The following terms may be arranged with a Tektronix Sales Office.

Net 30 Days Standard Terms

Standard terms of sale are Net 30 days following the date of invoice. There are no discounts for early payment.

60, 90, and 120 Days Extended Terms of Sale

Extended terms of 60 to 120 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. Request for extended terms must be made at the time of order placement.

Installment Purchases—Security and Lease Agreements

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.

Security and Lease terms are not invoiced. Reminders of each installment are sent to the customer 10 days prior to the due date. The due date of each monthly payment on an installment term will be approximately 30 days from the date of shipment and every 30 days thereafter until completion of the contracted term. Failure to receive any reminder notice from Tektronix shall not affect customer's obligation to pay charges when due.

Except for standard warranty, maintenance is not provided under either a Security Agreement or a Lease Agreement. Additional maintenance is not provided under either a Security Agreement or a Lease Agreement. Additional maintenance coverage may be purchased where offered as an option to the instrument or may be purchased as a separate transaction. Maintenance ordered as an option may be financed along with the product.

The customer is required to pay applicable property taxes, licenses, etc. and furnish adequate insurance to Tektronix for loss and damages for both Leases and Security Agreements.

Security Agreement

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 $1000 for six months to $2000 for thirty-six months. Longer terms of 48 months to 60 months are available by quotation for financed balances of more than $25,000. There are no maximum finance balances. Upon completion of the term of the Security Agreement and prescribed payments, the customer owns the equipment.

Lease Agreement (Minimum is $1,000)

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. Not available for Information Display Products.

Information Display Products

Information Display Computer Graphics Products are available under 3 expanded Leasing programs. Terms vary from 90 days to 4 years.

Comprehensive Lease—This full service lease provides 7 features ensuring customer flexibility. Key features include maintenance, product upgrade, and purchase credits. *Basic Lease*—Customers can use this program to acquire products at our lowest monthly rates. *Ownership Lease*—This even payment plan ensures title transfer at the lease end. No down payment or ending balloon payment is required.

In addition to these standard programs, specialized leasing programs answer customer needs in the areas of new product evaluation, short-term rental, supplying interim products for delayed items, credit acceptance, and others. Custom Leases can also be structured, providing a tailored solution for individual customer requirements.

Minimum Order

The minimum acceptable order is $25.00.

Shipment

All prices, quotations, and shipments are FOB Beaverton, Oregon, unless otherwise specified. Shipment will be made via the most economical method, and air shipments will be insured at full value unless your order instructs otherwise.

HARDWARE WARRANTY SUMMARY

Tektronix warrants to its Customers that the products that it manufactures and sells will be free from defects in materials and workmanship for the periods set forth in the table below. If any such product proves defective during the applicable warranty period, Tektronix, at its option, either will repair the defective products without charge for parts and labor or will provide a replacement in exchange for the defective products.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Tektronix will provide such service at Customer's site for certain categories of products, as indicated in the table below, if Customer's site is within the normal on-site service area. Tektronix will provide on-site service outside the normal on-site service area only upon prior agreement and subject to payment of all travel expenses by Customer. In all other cases, Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the service center is located. Customer shall be responsible for paying all shipping charges, duties and taxes, if the product is returned to any other location. The locations at which the services will be provided for different categories of products or product groups are set forth below.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THE LISTED PRODUCTS IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE A DEFECTIVE PRODUCT IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

