Tektronix

Measurement Products Catalog 1996



Convergence–
The Market We've Been Waiting For



In simple terms, convergence occurs with the merging of various data types into diverse switching and transmission networks. Its results, however, will be anything but simple: convergence will profoundly affect your life as a consumer and your work as a producer of technical products.

At Tektronix, we view convergence as the market we've been waiting for.

As we enter the convergence era, solutions addressing computation, communication, and video technologies become central to serving customer needs. While some companies can claim experience in some of these areas, no other is involved in all portions of the signal path from source to destination.

For 50 years we've been best known as an advanced supplier of products for high-speed analog and digital design–the acknowledged world leader in oscilloscopes and a leading supplier of logic analysis and spectrum analysis solutions.

Using core competencies in signal acquisition, signal processing, and fiber technology, Tektronix addresses the challenge of testing synchronous transmission with a full range of OTDR, TDR, SDH/SONET, BERT, jitter and wander, and ATM testers.

No other company can claim our undisputed position as the world's dominant supplier of video testing equipment and technology. Worldwide we help customers succeed in their work, regardless of what format or standard they follow.

In fact, what we know about television makes us uniquely qualified to serve the convergence market. Why? A key element is compression of the video signal. While video is the toughest part of the signal mix to understand–and the one most companies are only just beginning to learn–it's a technology we've mastered.

In the video industry, the Tektronix name is synonymous with television itself. In the early 1950s, it was our unique ability to trigger on video signals that gave rise to the video industry. Our 40-year history is rich with innovations.

We've earned eight Emmy Awards and an Oscar, not just for products, as you might expect, but for technologies that have advanced television and movies. Our engineers, long active in standards-setting committees, currently play a leading role in the group helping raise the bar on video compression performance. We've just introduced the MTS100 MPEG Compression Transport Stream Generator and Analyzer–the first product of its kind–with a partner company, Matra Communication of France. Adaptation of traditional test equipment to MPEG-2 is underway.

While market trends change, one constant is the Tektronix commitment to technologies, their applications, and our customers. We invite you to share in our understanding of convergence and in our excitement about the promise it holds for all of us.

Sincerely,

Dan Terpack

Dan Terpack
President, Measurement Business Division

Tektronix



Measurement Products Catalog 1996







Tektronix: A Lifetime of Value

Customer Support

No other test and measurement supplier can match the remarkable depth of customer support offered by Tektronix. We offer technical support, service training, and service warranties. For additional information and the Tektronix representative nearest you, see the listing in the back of this catalog.

TEKFAX

Literature Available Via Fax

You can now receive information via fax—ideal for technical information you need immediately. Product information or application notes are available any time of the day via Tektronix TekFAX. See page 564 for complete information.

Advantest

In 1993 Tektronix became the exclusive distributor of Advantest test and measurement products in North America. Featured in this catalog are a wide-range of Advantest products in the RF/Microwave and Telecommunications areas. These exciting products are highly complementary to the Tektronix instrument portfolio. So look for the Advantest logo throughout this catalog to identify new high-performance, high-quality products from another leading company in the Test and Measurement industry: ADVANTEST

Rohde&Schwarz

Also, in 1993, Tektronix has assumed exclusive marketing, distribution, service, and support for Rohde&Schwarz Test and Measurement products in the U.S. Similarly, Rohde&Schwarz has assumed marketing, distribution, service and support responsibility for Tektronix Test and Measurement, Telecommunications, and Television Test products in Eastern Europe, most of the Mediterranean and Middle East, and the CIS. ROHDE&SCHWARZ

Analogic

In 1994 Tektronix assumed exclusive marketing, distribution, service, and support for Analogic VXI products world-wide. Listed in the VXI selection guide are the VXI products from Analogic.

Tektronix Sales/Service Offices

We have a worldwide network of sales and service offices. To find the office nearest you, see the listing in the back of this catalog.

Tektronix TeleBusiness Center (TBC)

The same quality support found in our sales and services offices is available toll free. Call 1-800-426-2200, Ext. 99, Monday through Friday, 8:00 a.m. Eastern Time to 5:00 p.m. Pacific Time.

Distributor & Manufacturers Representatives

We have Authorized Tektronix Distributors and Manufacturers Representatives for selective products and geographic areas. To find the office nearest you, see the listing in the back of this catalog.

Federal Administration Office

Federal Agencies should obtain price and delivery from, and place orders directly with, Tektronix Federal Order Administration. See page 555 for information.

Reconditioned Products

Tektronix has a variety of quality, previously used products at prices significantly lower than our catalog prices. These products have been fully refurbished, tested and calibrated. Each comes with a warranty equivalent to our new products. See page 561 for information.

World Wide Web

See Tektronix on the World Wide Web:
http://www.tek.com

ISO 9000

ISO 9001
ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities. See the inside back cover for information.

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For further information, contact: Tektronix, Inc., Corporate Offices, 26600 SW Parkway, PO Box 1000, Wilsonville, Oregon 97070-1000. Phone (503) 682-3411, (800) 426-2200. Subsidiaries and distributors worldwide.

Prices and Specifications Subject to Change.

All prices, specifications and characteristics set forth in this catalog are subject to change without notice. Prices current at the time an order is accepted by Tektronix will apply. Check with your local Tektronix representative for current price and specification information.

Recycled paper used for packaging and the body of this catalog.

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New Size .....8 x 10!

Waste of any sort has a huge impact on our lives. Being an Oregon based company, Tektronix respects the value of our forests. To minimize our direct impact on the environment the 1996 catalog features a new size which reduces the amount of paper we use, while retaining the same level of content and quality that you expect from Tektronix.

Tektronix .....on the WWW!

See Tektronix on the World Wide Web: http://www.tek.com

Keep up to date with Tektronix. Access the latest information about products, publications, trade shows, and more.

Prices .....all in one place.

All prices have been consolidated into one section in the back of the catalog instead of appearing on individual pages. Makes looking up numerous prices easier and faster.

Your feedback is important to us!

In the back of the catalog is a mini-survey to let us know how we are doing and what we can provide to meet your changing needs. Just complete, mail, fax, or provide your input through the Tektronix WWW site.

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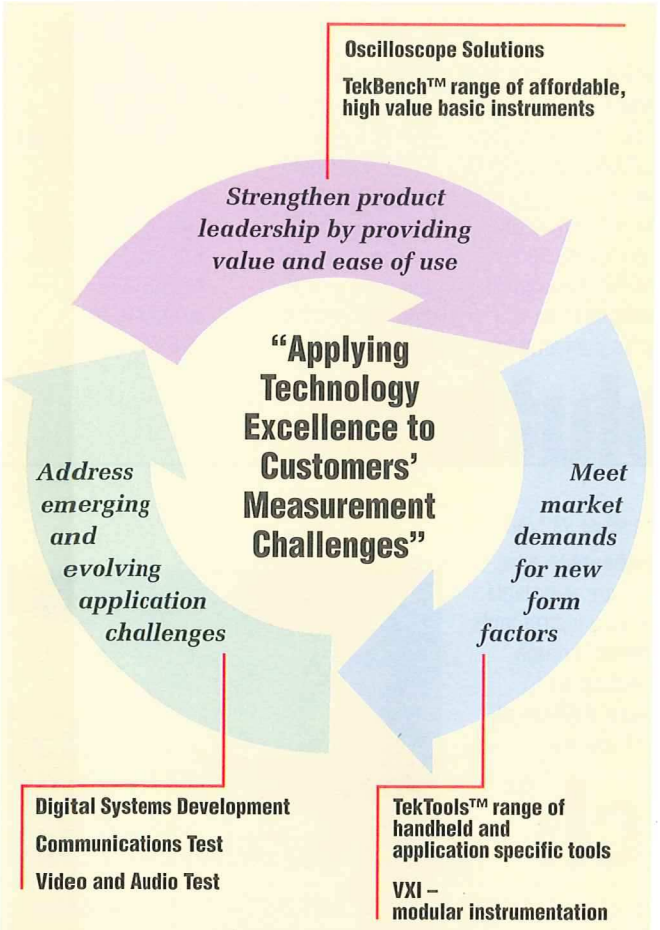
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The Measurement Business

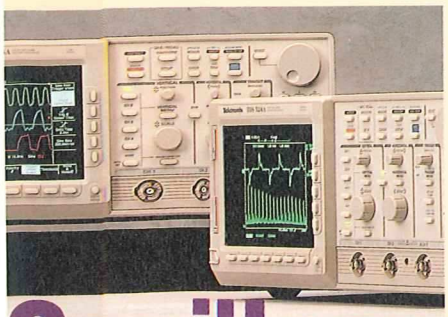
The Tektronix name has been synonymous with providing solutions to customers' electronic measurement challenges for almost 50 years. On a global basis, the measurement business has been through a period of rapid change over the last few years. In order to be successful during this time, Tektronix has had to be able to anticipate changes and develop products that will meet new challenges as they arise. The products shown in this catalog attest to the success of a strategy that identifies trends and technical needs and deploys resources to meet these customer-driven requirements.

At Tektronix we continue to focus our efforts in areas that customers tell us are important to them. We believe that our continued leadership in the measurement industry must be earned by applying our technology excellence to customers' measurement challenges in three distinct sectors, as shown in the adjacent diagram: delivering superior value and easy-to-use products, creating measurement solutions in new form factors, and addressing emerging and evolving challenges in global markets. As a leading vendor of test and measurement equipment for convergence applications, Tektronix relies on its world renowned expertise in video and communications to lead its next generation of products. Further analysis defines our measurement business in terms of the seven key areas shown, as defined by customer needs and Tektronix capabilities.

FROM SOURCE TO DESTINATION

Manufacturing R & D	Source	Production	Physical Test Distribution Processing	Transmission & Switching	Destination
Oscilloscopes	Baseband Video Handheld Equipment	Baseband Video Measurement	OTDRs	ISDN Testers	Demods
Logic Analyzers	VM700 Camera	–Analog Composite	TDRs	SDH/SONET Tester	Baseband Video Testers
RF Spectrum Analyzers	Digital Audio Monitors	–Analog Component	Power Meters	Signal Level Meters	Audio Testers
ATM Analyzers	Frame Syncs	–Serial Digital	Spectrum Analyzers	Spectrum Analyzers	
MPEG Analyzers	Audio Syncs (delay)	–Digital Composite		Audio Measurement. Sets	
Video Generators/Monitors		–Digital Component		RF Measurement Sets	
Video Synchronizers		–Video Generators		Wireless Testers	
Video/Audio Measurement Sets		–Audio Monitors		Oscilloscopes	
Jitter & Wander Analyzers				Sweeper	
VXI SDH/SONET				MPEG Analyzer	
Wireless Testers					

Tektronix Products for every signal type



Oscilloscope Solutions

Tektronix has been the leader in oscilloscopes for almost 50 Years and is widely recognized as the leader in oscilloscope solutions worldwide.

Tektronix offers more high performance oscilloscopes than all other companies combined; these are the scopes of choice due to the innovative technology used in products like the TDS family of digitizing oscilloscopes. Tektronix is particularly known for its pioneering in user interface technology – the TDS interface is widely regarded as an industry standard.

Tektronix is actively driving and supporting the migration from analog to digital technology in oscilloscopes.

Tektronix breakthroughs in digitizing scope technology include Digital Real Time, as seen in the TDS 300, TDS 600 and TLS 200 Series, and InstaVu™; as used in the TDS 700 Series.

Tektronix has a broad portfolio of TekBench™ basic instrumentation that addresses the needs of customers involved in manufacturing production, training, bench and field service, and product design.

Tektronix' TDS300 Series of oscilloscopes, with Digital Real Time technology, is the centerpiece of a range of TekBench™ products. Each TekBench™ product is designed to provide a balance of performance and cost-effectiveness unmatched for instruments of its type.

TekBench™ products are affordable, capable instruments offered through a widespread, expert network of distributors.



TekBench™ Basic Instrumentation



TekTools™

TekTools™ is Tektronix' brand name for its new range of affordable, smart, handheld, battery-operated electronic measurement tools for service professionals. These products take advantage of Tektronix' renowned measurement and manufacturing technologies and are designed to address the proliferation of electronic technology in industry. They offer the quality, reliability and support that service applications demand.

Tektronix has provided products to the service industry for nearly 50 Years and now is able to offer a growing portfolio of TekTools™ products that includes digital multimeters, compact oscilloscopes, specialized accessories and environmental monitoring tools such as light meters.

TekTools™ products are sold through distributors around the world. They are particularly suited for applications in which electronic measurement tools are "non-traditional."

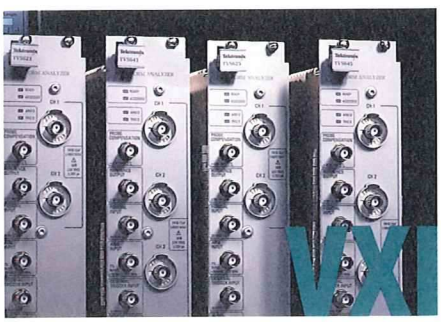
Electronic Measurement Instruments

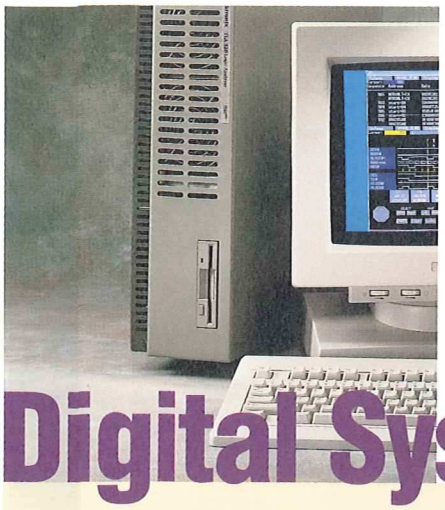
Tektronix has been in the VXI market since 1987 and was a leader in defining the VXIbus standard. As a founding member of both the VXI*plug&play* alliance and the VXIbus Consortium, Tektronix continues to be a driving force for creating and supporting open systems architecture.

The broad Tektronix portfolio of VXI hardware and software products entirely supports the open architecture of the VXIbus and VXI*plug&play* standards.

Tektronix VXI products continually set the price/ performance benchmark in their class, thus supporting the accelerating migration to VXI and away from conventional GPIB-based ("rack-and-stack") test systems.

Tektronix' commitment to VXI technology is evidenced by the company's use of VXIbus standards in designing instruments to address certain applications, notably SDH/SONET production testing.





Digital Systems Development

Tektronix is a leading supplier of instruments for digital systems development, with a range of products designed to help engineers meet productivity and time-to market challenges. The Digital Systems Development initiative addresses customers' unique hardware and software debugging and measurement challenges in the development of microprocessor-based, software-intensive digital systems.

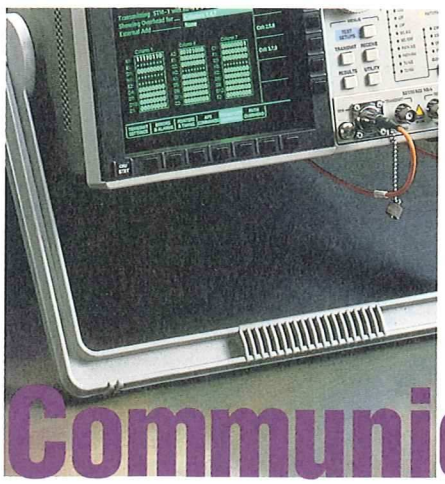
The Tektronix Digital Analysis Systems are leaders in a new form of networked, or "Enterprise," instrumentation for the digital systems designer, offering factory-wide linkages to software tools and software performance analysis capability. The Tektronix Logic Scope is a unique tool that bridges the gap between oscilloscopes and logic analyzers, while Tektronix oscilloscopes offer the performance and application-specific features to address high speed digital designs. To complete the portfolio, Tektronix probing solutions meet the challenge of accessing today's fine-pitch hybrids, surface mount devices and integrated circuits.

Video and Audio Test

Tektronix is the worldwide leader in test equipment for video and audio signal applications from source to destination. Having provided products to the television industry for over 40 years, we are recognized by the television industry for technical leadership through receipt of eight Emmy awards. Tektronix is an active member on worldwide standards committees.

Tektronix offers video and audio test instruments for signal processing and generation, and measurement equipment for broadcast, cable, production, manufacturing and transmission applications. Tektronix television products are widely recognized as "industry standards:" innovative, easy to use and based on an in-depth understanding of customer needs. In addition, Tektronix has allied itself with other leading vendors to offer the broadest line of video and audio test instrumentation available.



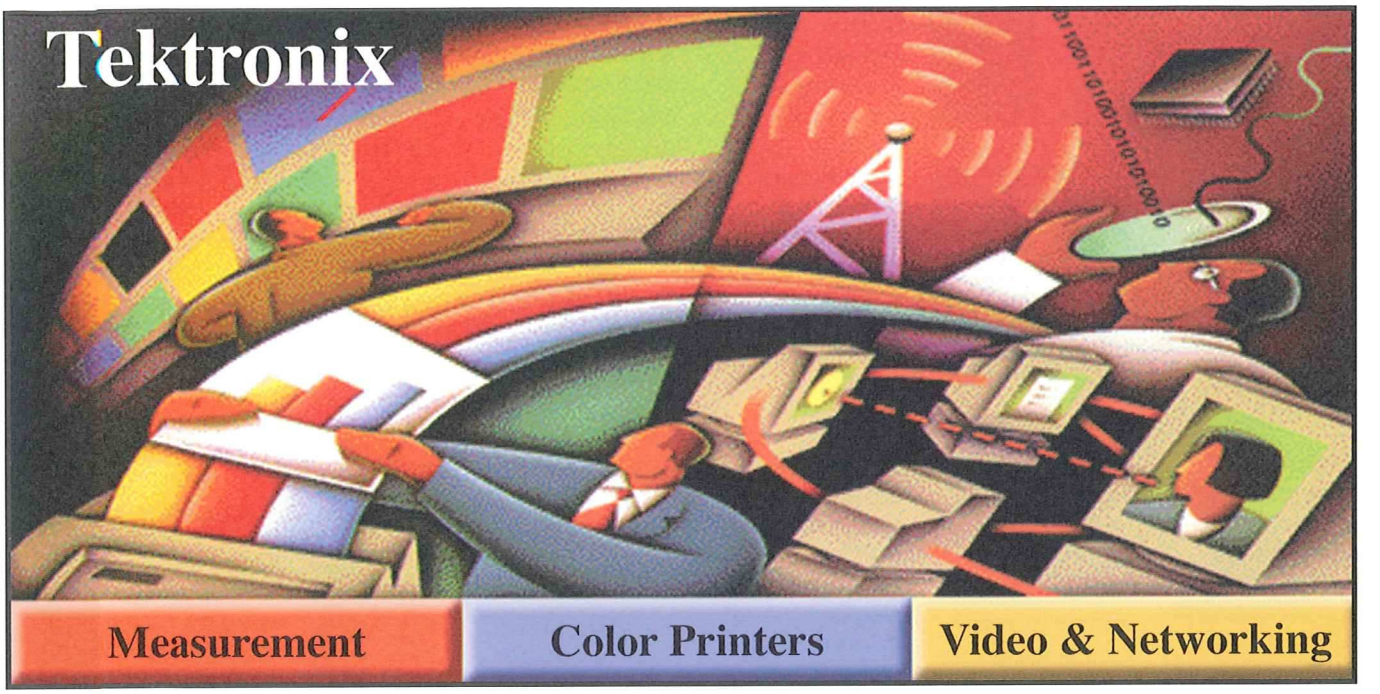


Communications Test

In the communications test area, Tektronix supplies diverse and innovative test solutions for emerging networks. Some of these products are designed to ensure network integrity and optimize performance; others verify new designs and assure product quality in communications equipment. Building on its leadership position in cable testing, Tektronix is expanding its commitment in broadband transmission testing and RF & wireless test instrumentation as well. Every one of these products benefits from Tektronix' proven competencies in high-speed data acquisition, processing, and display, as well as fiber optics and video.

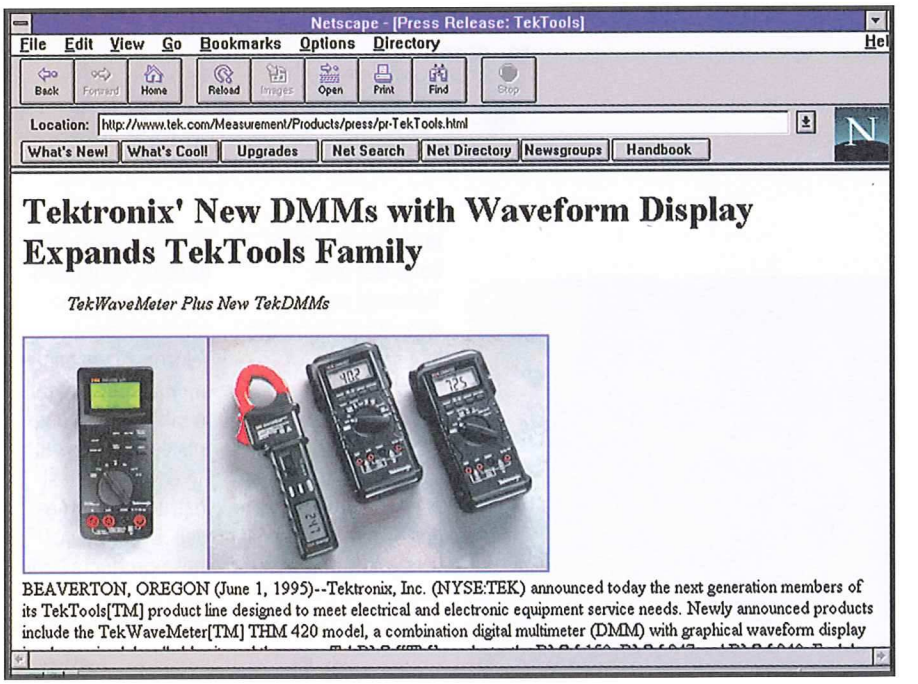
Tektronix is known and respected among communications equipment manufacturers for its test and measurement and TV/video products, where the company has a record of innovation, quality, flexibility and support. To address Network Operators, Tektronix has focused on emerging technologies, such as SDH/SONET and ATM. Tektronix is active on many standards organizations in the communications industry.