PRODUCT CATEGORIES	WARRANTY PERIOD	SERVICE LOCATION
Oscilloscopes (except 2200, 2300, 2400 Series); TM 500/TM 5000 Series; Communications Network Analyzers (except 834, 835, 836); Logic Analyzers (except 9200 Series); Spectrum Analyzers; Television Products; Waveform Digitizers; Curve Tracers; Photometers/Radiometers; Cameras; Carts (except K217S, K318); Probes; CRTs; Isolators; Test System Interface Series; PEP Systems Controllers; Personal Test Systems	1 year from date of shipment	Service Center designated by Tektronix
Oscilloscopes: 2200 (except 2205), 2300, 2400 Series; Communications Network Analyzers: 834, 835, 836	3 years from date of shipment	Service Center designated by Tektronix
Monitors: 606B, 608, 620, 634	3 months, except 1 year from date of shipment for CRT	Service Center designated by Tektronix
All 4000 Series: Graphics Workstations, Color Graphics Terminals (except those listed below), Color Graphics Output Systems, Graphics Tablets; Monitors: GMA201; 4041 Controller; Microprocessor Development Products (except V-Systems, MV Systems)	3 months, except 1 year from date of shipment for CRT	Customer's site if within normal on-site service area
Color Graphics Terminals: 4205, 4207, 4208, 4209; Color Graphics Netstation: 4211	1 year from date of shipment	Customer's site if within normal on-site service area
Custom Test Systems; Semiconductor Test Systems, Logic Analyzers: 9200 Series; Microprocessor Development Products: V-Systems, MV Systems	3 months, except 1 year for CRT, beginning on the date of installation by Tektronix, or one month from date of shipment, whichever is earlier	Customer's site if within normal on-site service area
Parts, Assemblies, Supplies and Test Fixtures: All 9-digit part numbered items except Probes, CRTs; Carts: K217S, K318	3 months from date of shipment	Service Center designated by Tektronix
Service	3 months from date of shipment or date of completion if performed on-site	Location where original service was performed

SOFTWARE WARRANTY SUMMARY

Tektronix warrants that any software product will conform to the specifications in the documentation provided with the product, when used properly in the specified operating environment, for a period of three (3) months. The warranty period begins on the date of shipment, except that if the program is installed by Tektronix, the warranty period begins on the date of installation or one month after the date of shipment, whichever is earlier. If any such software product does not conform as warranted, Tektronix will provide the remedial services as described in the documentation provided with the product. Tektronix does not warrant that the functions contained in the software product will meet Customer's requirements or that the operation of the programs will be uninterrupted or error-free or that all errors will be corrected. Software products for which Tektronix does not set forth specifications in the documentation provided with the product, are provided "as is" without warranty of any kind, either express or implied; except that, Tektronix warrants that the media on which such software products are provided will be free from defects in materials and workmanship for a period of three (3) months from the date of shipment. If any such medium proves defective during this warranty period, Tektronix will provide a replacement in exchange for the defective medium.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangments for such service in accordance with the instructions received from Tektronix. If Tektronix is unable, within a reasonable time after receipt of such notice, to provide the remedial services as described in the documentation provided with the product, when such services are indicated, or provide a replacement that is free from defects in materials and workmanship, Customer may terminate the license for the software product and return the software product and any associated materials to Tektronix for credit or refund.

This warranty shall not apply to any software product that has been modified or altered by Customer. Tektronix shall not be obligated to furnish service under this warranty with respect to any software product a) that is used in an operating environment other than that specified or in a manner inconsistent with the User's Manual and documentation or b) when the software product has been integrated with other software if the result of such integration increases the time or difficulty of analyzing or servicing the software product or the problems ascribed to the software product.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THE LISTED PRODUCTS IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO PROVIDE REMEDIAL SERVICE WHEN SPECIFIED, REPLACE DEFECTIVE MEDIA, OR REFUND CUSTOMER'S PAYMENT IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

OEM COMPONENTS

Special Information for OEM

At Tektronix, we offer many products with terms, conditions, and pricing for OEMs. Computer graphics components, small screen displays, certain cameras, tv signal test and measurement instrumentation—we offer these and other products on a special basis to the original equipment manufacturer.

Choose the Performance Level to Match Your System

In many product areas, our wide range of OEM components allows you to select just the optimal performance you need for the system you are building. When your systems demand highest performance, Tektronix will provide the quality products to meet your standards.

In price-sensitive situations, the wide Tektronix selection usually lets you select exactly the performance level you need—no more, no less.

Special OEM Terms and Pricing Help Keep You Competitive

Ask your local Tektronix representative about the special OEM terms and pricing available to you.