World Wide Web



Tektronix is on the World Wide Web at **http://www.tek.com**
Through this site you can access the latest information available about Tektronix products from all our Divisions.

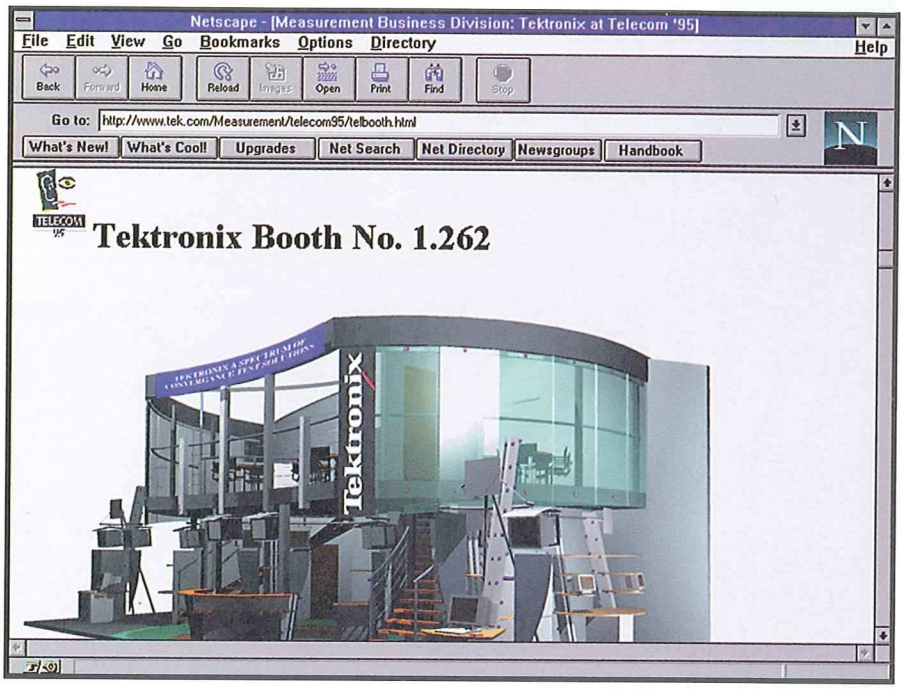
Keep up to date with news from Tektronix via the WWW! We publish our press releases in the What's New section the day they are released to the public. The press release is also linked to a data sheet giving more technical details of the product in the press release, if this is available.



See Tektronix on the World Wide Web **http://www.tek.com**

World Wide Web

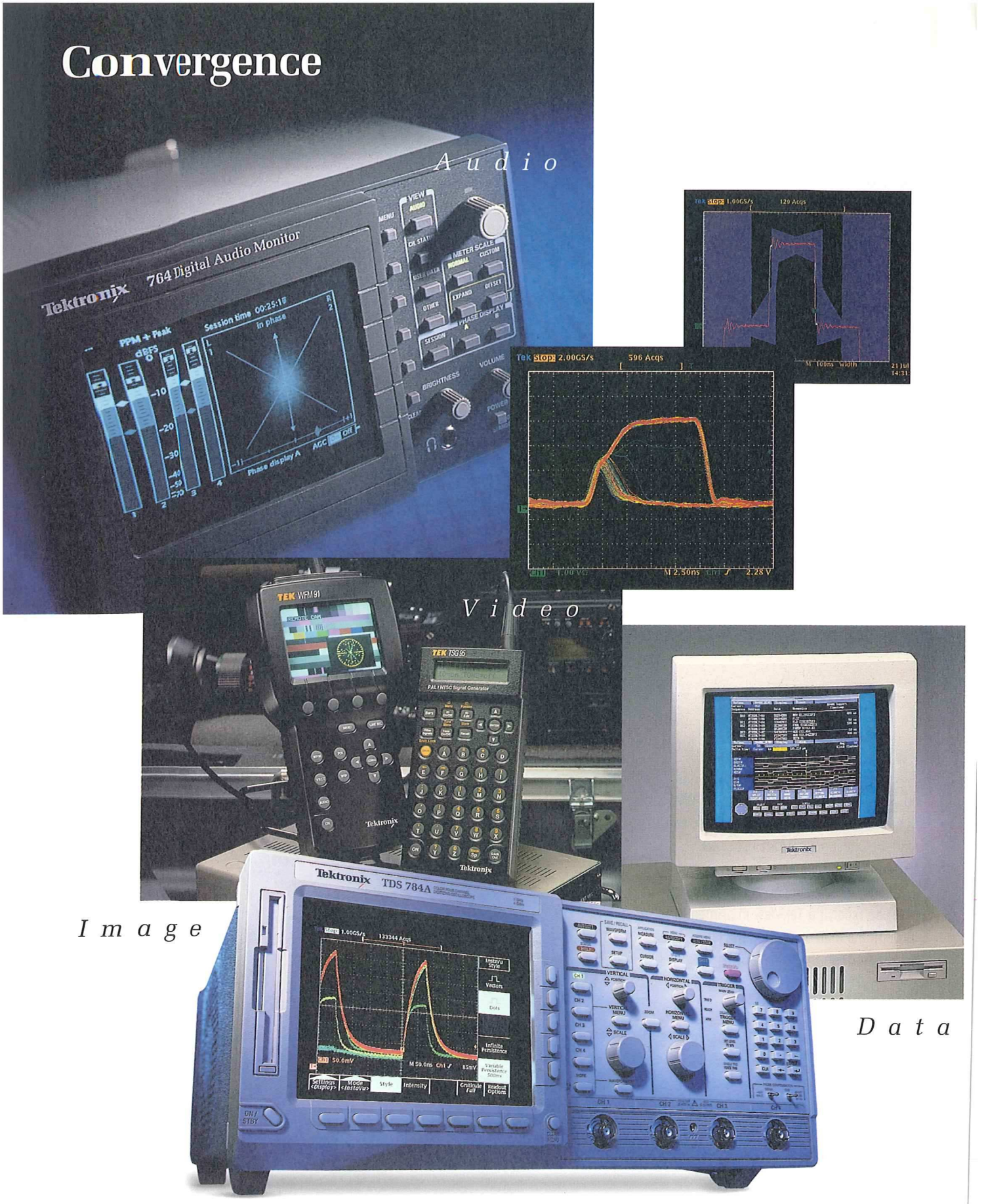
Key exhibitions are featured on the WWW site–gain a preview of what the Measurement Business Division will be showing at shows on a worldwide basis. If you cannot attend the show yourself, then ensure you do not miss out on key announcements at shows like Telecom '95.



TekView, our customer magazine, is published in 6 languages and is now available on-line through the WWW. Customers now have the opportunity to read the latest news from Tektronix Measurement Business Division in the language of their choice. They can choose between receiving TekView in printed form through the mail or reading the latest issue on-line through the WWW–or both!



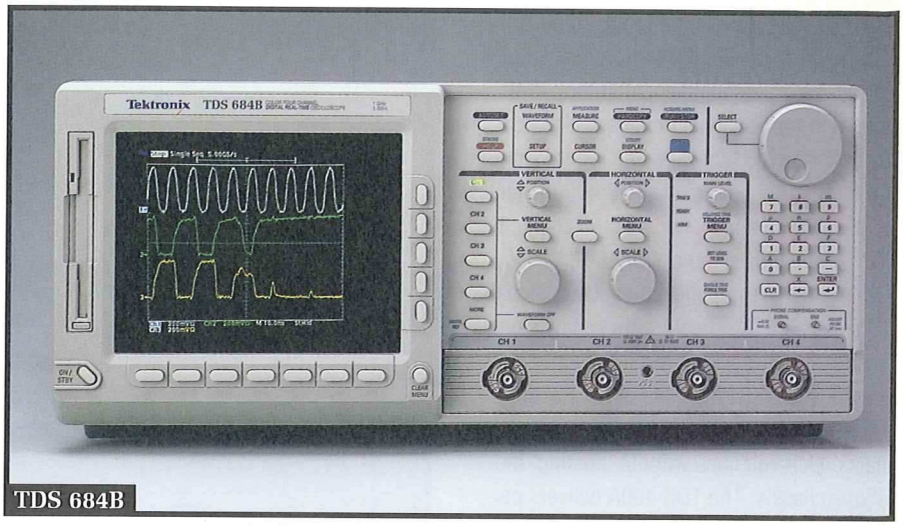
Convergence



Oscilloscopes

New TDS 600B

The TDS 600 oscilloscopes apply Tektronix' unique Digital Real Time technology to today's most difficult measurement problems--nonrepetitive events, ultra-fast pulse edges, and signal anomalies. With the scopes' full analog bandwidth (1 GHz in the TDS 684B) available on all channels simultaneously, the TDS 600B models are the best tool for examining glitches on one or two channels while triggering from a high-speed clock on a third. No other scope provides the confidence and the clarity when viewing one-time events that the TDS 600B family can.



TDS 684B

See Page 73.

Tektronix Digital Real Time (DRT) technology is like a powerful telescope that lets you see what others miss–tiny signal details, transient events, and weak impulses. DRT's advanced oversampling technology is used in Tektronix instruments ranging from VXI waveform analyzers to handheld scopes.



Oscilloscopes

New TDS 400A • New IPA 510

The TDS 400A is the first laboratory quality oscilloscope affordable enough for use as a personal benchtop tool. With two- and four-channel models available, a sample rate of 100 MS/s, and record lengths up to 120,000 points, the TDS 400A is suited to a wealth of applications. For example, the TDS 400A with optional ADA400A Differential Preamplifier can acquire signals as small as 5 µV--ideal for those tiny signals seen in biophysical research. In contrast, it's also possible (with the aid of the P5200 High-Voltage Differential Probe) to view signals on kilovolt lines without "floating" the scope chassis. The TDS 400A delivers performance where you need it, at a price far below lab scope standards.

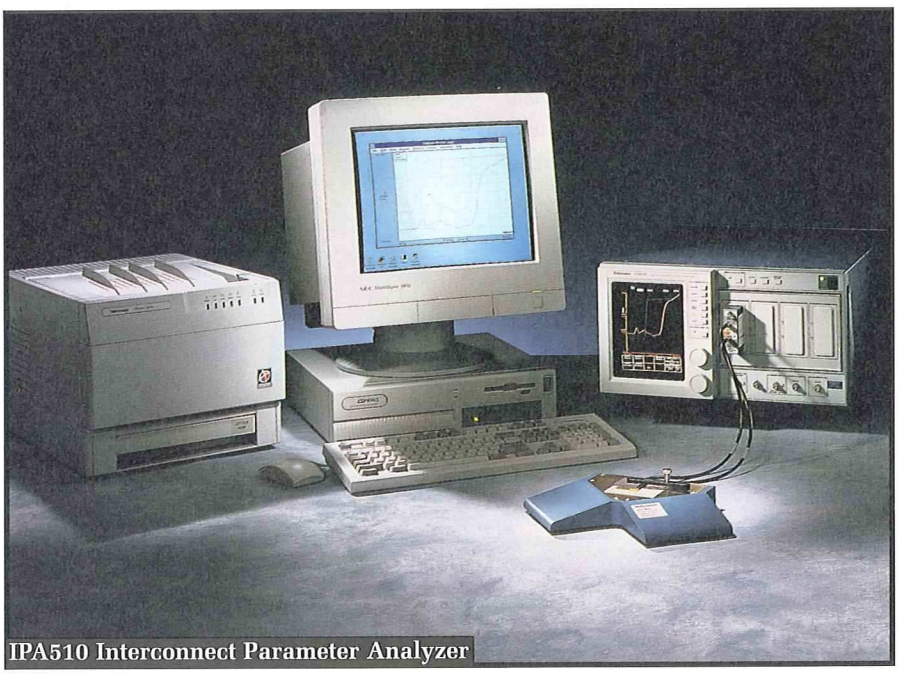
See Page 78.



TDS400A Personal Lab Scope

The IPA 510 Interconnect Parameter Analyzer is an integrated system that puts versatile characterization and modeling tools in the hands of circuit packaging and interconnect designers. Capable of both time- and frequency-domain measurements, the IPA 510 measures circuit characteristics then extracts, simulates, and verifies SPICE models of package and interconnect parameters. The system's unmatched accuracy and powerful signal processing tools ensure fewer design "turns" for ICs, connectors, and circuit boards operating in today's high-speed digital environment.

See Page 95



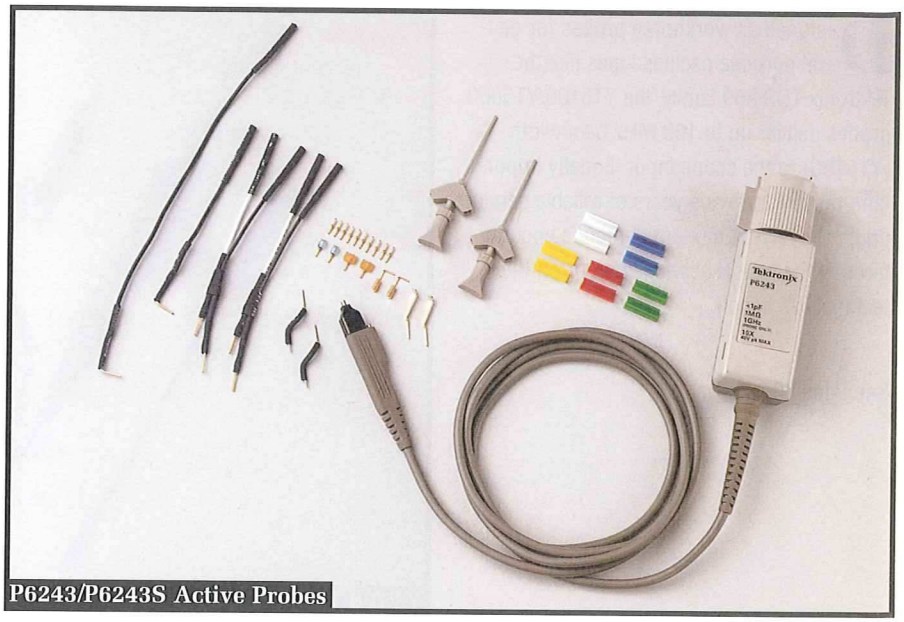
IPA510 Interconnect Parameter Analyzer

Accessories

New P6243/P6243S • New P5102

Configured for demanding SMD probing applications, the P6243/P6243S Active probes provide a reliable, solid, low-impact probing connection to the fine-pitch ICs used in today's high-speed digital circuits. When coupled with Tek's TDS scopes (for example, the TDS 784A and TDS 684B) these innovative probes can deliver a full 500 MHz bandwidth to the scope input. Their capacitive loading–only 1 pF–is so small as to be negligible at the rated bandwidth. Each probe is furnished with a host of contacts and leads to allow easy and confident connection to a variety of IC package types.

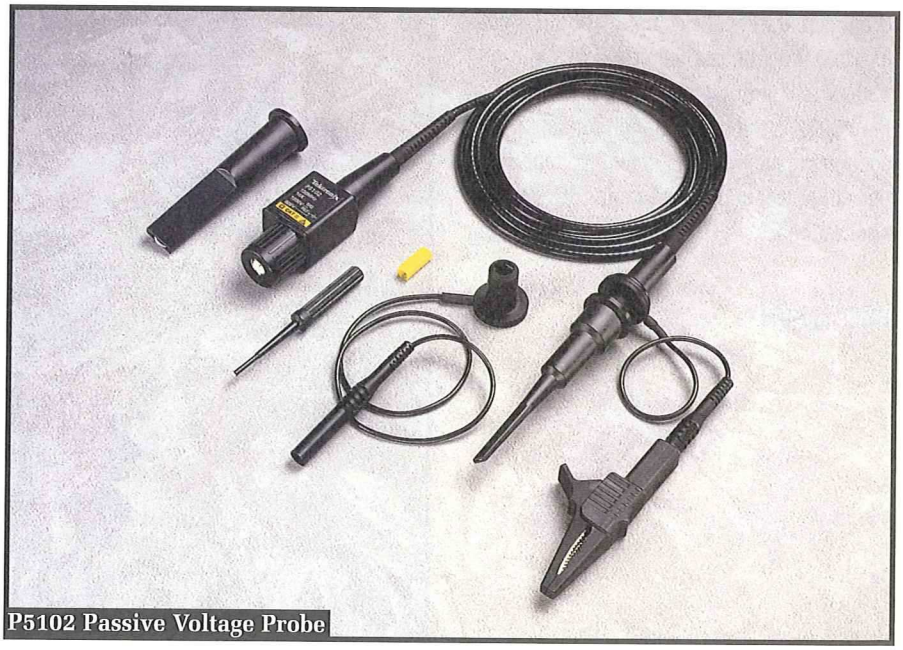
See Page 448.



P6243/P6243S Active Probes

Field measurements on industrial equipment like motor controllers and power supplies often require isolating a scope from earth ground. The P5102 probe is aimed at just such applications, and is IEC and UL-certified. The probe provides both scope-to ground and channel-to-channel isolation at voltages up to 1000 VAC RMS. The P5102 Passive Voltage Probe is a perfect mate to the THS 700 TekScope™ for high-voltage measurements under tough real-world conditions.

See Page 460.



P5102 Passive Voltage Probe

Accessories

New YT100/YT5060 • New P5205

Designed as workhorse probes for general purpose oscilloscopes like the Tektronix TDS 300 family, the YT5100/YT5060 probes deliver up to 100 MHz bandwidth (YT5100) to the scope input. Equally important, they will provide years of reliable service under the day-in, day-out demands encountered in the typical service shop or on the technician's bench.

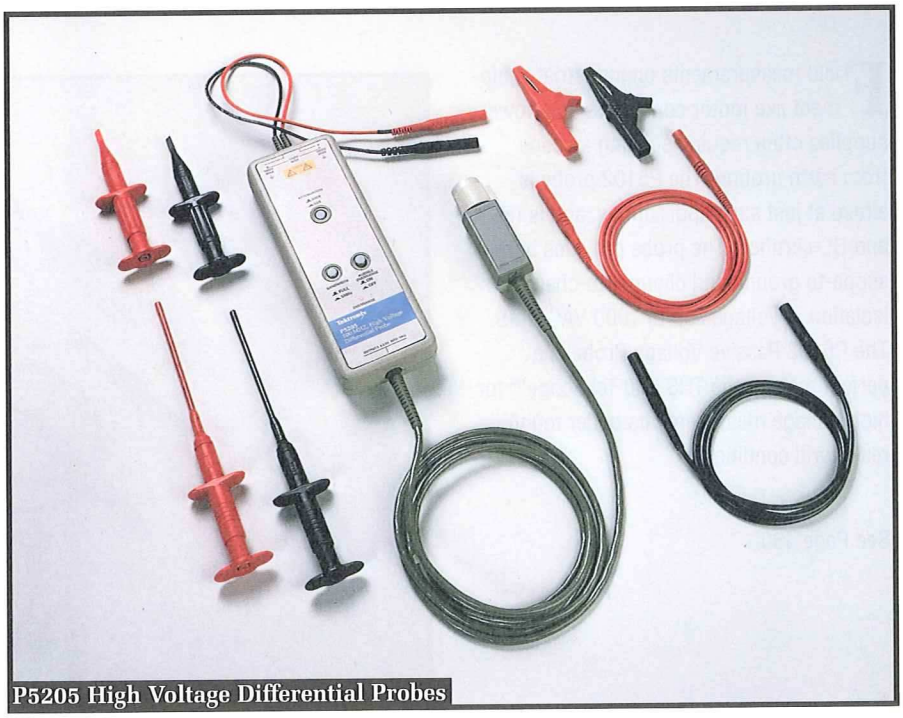
See Page 461.



YT100/YT5060 Passive Voltage Probes

The P5205 probe makes high voltage floating measurements with the scope grounded at frequencies up to 100MHz. With its 1000 V floating voltage capability and 1300 V maximum differential input voltage, the P5202 is the right solution for safe, accurate measurements in high voltage/current power supply and motor drive design applications.

See Page 494.



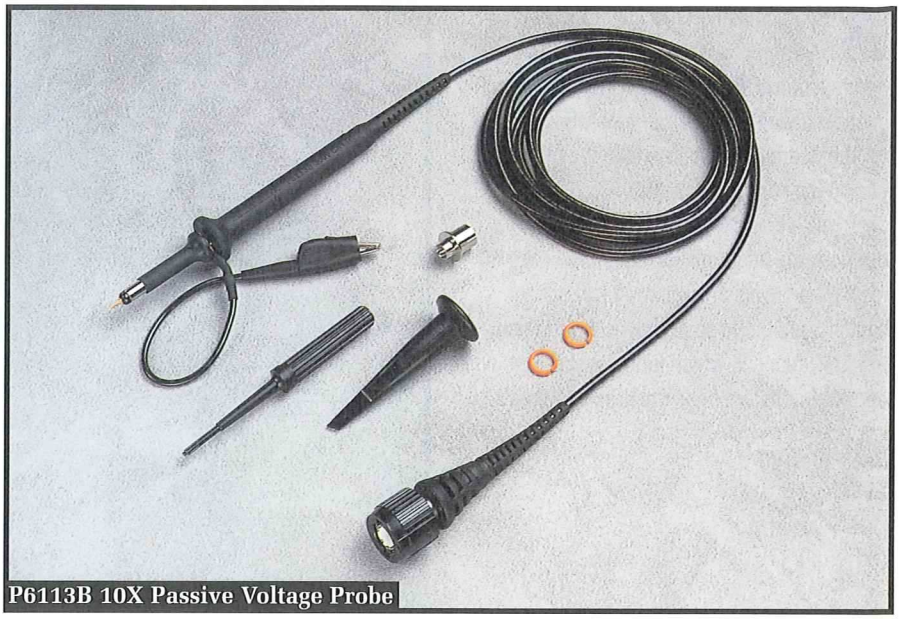
P5205 High Voltage Differential Probes

Accessories

New P6113B • New SF201 • SF202 • SF203

The P6113B is a 100 MHz passive voltage probe designed to provide signal transfer into the New THS700 Series Handheld Digital Oscilloscopes. The P6113B combines 100 MHz performance while allowing the THS700 Series operator to safely measure floating voltage levels up to 300 V AC RMS.

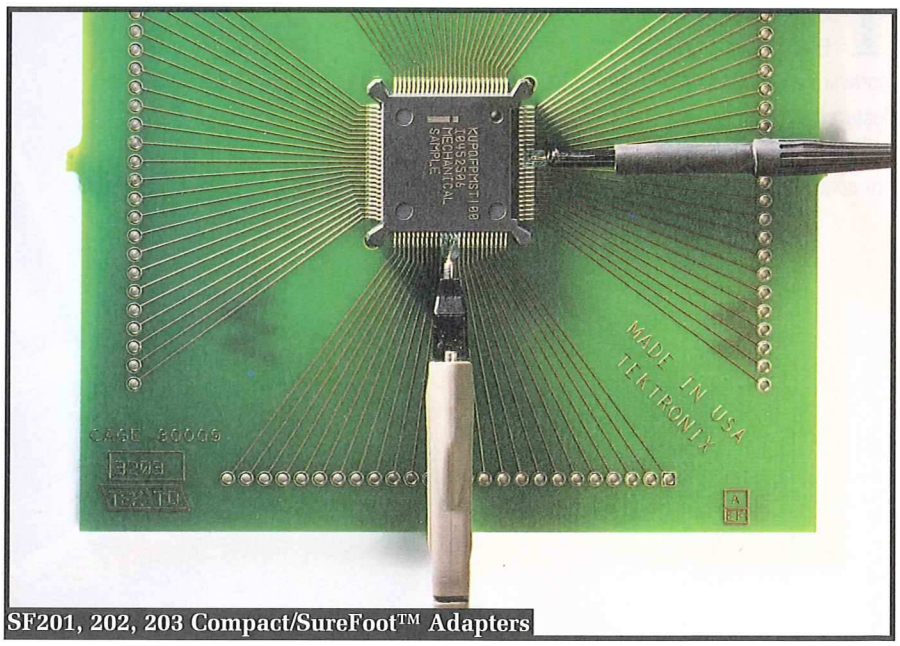
See Page 458.



P6113B 10X Passive Voltage Probe

The SF200 SureFoot™ Adapter Series of probing adapters has an integral probe tip and miniature guide that provide fault-free probing of fine-pitch SMD packages with the P613X (3.5 mm Compact Tip System) series of passive voltage probes for the TDS400/500/600/700 and 2400 series oscilloscopes. SureFoot's miniature plastic tines align the probe to the device under test while providing a barrier between the IC test leads. Color coding allows easy identification of the o.5 mm, 25 mil (0.65 mm) and 50 mil styles.

See Page 470.



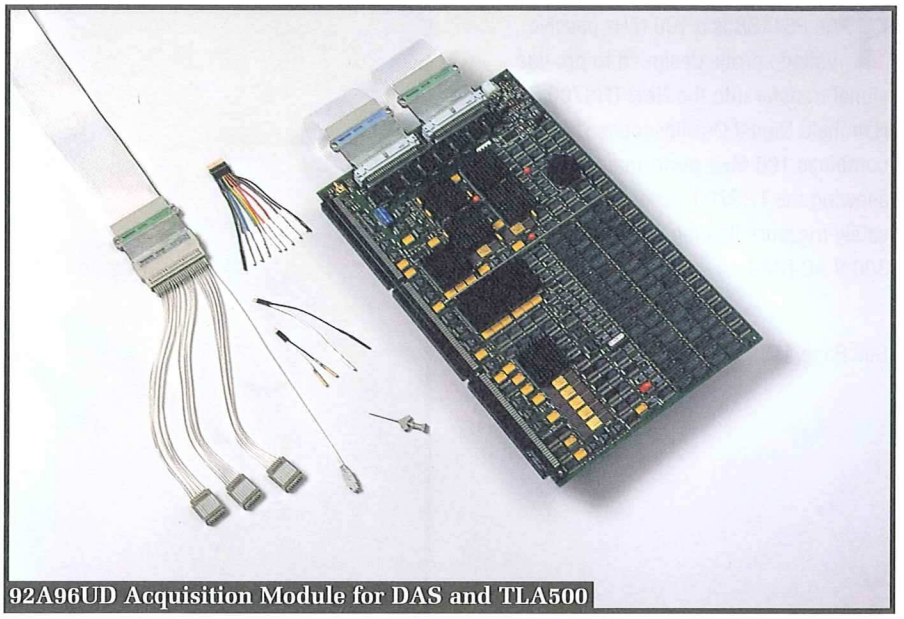
SF201, 202, 203 Compact/SureFoot™ Adapters

Logic Analyzers

New 92A96UD A Module

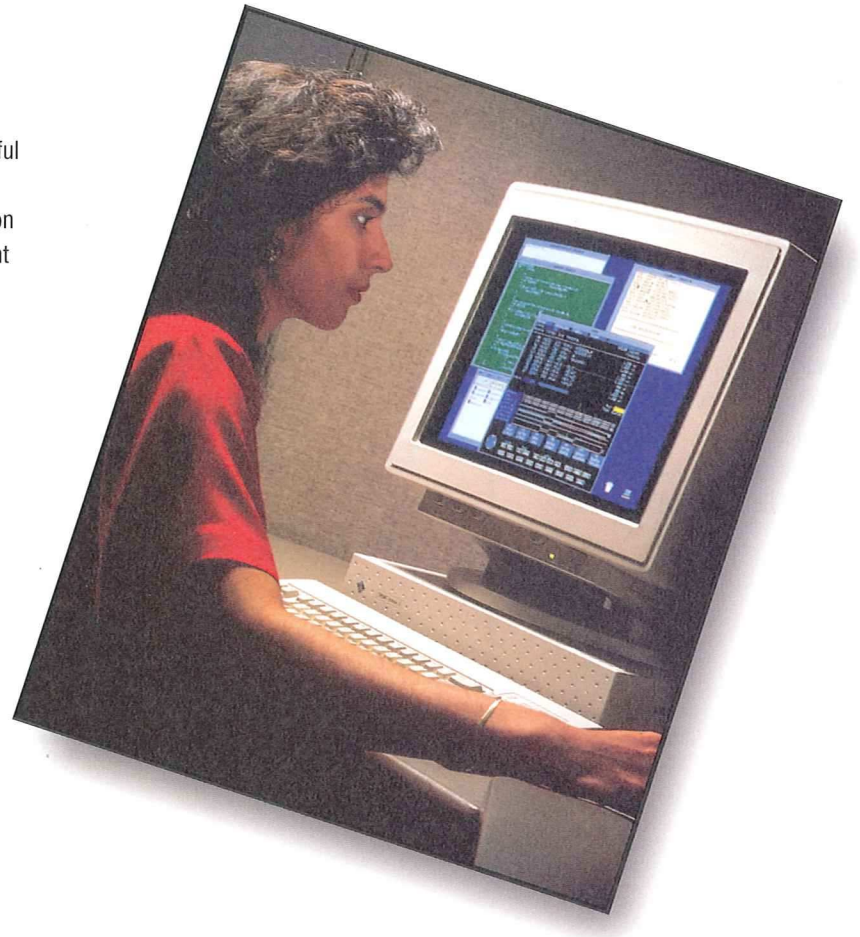
A new acquisition module for the Tektronix DAS and TLA 500 logic analyzer systems, the 92A96UD offers the deepest acquisition memory--2 MB--available for those product families. Like the other modules in the series, the 92A96UD provides 100 channels with 100 MHz state and 400 MHz timing acquisition. Its ultra-deep memory is ideal for analysis of large multi-processor systems, single-pass performance analysis, or applications in which long passages of complex software code must be captured.

See Page 136



92A96UD Acquisition Module for DAS and TLA500

Tektronix pioneered the concept of "Enterprise Instrumentation." Powerful software tools like LA-Offline put a full-featured logic analyzer on every workstation screen, while requiring only one instrument for acquisition.



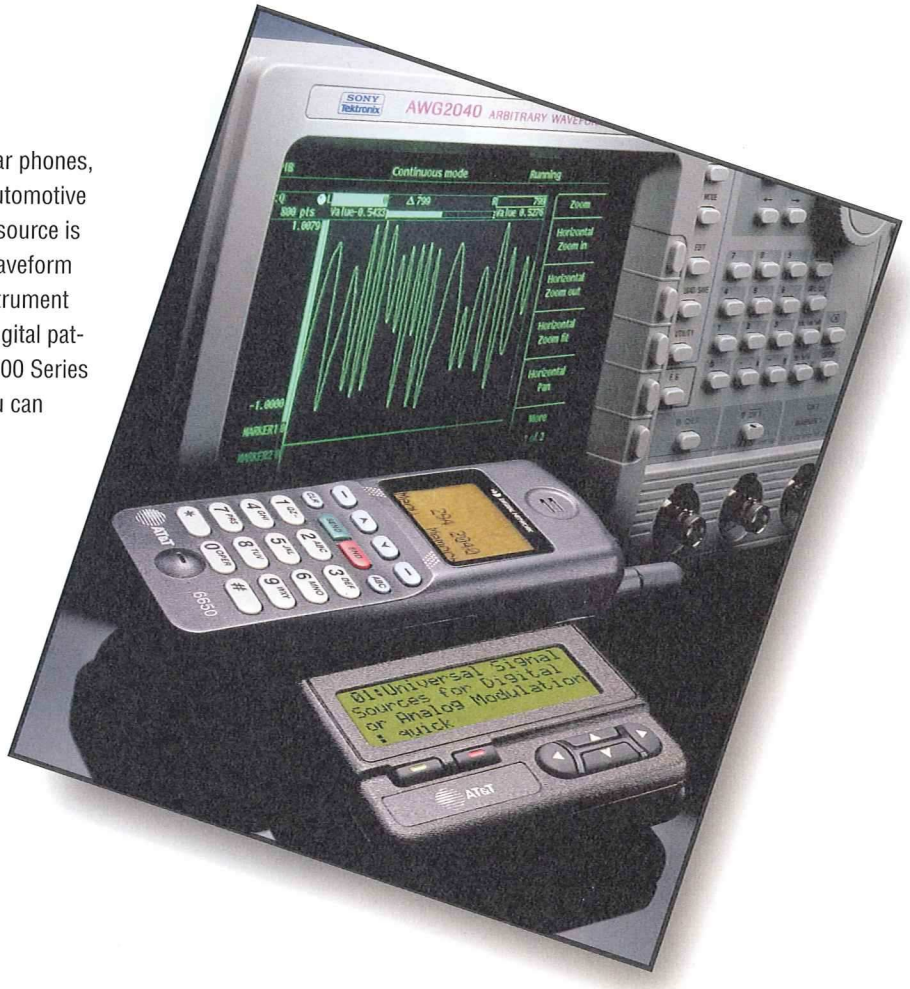
Signal Sources
New AWG 2041

The AWG 2041's powerful built-in graphical user interface, coupled with its extraordinary performance–1 GS/s sample rate and up to 4 MB waveform memory–make it the most versatile instrument of its kind. Features like waveform sequencing, direct waveform downloading from DSOs, and optional digital pattern generator make the AWG 2041 an ideal tool for applications demanding high bandwidth and complex waveforms. Among its many uses are disk drive testing, telecommunications circuit testing, and mixed-signal system design.

See Page 384.


AWG 2041

Whether you're testing cellular phones, disk drive electronics, or automotive engine controllers, no other signal source is quite as versatile as the arbitrary waveform generator (AWG). One dynamic instrument can provide carriers, modulation, digital patterns, and comparison data. The 2000 Series AWGs can create any waveform you can imagine!



Basic Bench Test Products

New THS710/720

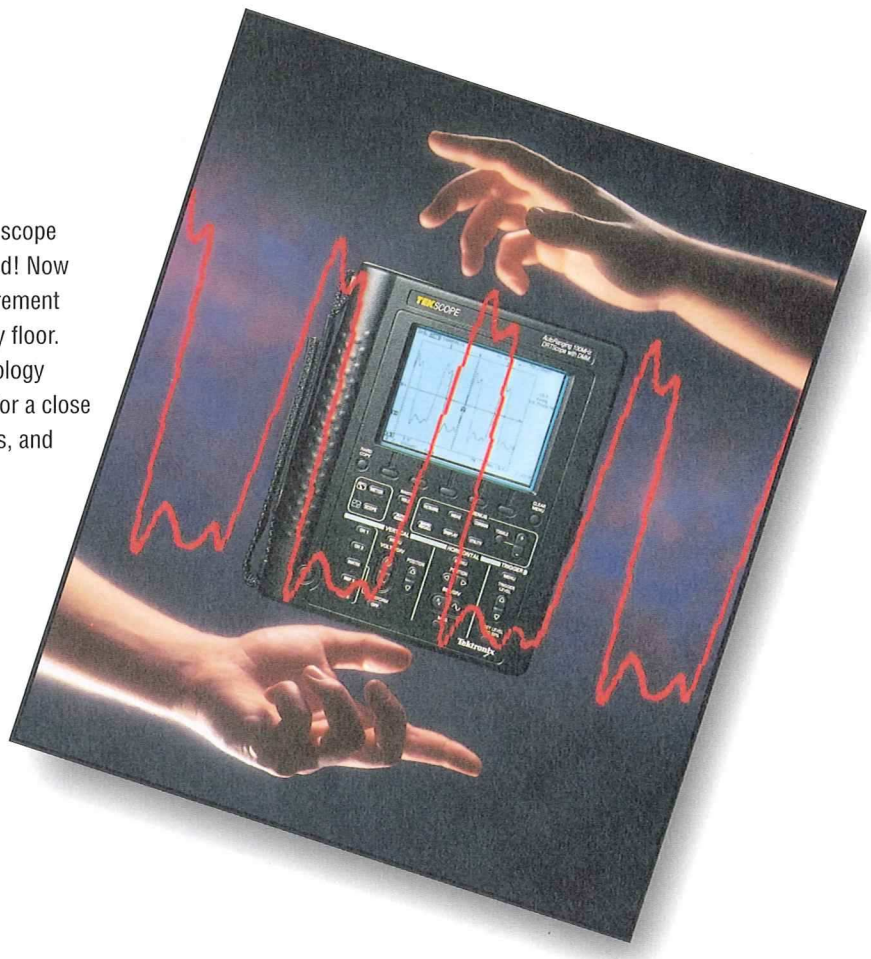
Built on Tektronix' proven Digital Real Time technology platform, the TekScope™ puts lab-quality scope performance in your hands. TekScope's 5X oversampling ensures uncompromised signal acquisition at maximum bandwidth–100 MHz!–on each of the scope's two channels simultaneously. Digital glitches, power spikes, and other transient events are revealed with unmatched clarity. With TekScope's combination of bandwidth, accuracy, and ease-of-use features, finding elusive circuit problems under rugged field conditions is easier than ever before.

See Page 404.



THS710/THS720 TekScope™

The TekScope™ puts benchtop scope power in the palm of your hand! Now it's easy to carry a powerful measurement tool into the field or onto the factory floor. TekScope's Digital Real Time technology gives you the bandwidth you need for a close look at elusive glitches, noise bursts, and surges.



Basic Bench Test Products

New DMM200/300 • THM420

For professional service and maintenance applications demanding exceptional accuracy and performance in a handheld DMM, the Tektronix DMM200 and DMM300 products are designed to provide fast, reliable results under pressing conditions. Among the capabilities of these instruments are true RMS measurements (DMM249 and DMM254), capacitance test (DMM252, DMM254), and a full range of component measurements for capacitors, diodes, SCRs, and LEDs (DMM353).

See Page 401.



DMM200/300 Handheld Digital Multimeters

No larger than a conventional handheld digital multimeter, the THM 420 WaveMeter takes the familiar DMM several steps further. The THM 420 is the right solution for equipment installation, maintenance, and troubleshooting of electrical and electronic equipment in the field. In addition to useful built-in functions like diode test, continuity check, and RMS measurement, the WaveMeter offers an autoranging scope mode that exposes AC signal conditions unseen on a conventional DMM.

See Page 407.



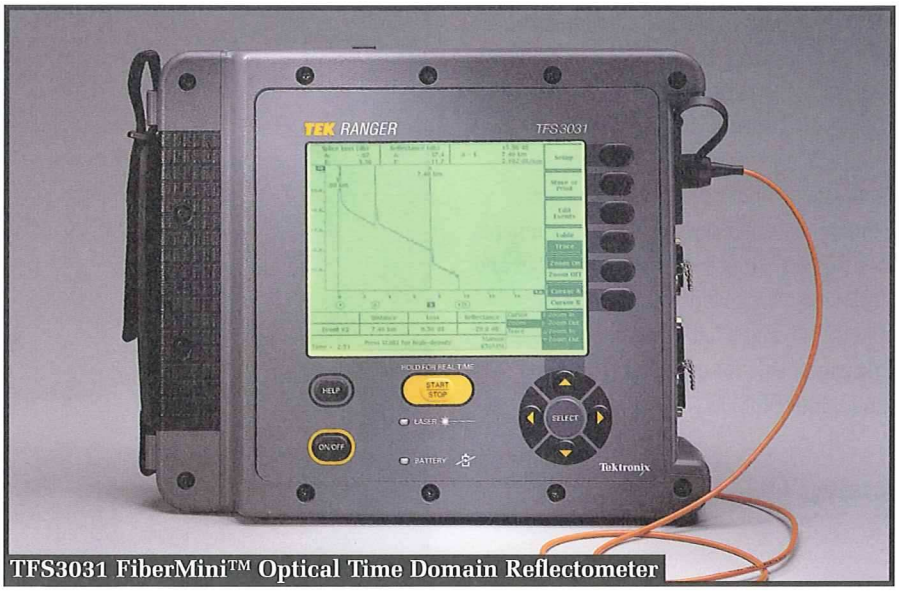
THM420 WaveMeter

Telecom

New TFS3031 • New TOP300

The TFS3031 FiberMini™ sets the standard for mini-OTDR performance in a portable package. The FiberMini™ is aimed at field test and maintenance requirements in the telecommunications and CATV industries. It's equipped for both single and dual-wavelength analysis, and functions as three products in one: an OTDR, a BreakFinder, and a unique automated "EventFinder." Many operations are activated with a single button, and user interface features like soft keys, windowed menus, and onscreen also help make the TFS3031 fast and easy to use.

See Page 302.



TFS3031 FiberMini™ Optical Time Domain Reflectometer

The TOP300 is a uniquely simple tool for fiber cable troubleshooting and continuity checking. Using an efficient short-wavelength laser diode, the TOP300 emits a visible light signal down the length of the cable under test. Breaks and interruptions in the cable will permit light to escape, allowing the fault's location to be observed visually, to an accuracy of just one millimeter. The TOP300 is among the most intuitive and easy-to-use tools in the technician's kit, yet one of the most effective at achieving fast results.

See Page 296.



TOP300 Visual Fault Finder

VXI

New TVS600

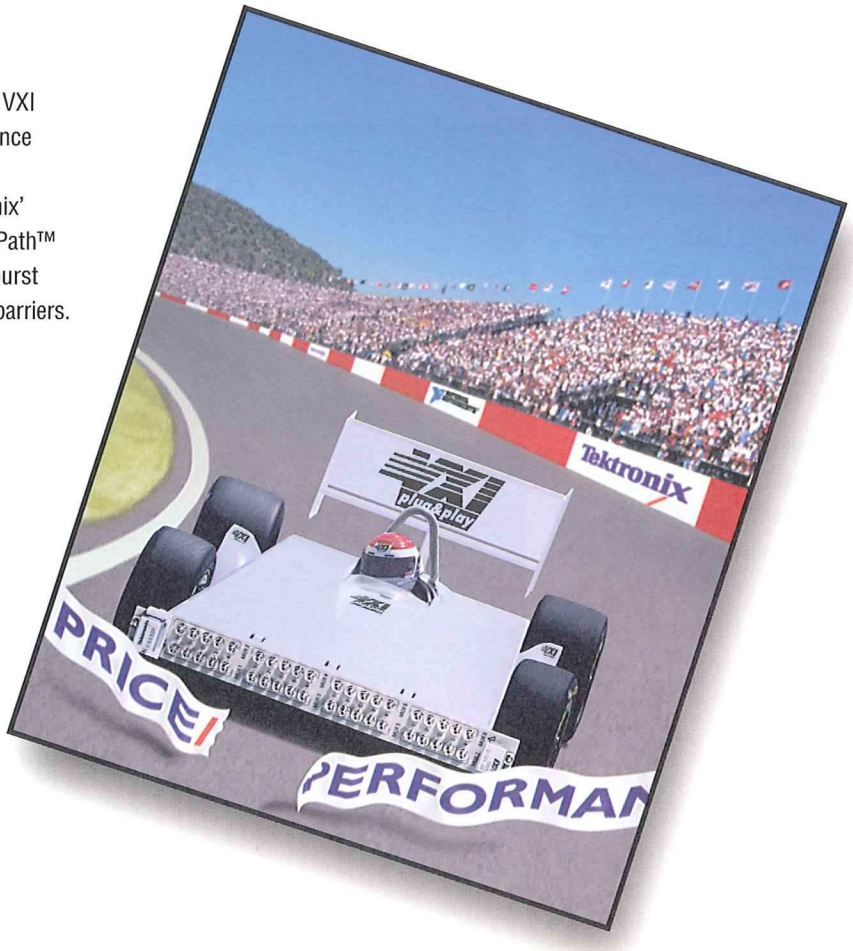
The TVS600 family of VXI waveform analyzers combines the Digital Real Time performance of Tektronix' powerful TDS oscilloscopes with the throughput and automation features required for research and high-volume production applications. With four channels and a bandwidth of 1 GHz, the TVS645 is an ideal building block for multichannel acquisition systems for laser research or EMP simulation. The TVS 621's 250 MHz bandwidth is well matched to manufacturing test applications ranging from circuit boards to jet engines.