Service and Support— When and Where You Need It

Tektronix has service centers throughout the U.S. and in many countries around the world. We offer long term parts support to protect your investment.

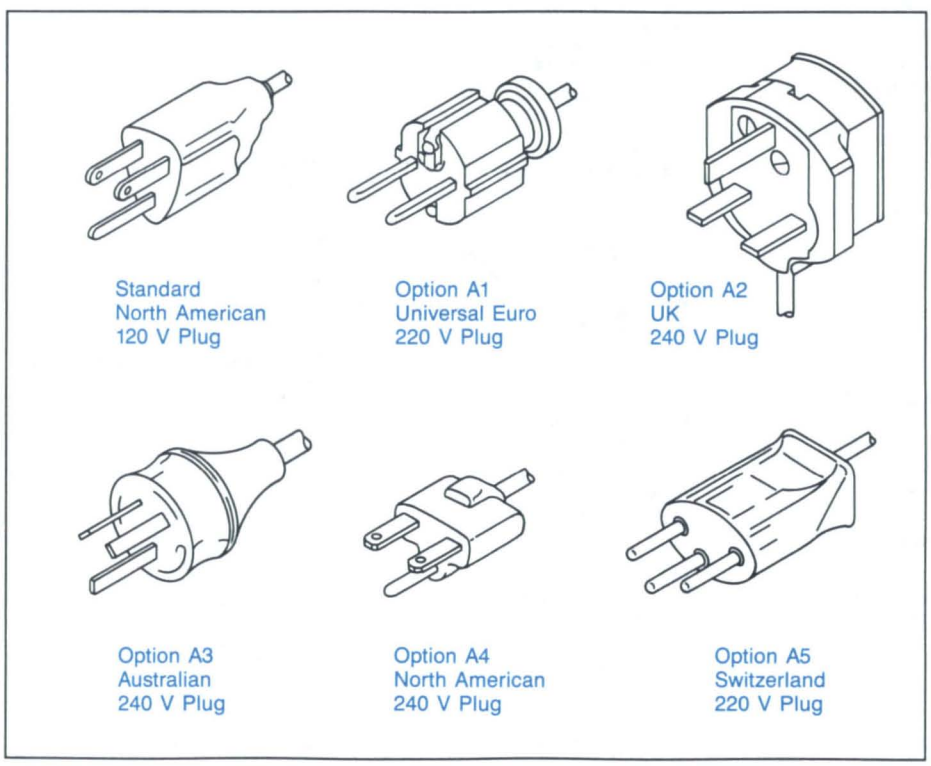
If you need applications assistance, we're ready to help. Our OEM specialists are trained to help solve interface problems. That's solid support when you need it.

You and Tektronix: A Quality Partnership

Explore the advantages of working with Tektronix: excellence in products, support, and service.

Your local Tektronix representative can help you obtain full details on how you can profit from a quality partnership with Tektronix.

See how our OEM expertise can add value to your system.



POWER SOURCE CONSIDERATIONS

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 to operate from a power source that will not apply more than 250 Volts RMS between the supply conductors or between either supply conductor and ground.

Many Tektronix instruments can be fitted with one of the power cord/plug options listed below and wired for the voltage as indicated, if specified on the purchase order.

North American	120 V	Standard
Universal Euro	220 V	Option A1
United Kingdom	240 V	Option A2
Australian	240 V	Option A3
North American	240 V	Option A4
Switzerland	220 V	Option A5

The power cord/plug options may become available on instruments not specified in this catalog. Refer to the individual product ordering information for those products offering these options as of publication date.

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

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For customers in areas not listed, see below for your nearest office.

Customers in Eastern Europe, Near- and Middle East contact:
Tektronix Ges.m.b.H., Austria

Customers in Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Djibouti, Equatorial Guinea, Gabon, Guinea, Malagasy, Mali, Mauritius, Niger, Senegal, Togo, Zaire contact: Tektronix S.A., France

Customers in Andorra, Angola, Azores, Gibraltar, Spanish West Africa contact:
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