See Page 114.



TVS600 VXI Waveform Analyzers

Tektronix has led the race toward VXI cost-effectiveness and performance since the first lap. It's a leader in VXI*plug&play* technology, and Tektronix' latest VXI introductions (like the SurePath™ switching module shown here) have burst through traditional price/performance barriers.

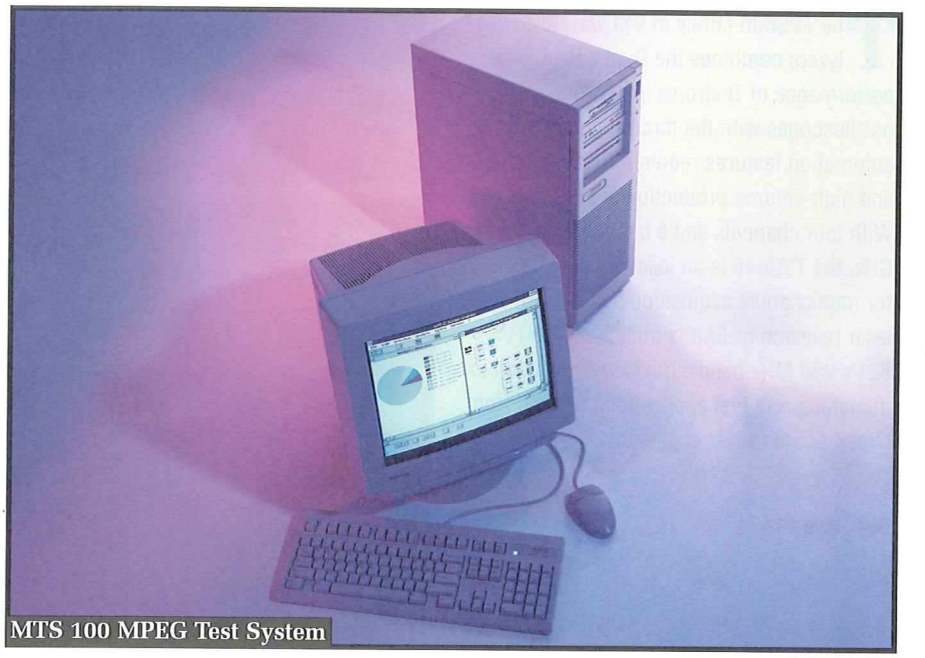


TV

New MTS 100 MPEG Test System • New 764 Digital Audio Monitor

The MTS 100 MPEG Test System integrates MPEG signal sources, signal acquisition, and analysis into a dynamic automated test system for digitized audio, video, and data transport streams. The system is furnished with pre-formed transport stream files, or the MTS multiplexer application (included) can be used to form a wealth of such files from Tektronix- or user-supplied elementary data. In addition to the MTS multiplexer, the MTS 100 system includes an MTS analyzer, table editor, channel coder, and data store controller, plus an 8 GB data store, a Windows® NT workstation, and associated I/O hardware.

See Page 530.



MTS 100 MPEG Test System

The 764 Digital Audio Monitor is a comprehensive measuring and monitoring tool for digital audio. Equally at home in the recording studio, broadcast studio, or duplication and mastering facility, the 764 meets the needs of the technician doing equipment setup and calibration, as well as production personnel monitoring signal levels, distortion, and system errors. The 764 Digital Audio Monitor's menu-based user interface is easy to learn and use, making the instrument's findings readily accessible to technicians, engineers, and behind-the-console personnel.

See Page 546.



764 Digital Audio Monitor

TV

New AM700

The AM700 Mixed Signal Audio Measurement Set is a fully integrated test instrument that supplants a full suite of conventional measurement components. This powerful new benchtop instrument includes an analog and digital signal generator, audio analyzer, two-channel FFT analyzer, and a distortion analyzer. These functions, plus the AM700's processing power, programmability, and rapid-access interface make it the industry's most versatile tool for combined analog and digital audio testing.

See Page 549.



AM700 Mixed Signal Audio M Set

The VM100 is a low-cost automated solution to a variety of measurement problems faced by cable TV or broadcast engineers. It's equipped to the standard suite of NTSC measurements mandated by FCC cable system regulations, from Differential Gain to Sync Amplitude. The VM100's unique "Signal ID" function automatically scans an input signal for valid test signals, identifying signals appropriate for a given video measurement. The VM100 reduces cost, saves time, and is suitable for technical personnel at all experience levels.

See Page 533.



VM100 Video Measurement Set

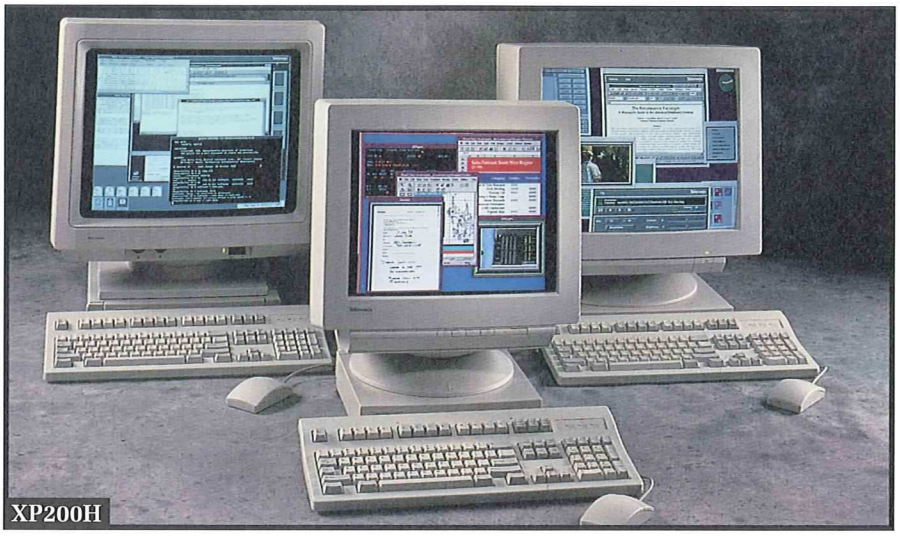
Multimedia Ready X Terminals

XP200H • XP400

TekXpress X Terminals

All TekXpress X terminals include standard: a display, base unit, mouse, 8 MB SIMM expandable to 136 MB, (4 MB SIMM expandable to 36 MB memory for XP200/H) 2 Ethernet LAN ports (1 for XP400), 2 serial ports, and physical installation guide. Software right-to-use, XpressWare X server software, and additional memory and options must be ordered additionally.

Available hardware options include; audio interface: PCMCIA, flash memory (2/4 MB), parallel port, additional memory, and for the XP400 a MPEG-1 digital video card.


XP200H

SELECTION GUIDE

XP400 Series	XP400 Logic Base	XP417C	XP419C	XP421CH	
Display Size	Base module only	17 in. color	19 in. color	21 in. color	
Resolution	Up to 1280x1024	1280x1024	1280x1024	1600x1180	
XP200 Series	**XP200 Logic Base**	**XP214M**	**XP214C**	**XP217C**	
Display Size	Base module only	14 in. mono.	14 in. color	17 in. color	
Resolution	Up to 1152x900	1024x768	1024x768	1152x900	
User Selectable				1024x768 q@72 Hz	
XP200H Series	**XP200CH Logic Base**	**XP219MH**	**XP217CH**	**XP219CH**	**XP219GH**
Display Size	Base module only	19 in. mono.	17 in. color	19 in. color	19 in. greyscale
Resolution	Up to 1280x1024	1280x1024	1280x1024	1280x1024	1280x1024

Product(s) available through your local Tektronix Distributor listed in the back of this catalog or inside the U.S. call: 1-800-547-8949.

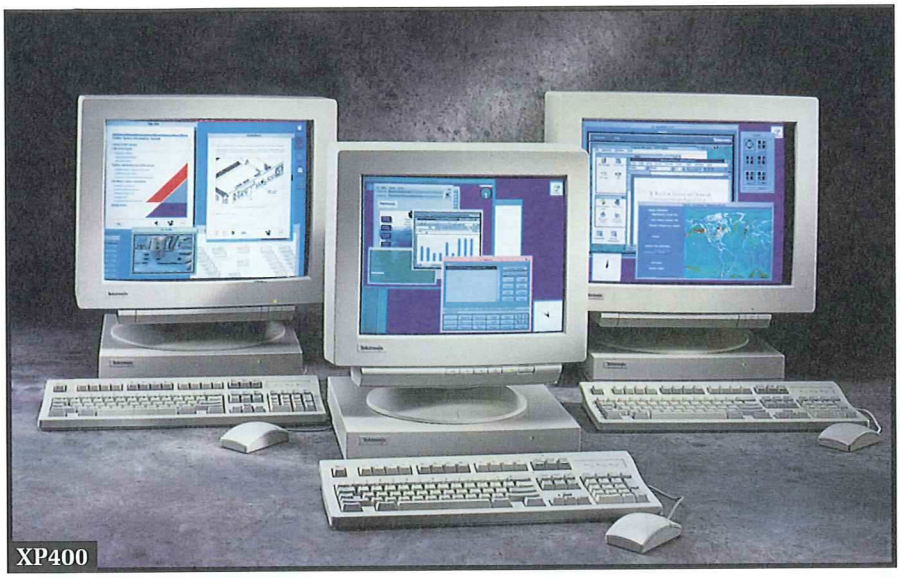
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ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

Multimedia Ready X Terminals

XP200H • XP400


XP400

XPRESSWARE SOFTWARE FEATURES

Boot Options	X Server code downloadable from host or optionally from Flash Memory; local boot server
Boot Protocols	TFTP, NFS, Optional; MOP/DAP
Network Protocols	Standard: TCP/IP, TFTP, NFS, BOOTP, RARP; Optional: Serial Xpress, DECnet, LAT
Network Management	Standard: DNS, SNMP, MIBII, PING, Boot Monitor, DECnet Mirror, DECnet Trigger
Parameter Set-up	Motif-like setup menu system and remote configuration files
Printer Support	Network printers, local print screen local BSD print spooler
Server	X server based on X11 Release 5
Server Extensions	Shape, Input, Multibuffer, font caching, Xidle and Xtest extensions Optional: XBlink extension, XIE imaging extension
Local Clients Standard	TekXpress Window Manager, VT220 Window Manager, VT220, TELNET, Console, Protocol Independent Chooser, Setup, Local Client Launcher, local clock, low memory indicator Optional: true OSF/Motif V2.0 window manager, DECnet (Cterm, LAT), Serial Xpress, true OPEN LOOK window manager, Tek340 emulator, 3270 emulator, 3278 print emulator, IBM graphics 3179G emulator, XIE
Multimedia Local Clients	Local audio player, local audio mixer, local XIE viewer, local MPEG video player
Multi-user PC Application Access	WinDD™ local client for running PC/Windows™ applications without emulation
Host-based Clients	Sun Audio Redirect driver, Adobe DPS/NX Display Postscript™ file viewer, Adobe Acrobat™ PDF file reader
Terminal Emulation	VT340, 3270 (Models 2, 3, 4, 5), 3170G (Models 2, 3, 4, 5), VT220, VT100
Fonts	27 Resident, 700+ available on server tape
Font Service	TFTP, NFS, Flash, Serial Xpress, DAP
Platforms	Sun, HP, DEC (OS/1, Alpha Open VMS, ULTRIX, VMS), IBM, RS/6000, SGI and other UNIX platforms
Media Forms	CD-ROM, Cartridge Tape, TK-50, 8 mm, 4 mm

WinDD Software

PC Application Access for UNIX

Features

NO EMULATION. NOPORTING. NO KIDDING!

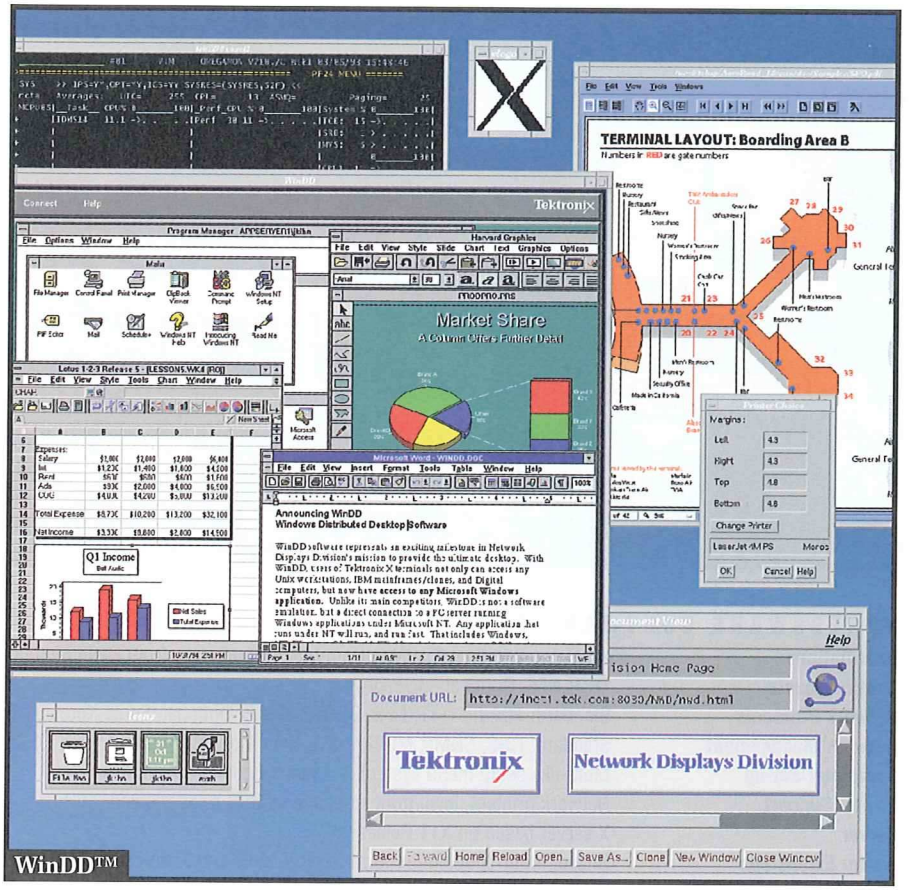
- WinDD™ – Windows Distributed Desktop from Tektronix
- Multi-user network operating system and application server software including Microsoft Windows NT™ Server 3.5, licensed from Microsoft with enhancements to provide network transparent use by multiple, simultaneous users

OPERATING SYSTEM SUPPORT

- SGI IRIX 4.05, SPARC SunOS 4.1.3, SPARC Solaris 2.3 HP 9000/700 HPUX 9.X

PC Applications on your X Terminal/Workstation.

Now your X terminal/workstation can access "shrink wrapped" PC applications at native speeds – without emulation. Multiple users can access Windows and Windows NT as well as DOS and OS/2 character-based applications on the network. Applications run on a PC application server and are displayed in a window on your X terminal/workstation with native performance and functionality. With access to UNIX and PC applications, WinDD™ offers X terminal/workstation users an extremely cost-effective, scalable solution for today's expanding UNIX networks.



ORDERING INFORMATION

SOFTWARE OPTIONS (PER X TERMINAL)

MOTIF Window Manager V2.0 Local Client – Additional Memory Required 3 MB.....Code 4L.

Optimization Kit for DEC – TDEnet, LAT, Motifwm V2.0, Additional Memory Required 3 MB.....Code 4N.

Optimization Kit for Sun – OPEN LOOK window manager.....Code SN.

IBM 3270 Local Client (Includes 3287).....Code 3P.

IBM 3179G (Includes 3270 & 3287).....Code 3Q.

Tek340 (VT340).....Code 3V.

ImageXpress XIE Image Compression – Additional Memory: Recommended 2-4 MB.....Code EX.

PS Xpress Display PostScript – Additional Memory Required 2 MB.....Code PS.

Serial Xpress (Order with Flash Memory) – Additional Memory: Recommended Flash Memory.....Code RS.

AudioXpress Audio and (Software and Card).....Code AX.

AVXpress Audio and Video (Software and Card) – Additional Memory: Recommended 2-4 MB.....Code AV.

Blink Extension.....Code BL.

XPRESSWARE SERVER MEDIA OPTIONS

Includes: User, Reference, and Installation manuals, except XSCD080, which includes Installation manual and Online Xpress documentation)

CD-ROM:

Multi-host Version – (supports HP, IBM, Sun, DEC and OSF/1).....Code XSCD080.

CD-ROM:

Generic Version ULTRIX.....Code XSC7080.

Sun 4 Tape 1/4" DC600 TAR Format.....Code XS01080.

DEC VMS TK50 tape.....Code XS04080.

DEC ULTRIX TK50 Tape TAR Format.....Code XS05080.

Generic UNIX 1/4" DC600 TAR Format.....Code XS07080.

IBM RS/6000 1/4" DC600 TAR Format.....Code XS08080.

IBM RS/6000 8 mm DAT TAR Format.....Code XS09080.

Generic UNIX/HP9000 4 mm DAT TAR Format.....Code XS10080.

SGI DC600 INST Format.....Code XS11080.

WinDD™ PC Application Server.....Order XPPC00.

WORKSTATION CLIENTS

1 WinDD™ SGI User.....Order XPWS01.

10 WinDD™ SGI Users.....Order XPWS10.

50 WinDD™ SGI Users.....Order XPWS50.

100 WinDD™ SGI Users.....Order XPWS100.

CD ROM (One Per Site).....Order XPWSCD.

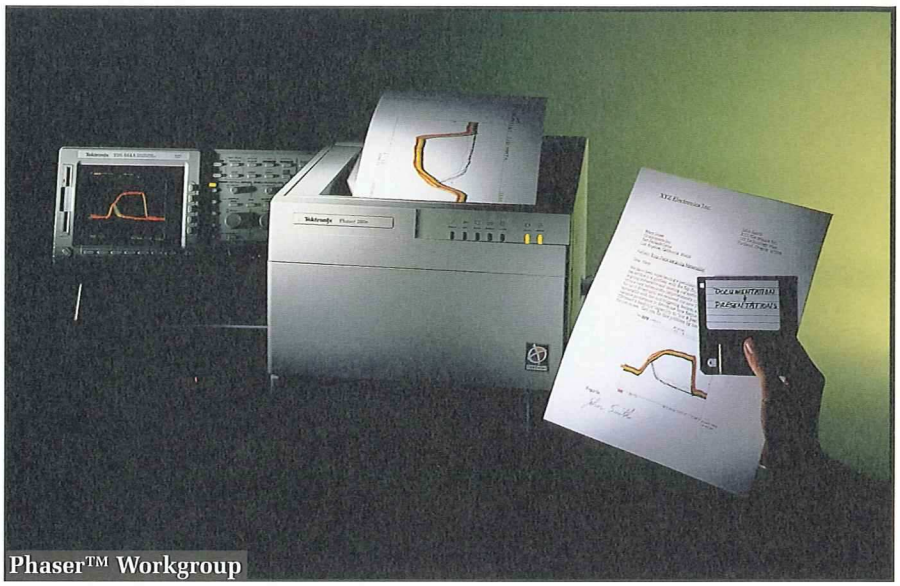
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See Tektronix on the World Wide Web: http://www.tek.com

Phaser™ Workgroup
Color Printers

Features

- Thermal-transfer: Unsurpassed for Overhead Transparencies and Reports
- Phase-change: Rich Vibrant Color Printing on Any Paper
- Dye Sublimation: Photorealistic Color Printing on Paper or Transparencies


Phaser™ Workgroup

Phaser™ Color Printers

Tektronix offers a comprehensive line of award-winning color printing solutions for technical, business, and graphic arts applications. Tektronix' high quality standards ensure rich, saturated color; crisp output; true Adobe™ PostScript™ Level 2 page description language; and compatibility with PCs, Macs, workstation or network, as well as with your TDS color oscilloscope.

Color helps you interpret the information your Tektronix instrument captures. Whether it's a waveform, a digital pattern, or an FFT plot, it is easier to see and understand when it appears in color. That's why so many Tek instruments offer color displays, and why the Tektronix Phaser™ family of color printers is indispensable for recording and publishing measurement data.

Tektronix Phaser™ printers use a variety of image-transfer technologies to faithfully reproduce the color image on your instrument screen or computer monitor. With a Phaser™ color printer, you'll find it easy to produce reports and presentations illustrated with crisp, accurate graphics from your Tektronix instruments.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

Oscilloscopes

From the highest performance to the most cost-effective solution, Tektronix offers a broad range of test and measurement instrumentation. Tektronix instruments provide the best connection to your device-under-test, the most accurate signal acquisitions, the sharpest waveform displays, and the most comprehensive on-board waveform measurements available.

Whether you choose analog or digital technologies, each has benefits and tradeoffs. The following pages present Tektronix' analog and digitizing oscilloscope solutions.

The oscilloscope section begins with a general reference section on pages 50-56. Our digitizing oscilloscopes begin on page 57, providing information for the TDS Series, 11800 Series (including plug-ins), and 200 Series Oscilloscopes.

The analog oscilloscopes begin on page 107 with the TAS Series, followed by the 2400 Series.

It takes a broad range of oscilloscope products to satisfy the spectrum of measurement applications throughout the world today, and Tektronix delivers the product line breadth sought by customers worldwide.

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Oscilloscope Reference

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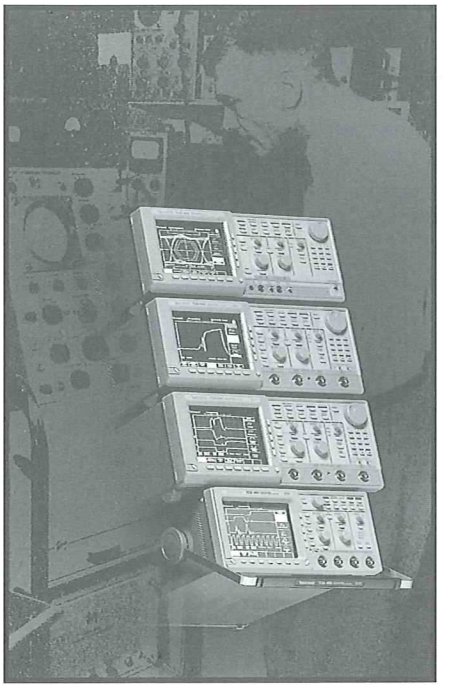
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Tektronix Quality and Reliability

Tektronix' oscilloscope quality and reliability are unmatched. Designs are thoroughly scrutinized and tested to ensure compliance with all applicable safety and environmental standards. Calibration is traceable to national standards and conforms to military procedures. Our service network is designed to help you keep your oscilloscope calibrated and working with fast turnaround.

Selecting an Oscilloscope

Often the application dictates the oscilloscope selection. Other times it's purely a matter of personal preference or budget. In any case, we can help you make the right decision. The following decision tree will help steer you in the right direction. Refer to the following pages for detailed descriptions of the families and individual models of Tektronix oscilloscopes and digitizers. Or simply call an authorized Tektronix representative to get some expert assistance.

OSCILLOSCOPE SELECTION GUIDE

Storage/Analog	Bandwidth	Repetition Rate	Models
Storage	>500 MHz	Repetitive	11801A, CSA 803A, TDS 820, TDS 784A
		Nonrepetitive	SCD 5000, RTD 720A, TDS 784A, TDS 684B, TDS 680B,
	≤500 MHz	Repetitive	TDS 744A, TDS 524A, TDS 520A, TDS 540A, TDS 460A, TDS 420A, TDS 410A, TDS 320, TDS 310, TDS 350, 2212
		Nonrepetitive	TDS 744A, TDS 524A, TDS 520A, TDS 540A, TDS 460A, TDS 620B, TDS 420A, TDS 410A, TDS 644B, TDS 320, TDS 310, TDS 350, 2212
Analog	50 MHz	Repetitive	TAS 250, TAS 220
Non-storage	400 MHz		2400 Series

Oscilloscope Reference

DIGITIZING OSCILLOSCOPES AND WAVEFORM DIGITIZERS

Model	Bandwidth	Sample Rate	Vertical Resolution	Record Length	Channels	Data I/O Ports	Page
CSA 803A	3 GHz to 50 GHz	200 kS/s	8-Bits	5 K points	1 to 4	GPIB, RS-232C, Centronics	330
11801B	DC to 50 GHz	200 kS/s	8-Bits	500 to 5 K points	1 to 136	GPIB, RS-232C, Centronics	90
TDS 800	6 to 8 GHz	n/a	14-Bits	500 to 15 K points	2	GPIB (RS-232C, Centronics opt.)	62
TDS 700A	500 MHz to 1 GHz	2 GS/s to 4 GS/s maximum	8-Bits, up to 13-Bits with Hi-Res	500 to 500 K points	4	GPIB, RS-232, Centronics	70
TDS 600B	500 MHz to 1 GHz	2.5 GS/s to 5 GS/s maximum	8-Bits	15 K points	2 to 4	GPIB, RS-232, Centronics	72
TDS 500A	500 MHz	1 GS/s maximum	8-Bits	15 K to 50 K points	2 to 4	GPIB, RS-232, Centronics	76
TDS 400A	200 to 400 MHz	100 MS/s	8-Bits, up to 12-Bits with Hi-Res	30 K to 120 K points	2 to 4	GPIB, (RS-232, Centronics opt.)	78
TDS 310	50 MHz	200 MS/s	8-Bits	1 K points	2	GPIB, RS-232, Centronics	82
TDS 320	100 MHz	500 MS/s	8-Bits	1 K points	2	GPIB, RS-232, Centronics	82
TDS 350	200 MHz	1 GS/s	8-Bits	1 K points	2	GPIB, RS-232, Centronics	82
THS 710	60 MHz	250 MS/s	8-Bits	2.5 K points	2	RS-232C	404
THS 720	100 MHz	500 MS/s	8-Bits	2.5 K points	2	RS-232C	404
THM 565	5 MHz	25 MS/s	8-Bits	2.56 points	2	RS-232C (accessory)	408
THS 560	5 MHz	25 MS/s	8-Bits	2.56 points	2	RS-232C (accessory)	408
224	60 MHz	10 MS/s	8-Bits	1 K points	2	RS-232	108
RTD 720A	500 MHz	200 MS/s to 2 GS/s	8- to 10-Bits	128 K points to 32 M points	2	GPIB	121
SCD 5000	1 GHz to 4.5 GHz	200 GS/s	11-Bits	1 K points	2	GPIB	118

ANALOG OSCILLOSCOPES

Model	Bandwidth	Channels	Time Base	Basic Cursors Setup	Computer Interfaces	Page
2400B	400 MHz	2 + 2	dual	yes	GPIB opt.	107
TAS 220	20 MHz	2	single	yes	no	111
TAS 250	50 MHz	2	single	yes	no	111

Oscilloscope Reference
Data Management

Data Management Solutions for Oscilloscopes

Digitizing oscilloscopes produce incredible amounts of data and information about waveforms. So much, in fact, that it is often hard to make the best use of it. In addition, programmable scopes open doors to a wide range of possibilities for test and procedure automation.

Tektronix offers several software solutions to these data management and control problems with software for:

- Saving and recalling waveforms and settings
- Handling graphic images of screens and waveforms for documentation
- Data logging
- Procedure generation and execution
- Data analysis and graphics
- Remote control

Here's a brief summary of the packages and the products they support.

Product Name	Product Number	Description	Oscilloscopes Supported
LabWindows®/CVI	S3FG910/912 LWCVI	data acquisition, analysis, and instrument control	TDS Series, 2200 DSOs
LabVIEW*1 PC Windows	LVWIN	data acquisition, analysis, and graphics	TDS Series, 11801B, CSA 803A, 2200 DSOs, 220 Family DSOs, RTD 720A
WaveWriter™	S3FT400	waveform capture generation and editing	TDS Series, 2200 DSOs
TDS Data Manager	S34TDS1	waveform and settings storage, graphics and data management	all TDS Series
CAT 200	CAT 200	remote control for field service	222A, 222PS, 224
DocuWave™	S60DWAV	links DSO to desktop publishing and spreadsheet analysis tools	11801B, 2200 Series, CSA 803A, TDS 300, TDS 400/A, TDS 500/A, TDS 600A/B, TDS 700/A, TDS 800 Series, THM 500 Series THS 700 Series

*1 *LabVIEW is a registered trademark of National Instrument Corporation.*

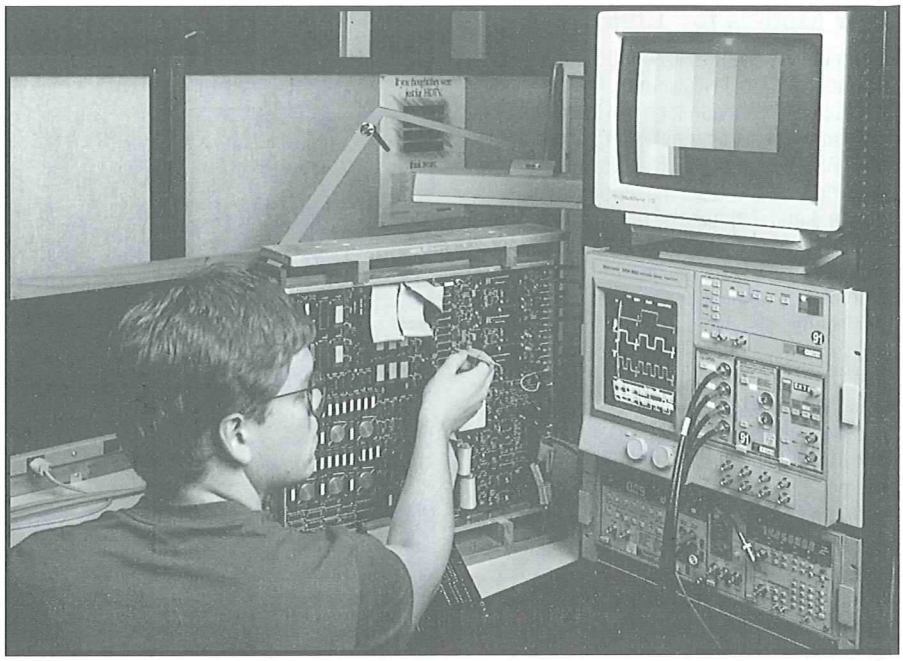
Oscilloscope Reference

Tektronix Oscilloscopes and Communication Signal Analyzers

These products include many innovative features designed to help our customers improve their productivity and reduce operating costs. The TDS Series of digitizing oscilloscopes and the TAS Series of analog oscilloscopes represent the best combination of performance features, human factors and price on the market today. There are other vital technologies only available from Tektronix such as:

- DC to 50 MHz current measurements
- Affordable digital signal processing
- Color-graded displays which give a statistical look at jitter and noise
- Low cost analog oscilloscopes for the service technician and home hobbyist
- Combination analog and digital storage technologies for flexibility in a single instrument
- Digitizing oscilloscopes with extraordinary power to capture fast transient signals, process them on the fly and measure their parameters
- The TDS 600B/700A helps digital designers quickly zero in on complex logic problems in high-speed digital systems
- The CSA communication channel analyzers that can give an accurate assessment of noise, jitter and compliance to CCITT and ANSI Standards up to 50 GHz bandwidth with 2.0 ps RMS jitter (1.3 ps typically) is available in the CSA 803A
- The High Bandwidth (50 GHz) 11801B offers the highest timing resolution and measurement repeatability. While the TDS 800 combines the sequential equivalent-time sampling technology of the 11801B with the mid-range TDS platform for DC-8 GHz bandwidth in a portable monolithic instrument

For complete information on all Tektronix oscilloscope accessories, please see page 434.



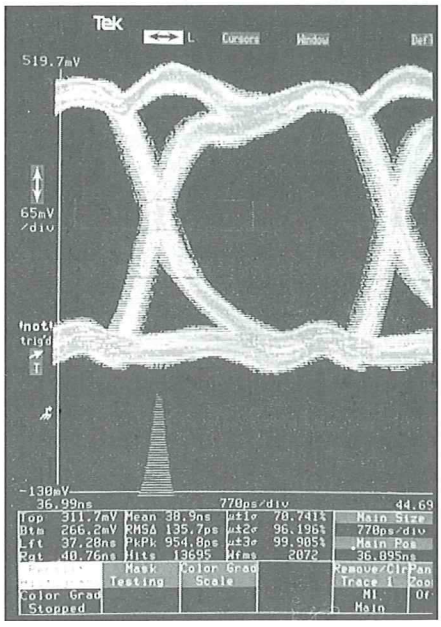
General Trends in Oscilloscope Development

Today you will find more and more special purpose oscilloscopes, such as the CSA 803A and 11801B with bandwidth to 50 GHz and color graded display for thorough analysis of high-speed communication channels and standards testing.

Scopes are smarter today. Our new low-cost TAS analog scopes have autoset for one-button signal capture and cursors to measure time and amplitude.

Our TDS Series scopes include powerful digital signal processing engines which can give you simultaneous time and frequency domain displays with fast updates.

Our scopes are constantly getting easier to use. We've reversed the trend toward more buttons and menus. Our new TDS and TAS models achieve a balance between performance and ease of use. We've done our homework, tested our ideas and greatly improved access to important new features without making the basic functions hard to find. Volts/division, time/division and trigger level have dedicated knobs so you can just grab and turn.



Measurement, trigger modes, hard copy setups and acquisition control lie within easy reach behind a graphic user interface (GUI). Information-packed displays are made easy to read with a high-resolution color monitor. Documentation of waveforms is simplified by direct storage of screens (in common file formats) to floppy disk for cut and paste into word processing software.

Oscilloscope Reference
Selection Guide

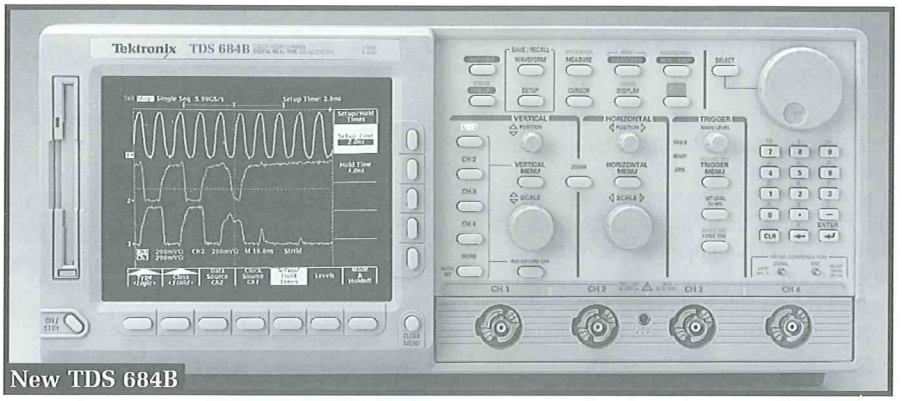
New Models for 1996

The new TDS 600B utilizes the Tektronix proprietary Digital Real-time sampling technology to provide high-performance acquisition on all channels simultaneously. The TDS 684B and TDS 680B provide 1 GHz bandwidth with 5 GS/s maximum sample rate on 4 and 2 channels, respectively. The TDS 644B and TDS 620B have 500 MHz bandwidth, with 2.5 GS/s maximum sample rate on 4 and 2 channels, respectively. These new DRT scopes also have a variety of unique new features, such as channel deskew and time-out pulse trigger. They also provide the same flexible triggering, powerful processing, and easy-to-learn TDS graphical user interface that has become an industry standard.

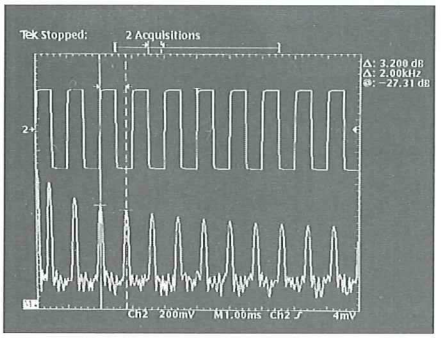
The TDS 524A, 644B, 684B, 744A, and 784A are full-feature models with a color display, floppy disk drive, and several new capabilities such as HDTV video trigger and segmented memory. You can even make color hardcopies with the optional Tektronix Phaser® 140 color printer, or cut and paste screen images directly into word processing documents. The TDS 520A, 540A, 620B and 680B are monochrome versions offering the same features at an even lower price.

The TAS Series user interface simplifies scope operation. The TAS 200 Series front panels are similar in operation and the important, frequently used functions are controlled directly with knobs or buttons.

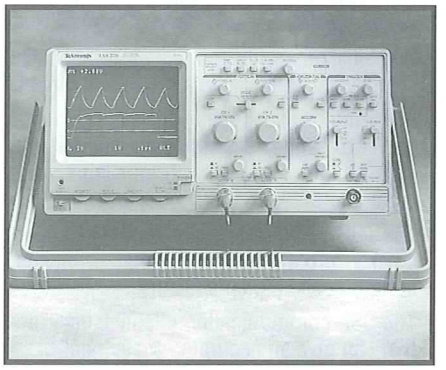
The TAS 200 Series provides measurement cursors and readouts to improve user productivity. Refer to the key specification selection chart and choose the analog scope best suited for your performance needs. And buy with confidence that these products are backed by the leader in oscilloscope technology, Tektronix.



The new TDS 684B features powerful logic triggering and 5 GS/s sampling on all four channels at once. A color monitor and graphic user interface helps make it a powerfully simple digital design tool.



Tektronix' exclusive TriStar™ DSP engine brings simultaneous time and frequency domain analysis to mid-range scopes in the TDS 400A, TDS 500A, TDS 600B, TDS 700A and TDS 800 products.

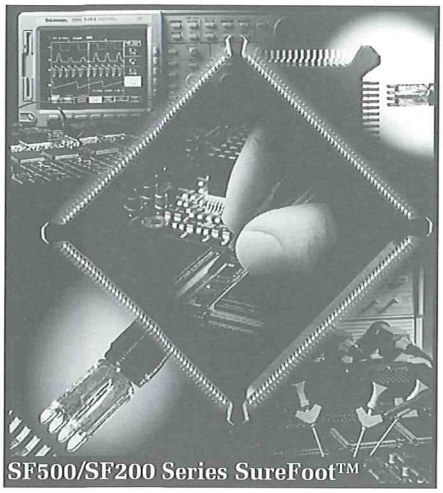


The TAS 200 Series of analog scopes provides powerful features such as cursor measurements and auto-setup in an easy to operate and low-cost package.

Oscilloscope Reference
Accessories

Oscilloscope Reference Section

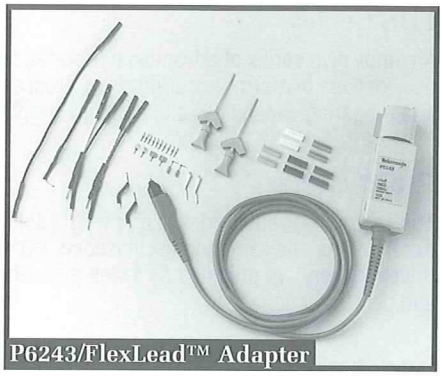
PROBES AND ACCESSORIES
Tektronix continues to dedicate research and development resources to helping customers find ways to connect instrumentation to the changing variety of today's new devices and packages. You will find some innovative new probes and connecting schemes that quickly and cleanly couple to all kinds of devices.


SF500/SF200 Series SureFoot™

SureFoot™ Adapters

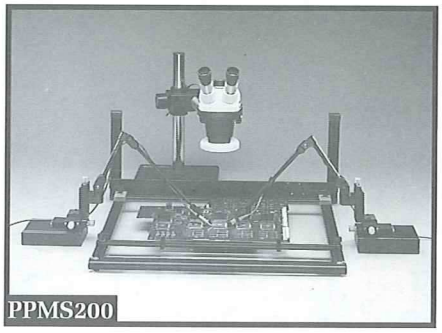
THE NEW SF200 AND SF500 SERIES
This new integral probe tip and guide system enables fault-free hand probing of 0.5 mm, 0.65 mm, 25 mil and 50 mil pitch packages. Side by side pin access is achieved by the offset stacking one SureFoot™ to another. SureFoot™ is available for the P613X (3.5mm) compact tip probes by ordering SF201, SF202, SF203.

See page 470.


P6243/FlexLead™ Adapter

SMALL GEOMETRY ACTIVE FET PROBE
A new low capacitance/low mass active probe now allows the digital designer a lower cost "off-the-shelf" direct access solution for probing surface mount packages. The P6243 SMD Active FET Probe is designed for Tektronix Oscilloscopes forming a measurement system optimized for low circuit loading, fast transient response and maximum bandwidth.

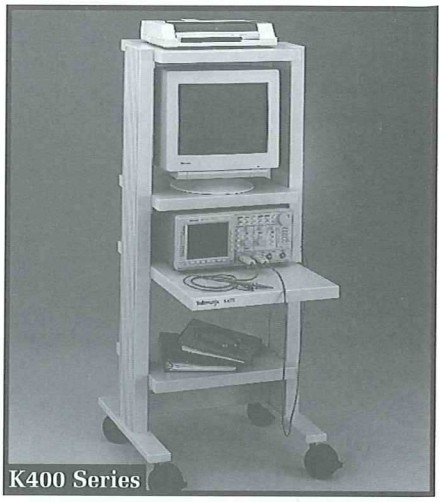
See page 448.


PPMS200

Hands-free Probing

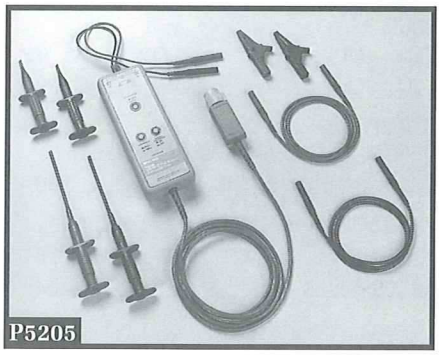
PROBING STATIONS AND ARTICULATED ARMS
Today's high speed densely populated circuitry requires assisted probing capability. The new PPMS Series Probing Stations and Articulated Arms allow the designer to position microwave and traditional handheld probes onto the small lead geometries of fine-pitch interconnects, SMD packages, MCMs (multi-chip-modules), hybrids and ICs. The PPMS family includes a High Resolution Probing Station, a Fine Pitch General Purpose Probing System, 1 Axis and 3 Axis Articulated Arms for use with microwave or traditional handheld probes, and a Stereo Zoom Microscope when vision assisted probing is required.

See page 472.


K400 Series

EASILY FREE UP VALUABLE DESK SPACE
The K400 Family of carts ergonomically improves work bench efficiencies and makes the key components of a test bench portable and easily accessible. These cart systems help individuals and work groups share costly equipment across variety of locations.

See page 520.


P5205

DIFFERENTIAL SIGNAL ACQUISITION SOLUTIONS
Three new products are available for acquiring differential signals. The ADA400A 1 MHz Differential Preamplifier allows single-ended oscilloscope measurements of very low signal levels (<10 µV) that are not ground referenced. The P5200 Differential Probe measures differential voltages up to 1,300 V and has a bandwidth of 25 MHz. The P5205 Differential Probe measures differential voltages up to 1,300 V. With a bandwidth of 100 MHz, the P5205 probe easily measures those fast dV/dt transitions in switching power devices.

See pages 493-495.

Digitizing Oscilloscopes

TDS • 11800 • DSA • CSA • 2200 • 200 Series

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CSA SERIES COMMUNICATIONS SIGNAL ANALYZERS

CSA 803A Up to 50 GHz Color 330

200 SERIES HANDHELD DIGITAL STORAGE

224 60 MHz 108

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TDS Series

An innovative series of advanced performance oscilloscopes built upon Tektronix' digitizing oscilloscope platform, featuring multi-processor speed and flexibility, advanced acquisition and triggering capabilities and a unique graphical user interface for intuitive operation.

11800 Series

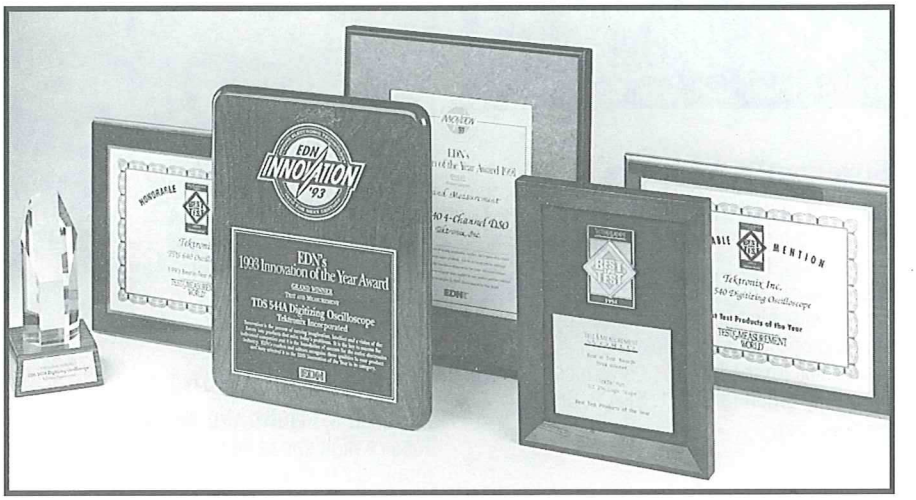
The Tektronix 11800 Series is a powerful set of analysis tools that alters your fundamental expectations of a sampling oscilloscope. Accuracy, sensitivity, bandwidth, offset, and overdrive recovery are provided by a well-planned instrument family having plug-in versatility and performance.

CSA Series

The Communications Signal Analyzer (CSA) Series offers signal analysis and the powerful measurement capabilities required to analyze high-speed digital communication signals. Features include histograms, mask testing, and a color-graded display. The CSA Series allows you to perform accurate measurements such as jitter, noise, phase and extinction ratio.

224

The compact size and battery operation make the 200 Series optimum scopes for industrial maintenance and field service.



The TDS family has been recognized for innovation and technology leadership by leading industry periodicals since its introduction in 1991.

Digitizing Oscilloscopes
TDS Series

Features

TDS SERIES

- 50 MHz to 8 GHz Bandwidth
- 100 MS/s to 5 GS/s Sample Rates
- 2 and 4 Input Channels
- Advanced Logic Pattern and State Triggering
- Runt and Glitch Triggering
- HDTV Video Triggering
- Infinite and Variable Persistence Displays
- High-resolution Color Display
- Record Lengths to 500,000 Points
- 8- to 13-Bit Vertical Resolution
- Tektronix TriStar™ DSP for Fast Waveform Processing and Live Measurement Updates
- DSP Math Including FFT, Integration, and Differentiation
- Automatic Measurements
- Pass/Fail Testing
- Easy Documentation with Saving of Image Files to Floppy Disk or Hardcopies Directly to Printer
- Full GPIB Programmability

Applications

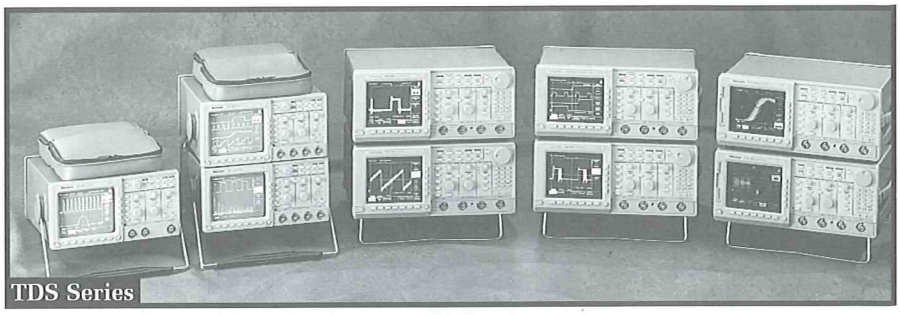
- Research and Development
- Electromechanical Design
- Telecom Service and Manufacturing
- Biophysical, Biomedical Research
- Power Supply Design
- Component Development and Characterization

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*



TDS Series

An innovative series of oscilloscopes built upon Tektronix' digitizing oscilloscope platform, featuring multi-processor speed and flexibility, advanced acquisition and triggering capabilities and a unique graphical user interface for intuitive operation.

With the TDS Series, Tektronix introduced a new and innovative generation of digitizing oscilloscopes designed to keep pace with current and evolving needs across the electronics industry. TDS combines the performance needed with the ease of use demanded by customers in digital design; research and development; electromechanical design; power supply design; biophysical/biomedical high-speed component development and characterization; and telecommunications design and automated test.

The TDS Series offers significant advantages over other oscilloscopes in four major areas:

HIGH-FIDELITY SIGNAL ACQUISITION

TDS offers sample rates ranging from 100 MS/s to 5 GS/s and bandwidths from 50 MHz to 8 GHz. TDS couples this performance with wide dynamic range, vertical resolution up to 13-Bits, fast overdrive recovery and 1 mV/div sensitivity. You'll find a model that precisely fits your needs.

POWERFUL AND FLEXIBLE TRIGGERING

TDS 500A, 600B and 700A models feature very innovative and accessible logic triggering features that can isolate glitches, runts and timing problems quickly and reliably. Video triggering for NTSC, PAL, SECAM and custom video standards makes the TDS 400A an excellent choice for video and display system design. Specialized HDTV triggering is available on the TDS 500A, TDS 600B and TDS 700A. 2 GHz trigger bandwidth in the TDS 800 and very low jitter make it ideal for high-speed component characterization and for telecommunications manufacturing, installation and maintenance.

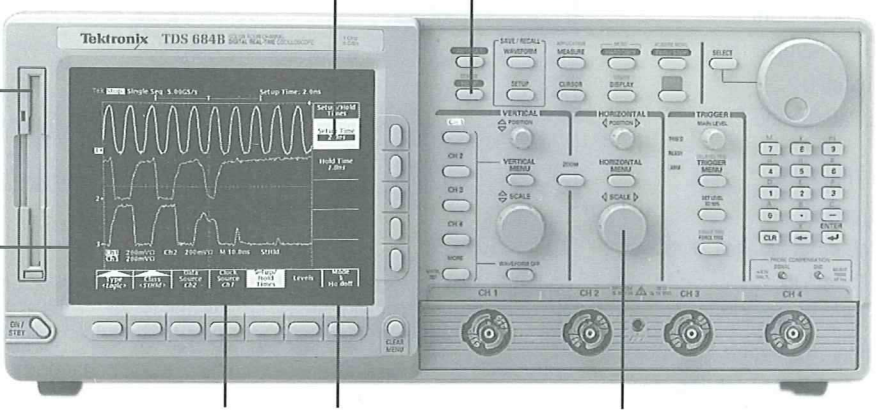
MULTIPROCESSOR ARCHITECTURE

Our TriStar™ Digital Signal Processor complements a multi-processor design in all TDS Scopes to permit more measurement flexibility, instant response to commands and live waveform math including FFT and waveform pass/fail testing in the TDS 400A, 500A, 600B, 700A and 800. Displays may be sent directly to a printer or plotter or exported as EPS (Encapsulated PostScript) or PCX (Microsoft Windows) files for use with common graphics and word processing software.

AFFORDABLE PERFORMANCE THAT IS EASY TO USE

A graphical user interface (GUI) makes operation intuitive. A familiar front-panel layout puts dedicated knobs for vertical, horizontal and trigger controls right where you expect to see them. This layout makes it easy for casual users to operate the basic oscilloscope features. Explanatory icons, pop-up menus, on-line help and the VGA-quality display quickly guide users to even the most powerful measurement features. A color VGA display is available with the TDS 500A, 600B, and 700A.

Digitizing Oscilloscopes
TDS Series

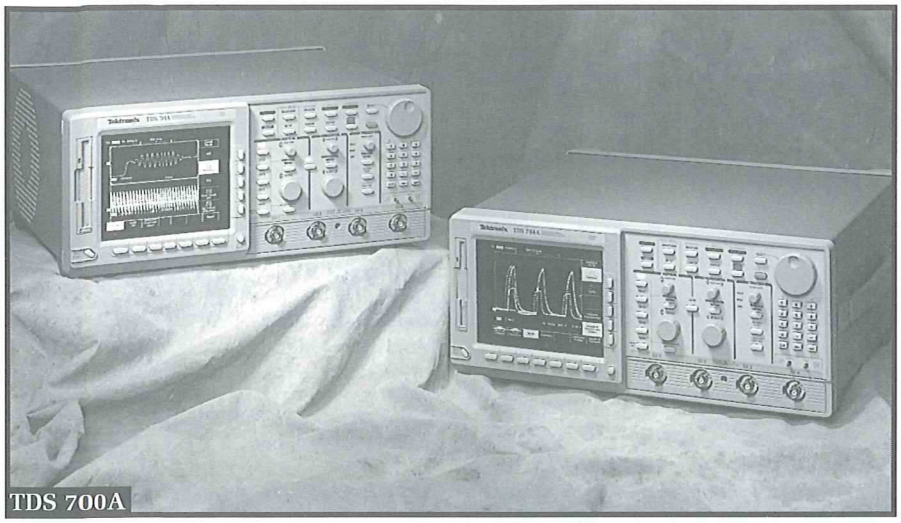


New TDS 684B

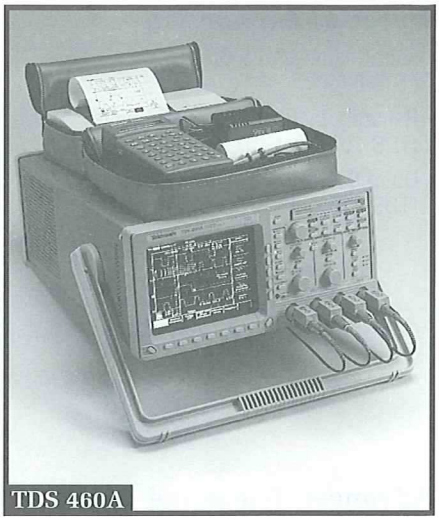
TDS SELECTION GUIDE

	TDS 310	TDS 320	TDS 350	TDS 410A	TDS 420A	TDS 460A
Signal Acquisition System						
Bandwidth	50 MHz	100 MHz	200 MHz	200 MHz	200 MHz	400 MHz
No. of Channels	2	2	2	2	4	4
Vertical Resolution	8-Bits			8-Bits; ≥12-Bits with Hi-Res; 11-Bits with averaging		
Vertical Sensitivity	2 mV – 10 V/div			1 mV – 10 V/div		
Accuracy	±2%			±1.5%		
Sample Rate	200 MS/s on all channels	500 MS/s on all channels	1 GS/s on all channels	100 MS/s on all channels		
Record Length Per Channel	1000 pts.			30,000 pts. (120 K Opt.)		
Peak Detection	10 ns			10 ns		
InstaVu™ Acquisition Mode	N/A			N/A		
Signal Processing Functions						
Common	Add, Subtract, Average, Envelope			Add, Average, Envelope, Interpolation (Sin x/x & linear), Multiply, Subtract (FFT, Int., Diff. Optional)		
Unique	–			Hi-Res	Hi-Res	Hi-Res
Triggering						
Trigger Conditioning	HF, LF & Noise Reject			HF, LF & Noise Reject		
Trigger Types: Common	Edge, Auto, NTSC, PAL, SECAM video			Edge, Auto, Init 50%; Opt. NTSC, PAL, SECAM video		
Trigger Types: Unique	–			–		
User Interface						
Monitor	Monochrome			Monochrome		
Disk Drive	No			Yes: 3.5 in. Disk Drive		
Desktop Publishing	TIFF, PCX, BMP, EPS, Interleaf			TIFF, PCX, BMP, EPS, Interleaf		
Page	82	82	82	78	78	78

Digitizing Oscilloscopes
TDS Series



The TDS 700A oscilloscopes.



TDS 460A 4-Channel, 400 MHz oscilloscope.

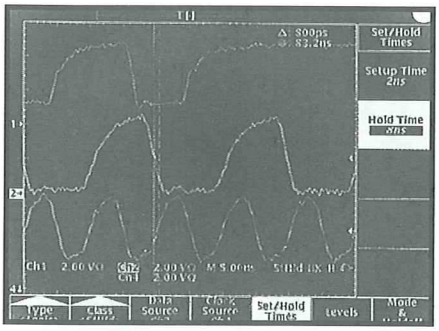
TDS SELECTION GUIDE

	TDS 520A/ TDS 524A	TDS 540A	NEW TDS 620B	NEW TDS 644B	NEW TDS 680B/684B	TDS 744A	TDS 784A	TDS 820
Signal Acquisition System								
Bandwidth	500 MHz		500 MHz	500 MHz	1 GHz	500 MHz	1 GHz	6 – 8 GHz
No. of Channels	2	4	2	4	2/4	4	4	2
Vertical Resolution	8-Bits; ≥12-Bits w/Hi-Res; 11-Bits w/averaging			8-Bits; ≥11-Bits w/averaging		8-Bits; ≥13-Bits w/Hi-Res; 11-Bits w/averaging		14-Bits
Vertical Sensitivity	1 mV – 10 V/div			1 mV – 10 V/div		1 mV – 10 V		2 mV – 200 mV/div
Accuracy	±1%			±1.5%		±1%		±0.7%
Sample Rate	500 MS/s (1-CH) 250 MS/s (2-CH)	1 GS/s (1-CH) 500 MS/s (2-CH) 250 MS/s (4-CH)	2.5 GS/s on all channels	2.5 GS/s on all channels	5 GS/s on all channels	2 GS/s (1-CH) 1 GS/s (2-CH) 500 MS/s (4-CH)	4 GS/s (1-CH) 2 GS/s (2-CH) 1 GS/s (4-CH)	N/A
Record Length Per Channel	15 K pts.	50 K pts.	15 K pts.	15 K pts.	15 K pts.	500-50 K pts. (500 K/1-CH, 250 K/2-CH, 130 K/4-CH Opt.)		15 K pts.
Peak Detection	4 ns		1 ns	1 ns	<1 ns	1 ns		N/A
InstaVu™ Acquisition Mode	N/A			N/A		Standard		N/A
Signal Processing Functions								
Common	Add, Average, Envelope Interpolation (Sin x/x & linear), Multiply, Subtract, (FFT, Int., Diff.)							
Unique	Hi-Res	Hi-Res	–	–	–	Hi-Res	Hi-Res	–
Triggering								
Trigger Conditioning	HF, LF & Noise Reject		HF, LF & Noise Reject			HF, LF & Noise Reject		–
Trigger Types: Common	Edge, Auto, Init 50%; 4 Input Pattern, State; Glitch and Width; Runt; Opt. HDTV, NTSC, PAL, SECAM video							Edge, Auto, Init 50%
Trigger Types: Unique	–	–	Setup/hold, slew rate, time-out			Setup/hold, slew rate		–
User Interface								
Monitor	Monochrome/Monochrome Color		Monochrome	Color	Monochrome/ Color	Color		Monochrome
Disk Drive	Standard with color		Standard with color			Yes		–
Desktop Publishing	TIFF, PCX, BMP, EPS, Interleaf		TIFF, PCX, BMP, EPS, Interleaf			TIFF, PCX, BMP, EPS, Interleaf		TIFF, PCX, BMP, EPS, Interleaf
Page	76	76	72	72	72	70	70	62

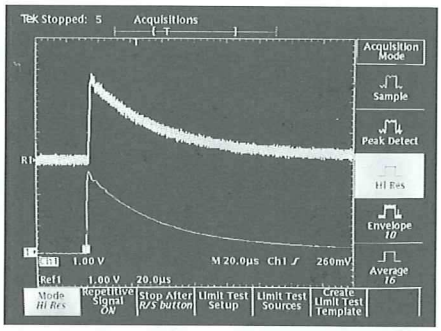
Digitizing Oscilloscopes
TDS Series

Powerful Acquisition

- Four Channels of 5GS/s (TDS 684B)
- Record Lengths of 500,000 Points (TDS 700A Opt. 1M)
- Up to 8 GHz Bandwidth (TDS 820 Opt. 1D)



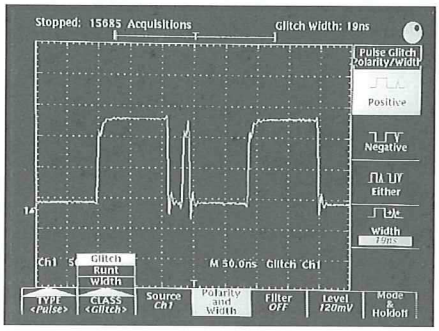
The TDS 684B provides four channels of 5 GS/s acquisition to capture events with high single-shot resolution.



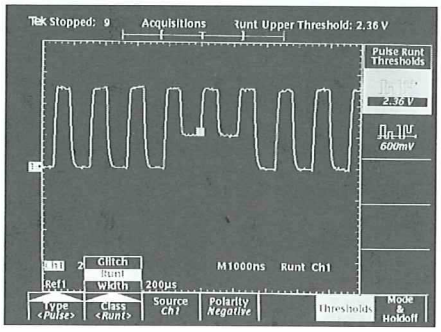
Hi-Res acquisition mode achieves extremely high signal to noise ratios (SNR) on single-shot events by oversampling the input signal (all TDS 400A, TDS 500A, and TDS 700A models).

Advanced Triggering

- Glitch Triggering (TDS 500A/TDS 600B/TDS 700A)
- Exclusive Runt Triggering (TDS 500A/TDS 600B/TDS 700A)
- HDTV Video Triggering (TDS 500A/TDS 600B/TDS 700A)
- Setup and Hold Time Violation Triggering (TDS 600B/TDS 700A)
- Slew Rate Triggering (TDS 600B/TDS 700A)



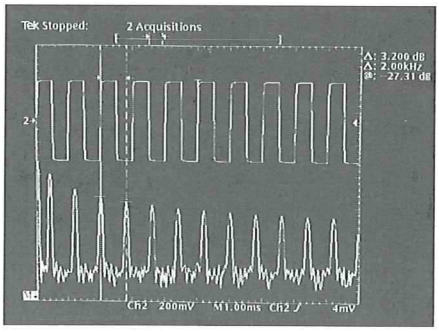
TDS triggering can capture glitches as narrow as 1 ns to help solve prototype circuit problems quickly (TDS 600B and TDS 700A models).



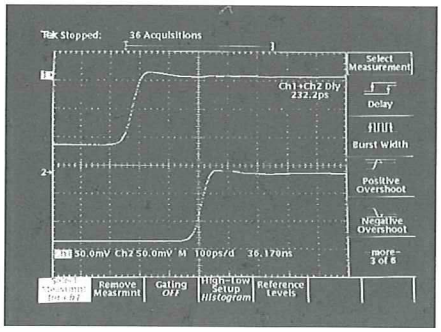
TDS exclusive runt triggering helps isolate invalid logic levels such as those caused by setup and hold violations (all TDS 500A, TDS 600B and TDS 700A models).

Powerful Processing

- FFT Analysis
- Manufacturing Pass/Fail Testing
- On-board Mask Drawing (TDS 820)



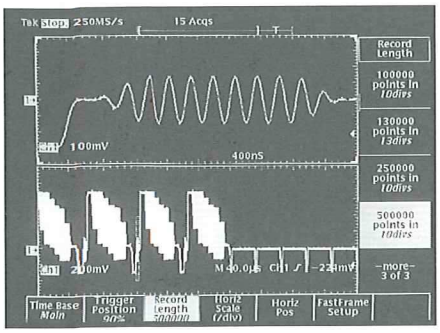
FFT analysis provides an extra dimension of performance with simultaneous displays in the time and frequency domains (optional on TDS 400A, monochrome TDS 500A/600B and the TDS 820, standard on color TDS 500A/600B/700A).



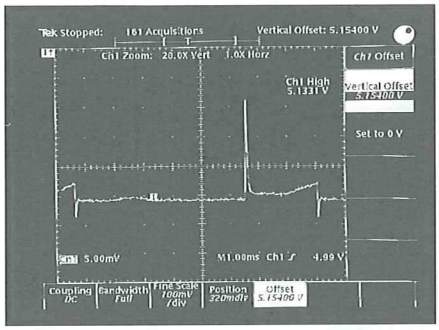
The TDS 820 provides 0.4 ps timing resolution and channel deskew capability to accurately measure delays in today's high-speed digital systems.

Digitizing Oscilloscopes
TDS Series

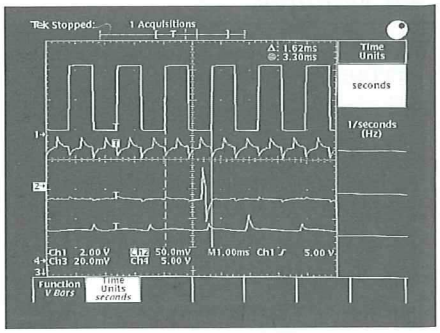
Powerful Acquisition



Record lengths of up to 500,000 points (TDS 700A Opt. 1M) enable very high timing resolution on even the most complex waveforms. Or capture unexpected events that happen well before or long after the trigger event (120 K points on TDS 400A Opt. 1M).

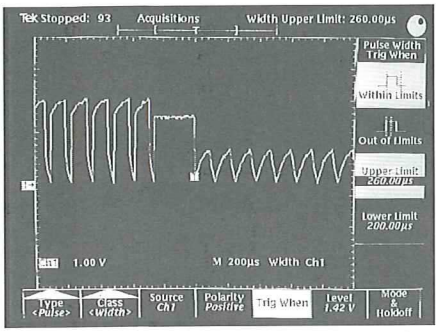


Calibrated vertical offset allows capture and analysis of small signals riding on top of large DC offsets (all TDS 400A, TDS 500A, TDS 600B and TDS 700A models).

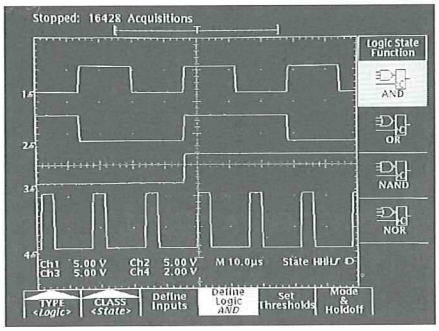


Four channels help show a time-correlated display of both digital control and analog feedback signals (TDS 420A, TDS 460A, TDS 540A, TDS 644B, TDS 684B, and TDS 700A).

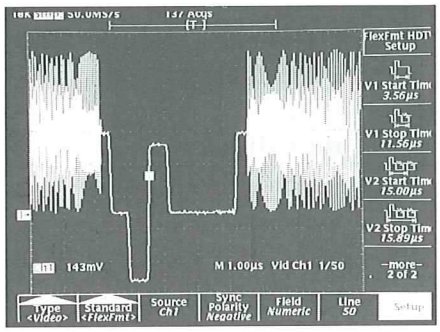
Advanced Triggering



Pulse width triggering can single out faults caused by pulses which are either too narrow or too wide (all TDS 500A, TDS 600B and TDS 700A models).

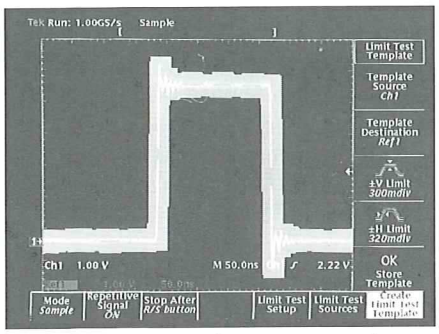


Logic timing analysis is clearly faster and easier with icon-driven state triggering (all TDS 500A, TDS 600B and TDS 700A models).

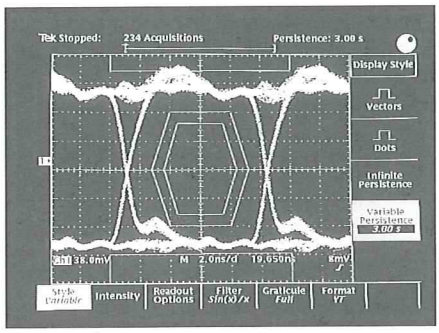


An optional video trigger features line and field selection on standard and user definable HDTV formats (TDS 500A, TDS 600B and TDS 700A models).

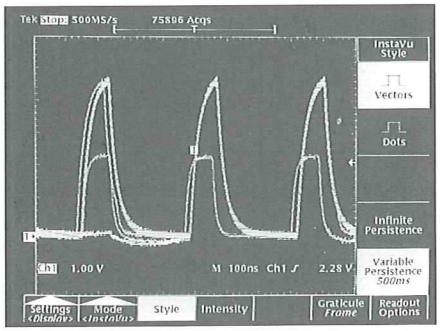
Powerful Processing



Automatic on-the-fly limit testing makes manufacturing pass/fail testing an easy task (all TDS 400A, TDS 500A, 600B, 700A and 800 models).



On-board mask drawing capability allows visual comparison of signals to standard masks in communication systems (TDS 820).



The new InstaVu™ acquisition mode adds a third dimension to your waveforms. InstaVu™ has the fastest waveform capture rate – over 400,000 waveforms per second, and it provides a color-graded historical view of waveform changes in 16 levels of color (TDS 700A).

Digitizing Oscilloscopes
TDS 820

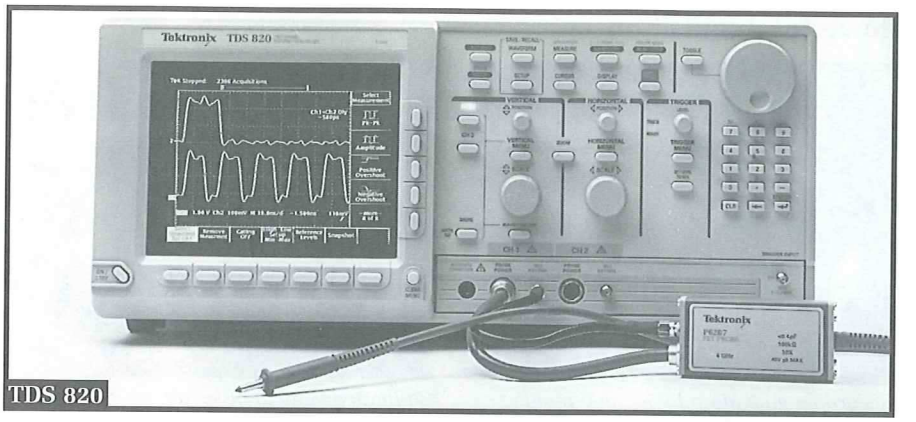
Features

TDS 820

- 6-8 GHz BW
- 0.4 ps Timing Resolution
- 2 Input Channels
- 20 ps/div to 2 ms/div Sweep Speeds in 5 ps Steps
- 2 GHz External Trigger Bandwidth
- 3 ps RMS Jitter
- Infinite and Variable Persistence Displays
- 14-Bit Vertical Resolution
- 27 Automatic Measurements
- Electronic Mask Drawing and Display
- Automatic Pass/Fail Limit Testing
- Full GPIB Programmability
- Optional Hardcopy Interface
- Optional Advanced DSP Waveform Math Including FFT, Integration and Differentiation
- 0.5 pF FET Probes Standard

Applications

- Telecom Service and Manufacturing
- Semiconductor Characterization
- Digital System Design and Characterization



SIGNAL ACQUISITION SYSTEM	TDS 820	TDS 820 Opt. 1D
Channels	2	2
Rise time	58.3 ps	43.8 ps
Bandwidth (0.35/rise time)	6 GHz	8 GHz
Max operating input voltage	2 V p-p; ±3 V DC	1 V p-p; ±1.5 V DC
Sensitivity	2 m V/div to 200 mV/div	1 mV/div to 100 mV/div
Random noise	1.2 mV max, 600 µV typical	600 µV max, 300 µV typical

DC Gain Accuracy – ±0.7% after user-initiated automatic vertical calibration.

Vertical Resolution – 14-Bits (Approx. 16,384 levels over 10.24 vertical divisions).

Input Impedance – 50 Ω.

ACQUISITION MODES

Normal – New data acquired on each sweep.

Envelope – Max/min values acquired over one or more acquisitions.

Average – Waveform averages selectable from 2 to 10,000.

TIME BASE SYSTEM

Time Bases – Main, Delayed.

Time/Division Range – 20 ps/division to 5 ms/division in 1-2-5 steps or settable from the numeric keypad in 5 ps steps.

Delta time measurement accuracy –

Time interval	Accuracy
Ti ≥1 ns	0.1% x interval +15ps
100 ps	5 ps
10 ps	2 ps

Channel Deskew – Up to 100 ns (each channel).

Record Length – 500, 1000, 2000, and 5000, and 15,000 samples per channel.

Pre-Trigger View Time – 1.5 ns.

TRIGGERING SYSTEM

Trigger Sources – External input, internal rate generator, CH 1, CH 2.

External Trigger Sensitivity – 40 mV p-p from DC to 200 MHz, increasing linearly to 200 mV p-p at 2 GHz.

External Trigger Minimum Pulse Width – 0.25 ns.

Internal Trigger Sensitivity – 80 mV p-p from DC to 200 MHz, increasing linearly to 400 mV p-p at 1 GHz.

Trigger Delay Jitter – 3 ps RMS + 30 ppm of time base delay.

Holdoff Range – 15 µs to 2 s.

DISPLAY

Waveform Style – Dots or vectors. Infinite and variable persistence from 250 ms to 10 s.

Gray Scaling – With variable persistence selected, waveform points gradually decay through 16 levels of intensity, providing "z-axis" information about rapidly changing waveforms.

Graticules – Full, grid, cross hair, frame.

Format – YT and XY.

CRT Type – 7 in. diagonal, magnetic deflection. Horizontal raster-scan. P4 White phosphor.

CRT Resolution – 640 horizontal by 480 vertical displayed pixels.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*

Digitizing Oscilloscopes
TDS 820

MEASUREMENT SYSTEM
Automatic Waveform Measurements –

Period	Frequency
High	Low
+ Width	– Width
Maximum	Minimum
Rise	Fall
Peak to Peak	Amplitude
+ Duty Cycle	– Duty Cycle
+ Overshoot	– Overshoot
Propagation Delay	Burst Width
Mean	Cycle Mean
RMS	Cycle RMS
Phase	Cycle Area
+ Cross	– Cross
Area	

Continuous update of up to four measurements on any combination of waveforms. Snapshot mode shows all measurements on the selected waveforms.

Thresholds – Settable in percentage or voltage.

Cursor Measurements – Absolute, Delta; Volts, Time, Frequency.

Cursor Types – Horizontal bars (volts); Vertical bars (time); Paired (volts and time).

WAVEFORM PROCESSING
Waveform Functions – Interpolate-selectable sin(x)/x or linear, Average, FFT, integrate, and differentiate.

Arithmetic Operators – Add, Subtract, Multiply, Invert.

Autosetup – Single button, automatic setup on selected input signal for vertical, horizontal and trigger systems.

COMPUTER INTERFACE
GPIB (IEEE-488.2) Programmability – Full talk/listen modes. Control of all modes, settings, and measurements.

HARD COPY
Formats – HP ThinkJet, Epson, PostScript, Interleaf, DeskJet, LaserJet, EPS Monochrome, EPS Color, TIFF, PCX, BMP, HPGL.

Optional Hardcopy Interface – Centronics and RS-232C.

STORAGE
Waveforms – Up to 15 K points.

Setups – 10 front-panel setups.

POWER REQUIREMENTS
Line Voltage Range – 90 to 250 V RMS.

Line Frequency – 47 to 63 Hz.

Power Consumption – 250 W max.

ENVIRONMENT AND SAFETY
Temperature – Operating: 0 to +50°C. Nonoperating: –40 to +75°C.

Humidity – Operating and nonoperating: Up to 95% relative humidity at or below +40°C; to 75% relative humidity from +41°C to 50°C.

Altitude – Operating: 15,000 ft. Nonoperating: 40,000 ft.

Electromagnetic Compatibility – Meets MIL-STD-461C, CE-03, Part 4, Curve # 1, RE-02, Part 7; meets VDE 0871, Category B, FCC rules and regulations, Part 15, Subpart B, Class A.

Safety – Listed UL 1244. Certified to CAN/CSA-C22.2 No. 231-M89.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	193	7.6
with acc. pouch	236	9.3
Width	445	17.5
Depth with front cover	432	17.0
Weight	**kg**	**lb.**
Net	13.2	29.1
Shipping	23.6	52.0

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TDS 820
2-CH, 6 GHz Digitizing Oscilloscope.
Includes: Two P6207 Probes; Reference (070-8511-01), User Manual (070-8512-01), Programmer Manual (070-8513-01), Performance Verification Manual (070-8696-00), U.S. Power Cord (161-0230-01), Two 12-inch 50 Ω Male-to-Male SMA Cables (174-1364-00), 60-inch 50 Ω Male-to-Male SMA Cable (174-1428-00), Antistatic Grounding Wrist Strap (006-3415-04), SMA "T" (015-1016-00), SMA Female-to-Female Adapter (015-1012-00), Two SMA Short Circuit Male Terminations (015-1020-00), Front Cover (200-3696-00).

Opt. 2D – Delete Two P6207 Probes.

Opt. 13 – RS-232/CENTRONICS Hardcopy Interface.

Opt. 1R – Rackmount.

Opt. B1 – Service Manual.

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1–A5 available.
See General Customer Information Section for description.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES
Also see page 434.

PROBES

Active – 3.5 GHz, 0.4 pF/100 kΩ, 1 m. Order P6207.

Differential – 100 MHz, active differential, 6 ft. Order P6046.

50 Ω Divider – 9 GHz, 0.15 pF/500 Ω, Tips 1X, 10X. 1 m. Order P6150.

CARTS – Order K420 Scope Cart.

HARDCOPY DEVICE

Plotter – Order HC100 Opt. 01.

Static Isolation Unit – Order SIU800.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*

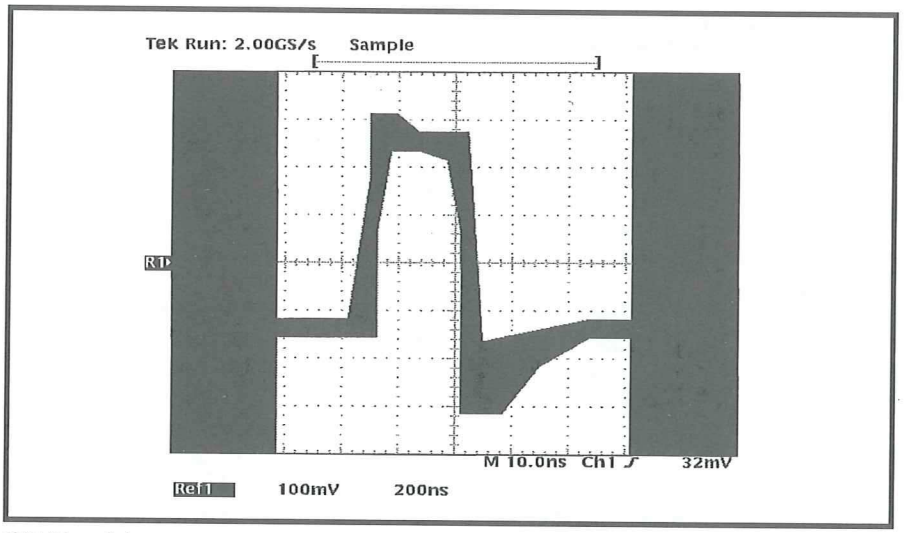
Digitizing Oscilloscopes

TTiP i-Pattern™

Features

TTiP

- Compare Live Signals to Industry Standard Templates
- Oscilloscope Setup Files Provided for Convenience
- Pass/Fail Testing of Acquired Signal
- i-Pattern™ Software for Statistical Measurement, Examination of Signal Noise and Timing Jitter
- Set of Nine Optical Standard Masks Provided with i-Pattern™ Software



DS1 Template.

TDS Telecommunication Package

One of the most frequently performed tasks in the design, manufacture and service of telecommunications equipment is comparing the live signals to a predefined industry standard template. The TTiP telecommunications package for the TDS 400A/500A/600B/700A models provides the user with the capability to make this comparison. In addition, the i-Pattern™ software lets you analyze and visually examine signal noise and timing jitter on IBM compatible PCs.

PRE-DEFINED TEMPLATES AND SCOPE SETUPS

The TTiP package includes twenty-seven pre-defined templates, simplifying what used to be a time-consuming and inaccurate measurement task.

Appropriate oscilloscope setup files for the TDS 400A/500A/600B/700A scopes are also provided. These setup files simplify the task of aligning the signal with the templates. For TDS without internal disk drives, the templates and setup files are available in GPIB formats.

PASS-FAIL TESTING

Once the signal is aligned and scaled, you can choose to perform the Pass/Fail test on the acquired signal. The TDS oscilloscope's limit testing capability makes it simple to determine if the signal passes or fails to meet the standard.

i-Pattern™ Software and Telecommunication Masks

The i-Pattern™ software provides statistical measurements and visual examination of signal noise and timing jitter by importing captured waveforms from the oscilloscope via GPIB to the PC. There the waveforms can be stored and analyzed.

The operation of the i-Pattern™ software is simplified by the integration of "drop-down" menus and pop-ups, intuitive use of arrow keys, use of "hot-keys," command short cuts, and extensive on-line HELP. A set of nine Optical Standard Masks to be used with the software is provided.

REQUIRED CONFIGURATION

The i-Pattern™ software requires a GPIB connection to the TDS scope for waveform retrieval. The following configuration is recommended for the normal operation of i-Pattern™ software: a TDS oscilloscope connected via GPIB cable to a IBM-PC/AT or compatible controller with a National Instruments GPIB interface card: GPIB-PC, GPIB-PC2, GPIB-PC2A, MC-GPIB, AT-GPIB or GPIB PCIII and a 3.5 in. floppy disk drive.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*

ORDERING INFORMATION

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TTIP
Telecommunication Package and i-Pattern™ Software.

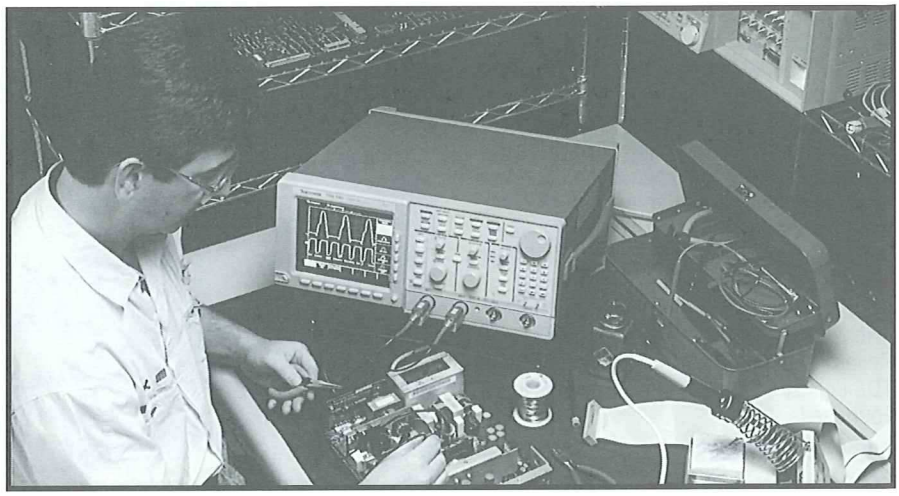
Includes: TDS Template and Setup Files on 3.5 in. Floppy; GPIB Templates and Setup Files and i-Pattern™ Software with Predefined Telecommunication Masks on 3.5 in. Floppy; User Manuals.

TDS Series Reference

TDS 500A Series • TDS 600B Series • TDS 700A Series

Features

- 500 MHz and 1 GHz Bandwidths
- Sample Rates to 5 GS/s
- 2 and 4 Input Channels
- Record Lengths to 500,000 Points
- 8-Bit Vertical Resolution
- Color and Monochrome Displays
- Infinite and Variable Persistence Displays
- FFT, Integration and Differentiation
- Waveform Pass/Fail Testing
- 25 Automated Measurements
- 3.5 in. DOS Format Floppy Disk Drive
- GPIB, RS-232, Centronics and VGA I/O Ports



The TDS Series instruments can be used for a variety of applications including power supply development, embedded microprocessor design, laser diode research and more.

TDS Series

A common instrument platform is the foundation of the TDS 500A, TDS 600B and TDS 700A Series digitizing oscilloscopes. Each instrument in these series offers a lively update rate, quick response to front-panel button or knob changes, a common, icon-enhanced user interface, on-line, context-sensitive help and more. Control of all instruments uses the same human and computer interface. Moving between any of the nine models is simple once you have learned the operating basics of any instrument in the Family.

TDS SELECTION GUIDE

	TDS 500A	TDS 600B	TDS 700A
Total Channels	2 or 4	2 or 4	4
Maximum Real Time Channels	1	4	1
Bandwidth	500 MHz	500 MHz and 1 GHz	500 MHz and 1 GHz
Sample Rate (max)	1 GS/s*2	5 GS/s	4 GS/s
Record Length (max)	50,000 points	15,000 points	500,000 points
Vertical Resolution	8-Bits >11-Bits w/averaging	8-Bits >11-Bits w/averaging	8-Bits >11-Bits w/averaging
Hi-Res	>12-Bits	–	>13-Bits
Vertical Accuracy	1%	1.5%	1%
Peak Detect	4 ns	≤ 1 ns	1 ns
InstaVu™ Acquisition	–	–	Standard
FastFrame™	Standard	–	Standard
Dual Window Zoom	–	Standard	Standard
Channel Deskew	–	Standard	–
Runt Pulse Trigger	Standard	Standard	Standard
Setup/Hold Time Violation Trigger	–	Standard	Standard
Time Out Trigger	–	Standard	–
Slew Rate Trigger	–	Standard	Standard
Display Type	Color/Monochrome	Color/Monochrome	Color
Floppy Disk Drive	Optional	Standard*1	Standard
GPIB, VGA	Standard	Standard	Standard
RS-232, Centronics	Optional	Standard*1	Standard

*1 Only standard on selected models.

*2 500 MS/s on 2 channel models.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.*

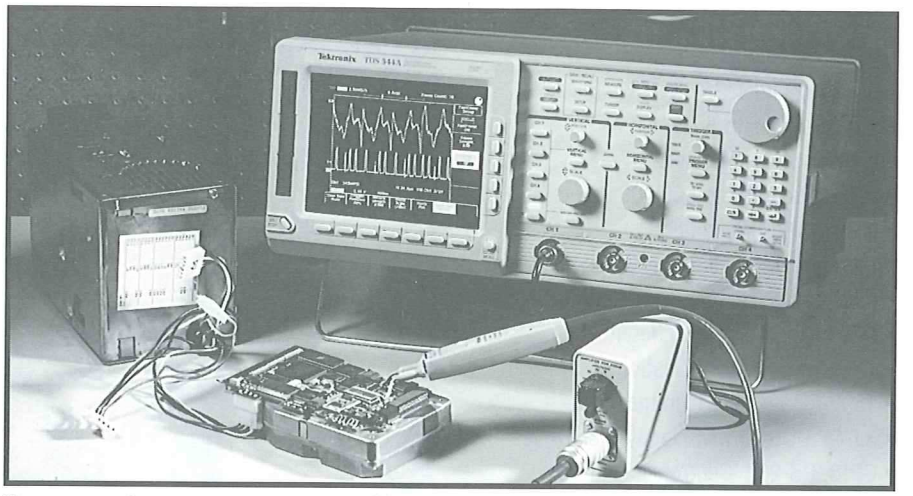
See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*

TDS Series Reference

TDS 500A Series • TDS 600B Series • TDS 700A Series

Need performance but have a restricted budget? Consider the TDS 520A. A two-channel, 500 MHz instrument, the TDS 520A is available without the floppy disk drive and I/O interfaces to keep your initial investment low. You can enhance your instrument and extend its useful life at any time in the future by adding either item later. Are you working with high-speed digital hardware? Consider the 1 GHz bandwidth TDS 684B. With 5 GS/s simultaneous sampling on four channels, the TDS 684B makes short work out of characterizing digital hardware timing violations. Regardless of your application, there is a TDS digitizing oscilloscope ideally suited to your needs.



Features such as 500,000-point record length, FastFrame™, dual window zoom, FFT analysis, runt pulse triggering and pulse width violation triggering make these instruments ideal for researchers, engineers and technicians working with disk drives.

ACQUISITION MODES

Peak Detect – High frequency and random glitch capture. Captures glitches using hardware at all real-time sampling rates.

Sample – Sample data only.

Envelope – Max/min values acquired over one or more acquisitions.

Average – Waveform averages selectable from 2 to 10,000.

Hi-Res – Vertical resolution improvement and noise reduction on low frequency signals, e.g., 13-Bits at 5 ms/div and slower. (Not available on the TDS 600B Series.)

FastFrame™ – Segment acquisition memory into as many as 910 segments. Trigger rate over 50,000 per second. (Not available on the TDS 600B Series.)

InstaVu™ – Custom hardware increases update rate to over 400,000 waveforms per second. Instantly displays small signal variations and infrequent glitches. Color is used to indicate rate of occurrence of events (Available on TDS 700A only).

WAVEFORM PROCESSING

Waveform Functions – Interpolate (selectable as either sin x/x or linear), Average or Envelope.

Advanced Waveform Functions – FFT, Integration, Differentiation.

FFT – Frequency Range: DC to 500 MHz. Amplitude Display: power is dBV RMS, Linear RMS. Phase is degrees or radians. Signal to Noise: 55 to 65 dB (Avg. or Hi-Res). Transform Size: 500 to 10,000 points selectable. Windowing, Rectangular, Hamming, Hanning, Blackman-Harris.

Arithmetic Operations – Add, Subtract, Multiply, Divide, Invert.

Autosetup – Single button, automatic setup on the selected input for vertical, horizontal and trigger systems.

Waveform Limit Testing – Compares incoming or math waveform to a reference waveform's upper and lower limits.

MEASUREMENT SYSTEM

Automatic Waveform Measurements

Period	Frequency
High	Low
+ Width	– Width
Maximum	Minimum
Rise Time	Fall Time
Peak to Peak	Amplitude
+ Duty Cycle	– Duty Cycle
+ Overshoot	Undershoot
Mean	Cycle Mean
RMS	Cycle RMS
Area	Cycle Area
Phase	Burst Width
Propagation Delay	Continuous update of up to four measurements on any combination of waveforms.

Measurement Thresholds – Settable in percentage or absolute voltage.

Gated Measurements – Any region of the record between the vertical bar cursors.

Measurement Snapshot – Performs all measurements on any one waveform showing results from one instant in time.

CURSORS

Cursor Types – Horizontal bars (volts); Vertical bars (time); operate tracking or independently.

Cursor Measurement Types – Absolute, delta; Volts, Time, Frequency; IRE and line number with video trigger option.

DISPLAY

Waveform Style – Dots or vectors. Infinite and variable persistence from 250 ms to 10 s.

Gray Scaling – With variable persistence selected, waveform points gradually decay through 16 levels of intensity, providing "z-axis" information about rapidly changing waveforms.

Color Grading – With variable persistence selected, waveform points gradually decay through the selected color spectrum, providing historical information.

Update Rate – Over 400,000 waveforms/sec with InstaVu™ selected (TDS 700A only). 150 waveforms/sec (TDS 500A and TDS 700A) or 100 waveforms/sec (TDS 600B) [500 point record length and infinite persistence selected].

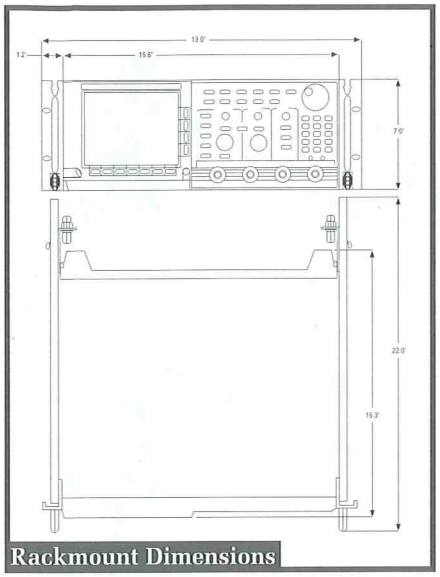
Graticules – Full, grid, cross hair, frame; NTSC and PAL with video trigger option.

Formats – YT and XY.

Fit to Screen – Display all points in the record on screen.

TDS Series Reference

TDS 500A Series • TDS 600B Series • TDS 700A Series



Rackmount Dimensions

CRT TYPES

Monochrome – 7 in. diagonal, magnetic deflection. Horizontal raster-scan. P4 white phosphor (TDS 520A, TDS 540A, TDS 620B, TDS 680B).

Color – 7 in. diagonal, NuColor™ liquid crystal shutter with 256 color levels (TDS 524A, TDS 644B, TDS 684B, TDS 744A, TDS 784A).

Resolution – 640 x 480 pixels for both monochrome and color displays.

ZOOM

Allows waveforms to be expanded, compressed and positioned in both vertical and horizontal axis. Allows precise comparison and study of fine waveform detail without affecting ongoing acquisitions. Zoom provides an effective vertical dynamic range of 1,000 divisions or 100 screens when used with Hi-Res or average mode.

Dual Window Zoom – Allows that portion of a waveform within the one or two zoom boxes to be displayed in a separate graticule (TDS 700A and 600B only).

TRIGGERING SYSTEM

Triggers – Main and Delayed.

Main Trigger Modes – Auto, Normal, Single.

Delayed Trigger – Delay by time and/or events.

Delay Time Range – 16 ns to 250 s (time/div ≤10 µs); 15.1 ns to 250 s (time/div ≥25 µs).

Delay Event Range – From 1 to 9,999,999 events.

External Trigger – >1.5 kΩ; Max input voltage is ±20 V (DC + peak AC). (Not available on the TDS 520A/524A).

TRIGGER TYPES

Edge		Conventional level driven trigger. Positive or negative slope. Coupling selections: DC, AC, noise reject, HF reject, LF reject.
Pulse	Width	Trigger on the width of a positive or negative pulse either within or not within selectable time limits: settable from 2 ns to 1 second.
	Glitch	Trigger on or reject glitches of positive, negative, or either polarity: Minimum detectable glitch width 2 ns settable with 200 ps resolution.
	Runt	Trigger on a positive, negative or either polarity pulse that crosses one threshold, but fails to cross a second threshold before returning across the first.
	Slew Rate (Selected models)	Trigger on a positive, negative or either edge that is slower than or faster than the selectable slew rate: settable from 1 ns to 1 second.
	Time Out (TDS 600B only)	Trigger on an event which remains high or low, for a user-specified time. Time range is settable from 1 ns to 1 s, with 200 ps resolution.
Logic	Pattern	Trigger on a logical combination (AND, OR, NAND, NOR) of the four input channels (Hi, Lo, Don't Care) when the pattern stays true or false for a user specified time: settable from 2 ns to 1 second.
	State	Trigger on a logical combination (AND, OR, NAND, NOR) of the three primary input channels (Hi, Lo, Don't Care) when the active clock edge (positive or negative slope) occurs on the clock channel.
	Setup/Hold Time (Selected models)	Trigger when the time between any transition of the defined data input occurs within the specified setup and hold time window when the active clock edge (positive or negative slope) occurs on the clock channel. Settable from –1 ns to +100 ns min $t_{su} + t_h = 2$ ns.
Video (Optional), NTSC, PAL, HDTV, FlexFormat™		Trigger on a specific line of individual field, odd/even or all fields. Trigger on a specific pixel of a line by using video trigger with delay by events. Choose horizontal SYNC polarity. Choose from popular HDTV formats (1125/60, 1050/60, 1250/50, 787.5/60) or use FlexFormat™ for other HDTV-type formats by defining frame rep rate, number of lines and fields and SYNC timing structure.

COMPUTER INTERFACE

GPIB (IEEE-488.2) Programmability – Full talk/listen modes. Control of all modes, settings and measurements.

HARD COPY/DESKTOP PUBLISHING

Printer Support – Tektronix Phaser™, HP ThinkJet, DeskJet, LaserJet, Epson, PostScript, DPU 411/412.

Plotter Support – HPGL.

Export File Formats – BMP, EPS, PCX, RLE, TIFF and Interleaf. MathCAD and spreadsheet on TDS 600B and TDS 700A.

I/O Ports – GPIB, Centronics, RS-232 (talk only). (Centronics and RS-232 are optional on the TDS 520A, TDS 540A, TDS 620B and TDS 680B.)

Floppy Disk Drive – 3.5 in. 1.44 MB DOS format. (Optional on the TDS 520A, TDS 540A, TDS 620B and TDS 680B.)

VGA Output – 15-Pin analog output. Monochrome or color, depending on instrument display type.

NON-VOLATILE STORAGE

Waveforms – 4 full length waveforms internally. 119,008 500-point waveforms on 1.44 MB diskette.

Setups – 10 front-panel setups internally. 78,947 setups on 1.44 MB diskette.

ENVIRONMENTAL AND SAFETY

Temperature – Operating: +4°C to +50°C (floppy not used); +10°C to +45°C (floppy in use). Nonoperating: –22°C to +60°C.

Humidity – Operating: To 80% RH at ≤32°C; Derates to 30% RH at +45°C. Nonoperating: To 90% RH at ≤40°C; Derates to 30% RH at +60°C.

Altitude – Operating: 15,000 ft. (4,573 m). Nonoperating: 40,000 ft. (12,195 m).

Electromagnetic Compatibility – Meets or exceeds VFG 243/1991 amended per VFG 46/1992; FCC 47 CFR, Part 15, Subpart B, Class A; EN 50081-1; and EN 50082-1.

Safety – Listed UL 1244; CSA-C22 No. 23; Tektronix self-certification to comply with IEC 348 recommendations.

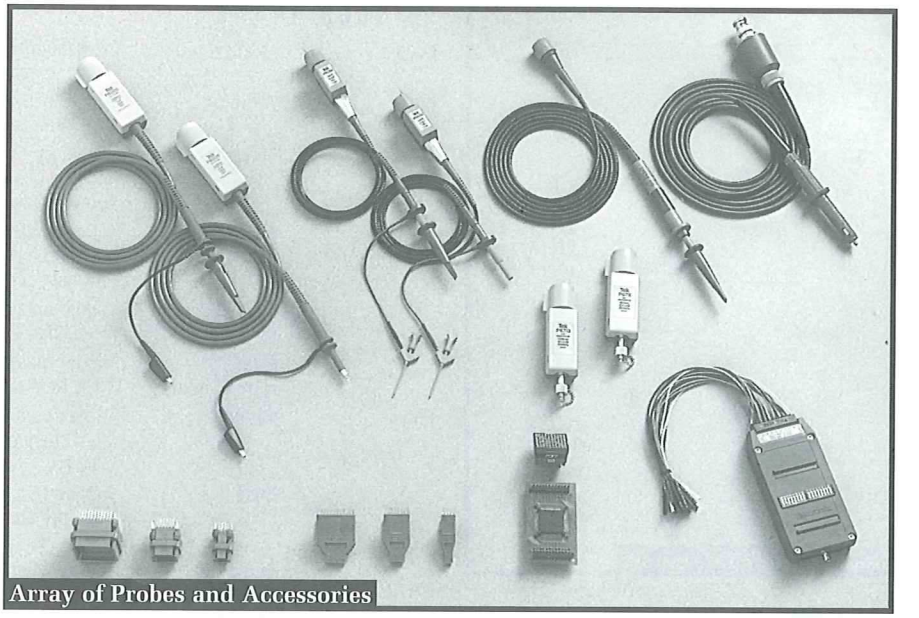
Power Requirements –
Line voltage range: 90 to 250 V RMS.
Line frequency: 45 to 440 Hz.
Power consumption: 300 W maximum.

TDS Series Reference

TDS 500A Series • TDS 600B Series • TDS 700A Series



The recommended instrument cart (K420) is designed specifically for the TDS Series instruments. It provides adjustable height, tiltable shelf and a large drawer for accessories.



Tektronix manufactures a large selection of probes ideally suited to the TDS instruments. Complementing these probes are accessories that make it easy to attach to today's modern circuits, including ICs in 25-mil and 20-mil QFP packages.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height with feet	236	9.3
Without feet	193	7.6
Width with handle	445	17.5
Depth with front cover installed	432	17.0
Weight	**kg**	**lb.**
Net approx.	12.3	27
Shipping approx.	20	44

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

RECOMMENDED ACCESSORIES – Also see page 434.

PROBES

Active Probes –
750 MHz. 2pF/1M, 10X, 1.5 m. Order P6205.
1 GHz. 10X, 1.5 m. Order P6243.
1.5 GHz, 1pF/1M, 10X, 1.5 m. Order P6245.

Passive Probes –
500 MHz, 8pF/10M, 10X, 1.3 m. Order P6139A.
500 MHz, 5pF/9.5M, 20X, 1.5 m. For Fine Pitch/Surface Mount Devices. Order P6563AS.

Differential Probes –
100 MHz, 10,000:1 CMRR, 1X/10X, 2 m. Order P6046.
100 MHz, –50 dB CMRR, 50X/100X. Order P5205.
1 MHz, 100,000:1 CMRR, 1X/10X/100X, Differential Amplifier. Order ADA400A.

High Voltage Probes –
2.5 kV, 250 MHz, 2.75 pF/10M, 100X. Order P5100.
20 kV, 75 MHz, 3pF/100M, 1000X, 3.1 m. Order P6015A.

Word Recognizer Probes – 20 MHz, 17-Bit TTL, 40 ns word. Order P6408.

Current Probes, AC Only –
120 Hz to 60 MHz, 7.5 A peak. Order P6021.
965 kHz to 120 MHz, 3 A peak. Order P6022.

Current Probes, AC and DC –
DC to 50 MHz, 20 A DC/50 A Peak. Order AM503S.

PLOTTERS/PRINTERS

Plotter – With GPIB and Centronics Interface. Order HC100 with Opt. 01.

Monochrome Printer – With Centronics Interface. Order HC220.

Color Printer – With RS-232, Centronics, AppleTalk. Order Phaser™ 140.

CART
Order K420.

U.S. Power Strip for K420 – Four Outlet, 6 ft., Noise/surge Suppression. Order 131-5342-01.

TRANSIT CASES

Soft-sided Carrying Case –
Order 016-0909-00.

Hard Transit Case – Order 016-1157-00.

Accessory Pouch – For any TDS 500/500A, 600/600B, or 700/700A Series Instrument. Order 016-1268-00.

QuickStart III Tutorial – Includes Lab Manual, Circuit Board and 9 V Power Source. With U.S. Power Cord. Order 020-2024-00. With Universal European Power Cord. Order 020-2025-00.

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GPIB IEEE-488 *The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.*

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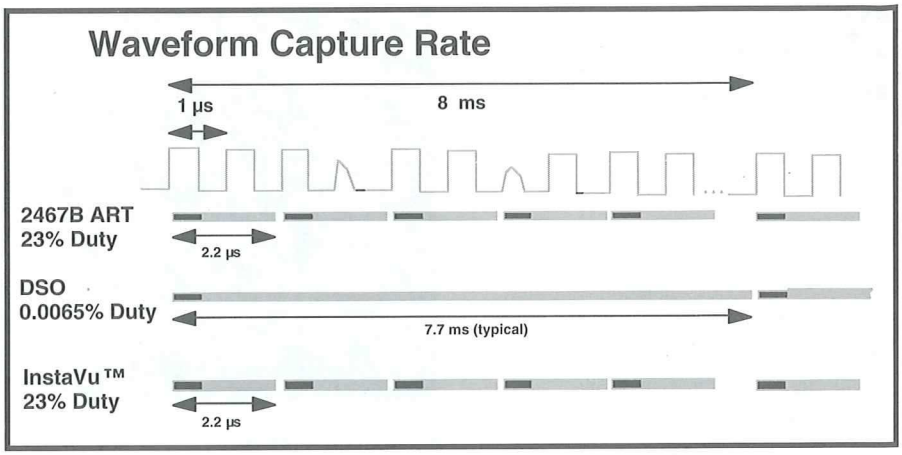
ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*

InstaVu™ Acquisition Mode

Features

InstaVu™ ACQUISITION

- Delivers the Fastest Waveform Capture Rate (400,000 wfms/sec)
- Instantaneous Capture of Glitches and Infrequent Anomalies in Fraction of the Time Relative to Non-InstaVu™ Acquisition DSOs
- Acquisition Rates on a DSO Faster than the Worlds Fastest Analog Oscilloscopes

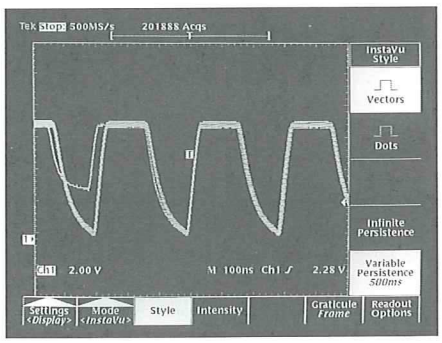


InstaVu™ Acquisition Mode

The TDS 700A family introduces InstaVu™ Acquisition mode which provides the world's fastest waveform capture rate. Prior to InstaVu™ Acquisition mode, sporadic signal events could only be captured with a Tektronix 2467B and 7104 with their Multi Channel Plate (MCP) display. The TDS 700A oscilloscopes with InstaVu™ Acquisition mode can capture waveforms even faster than the world's fastest analog scopes.

With waveform capture rates exceeding 400,000 waveforms per second, InstaVu™ allows you to instantaneously capture glitches and signal anomalies that could take hours for a state-of-the-art digitizing oscilloscope in persistence mode to capture or that would be completely missed by common analog scopes. Today's state-of-the-art DSOs can only capture a maximum of a couple hundred real-time waveforms per second, which translates to about an 8 ms hold-off between acquisitions or 0.0065%of the time actually spent on acquiring data. In comparison, InstaVu™ has a minimum hold-off between acquisitions of only 1.7 µs, which means that it is acquiring a signal 23% of the time – a 3500 times increase over a state-of-the-art DSO! Therefore, with InstaVu™ you will instantly capture glitches that you've either had to wait a long time for, or that you never knew existed.

A new button dedicated to InstaVu™ has been added to the enduring TDS front panel. This button instantly moves you between standard DSO acquisition modes and InstaVu™. Push the InstaVu™ button to instantly see what is going on in your system, and then push the button again to go back to standard DSO modes to isolate and analyze any anomalies found with InstaVu™ by using the TDS 700A's specialized triggers and advanced math. Like an analog scope, InstaVu™ provides a single screen of data, and it shows intensity information (relative occurrence of events) using color grading. Unlike an analog scope, InstaVu™ can perform automatic measurements and save screen images to disk or to a printer. Moreover, you also have the full utility of the world's most advanced digitizing oscilloscopes at the push of a button.











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See Tektronix on the World Wide Web: http://www.tek.com

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Digitizing Oscilloscopes

TDS 744A • TDS 784A

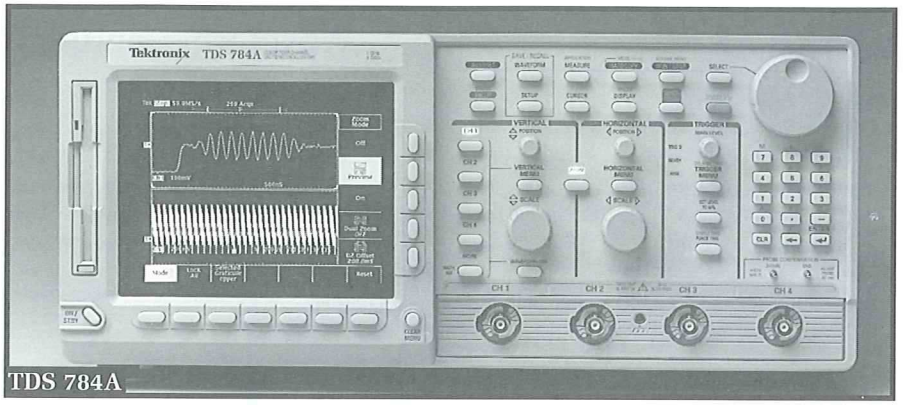
Features

TDS 744A/TDS 784A

- 1 GHz and 500 MHz Bandwidth
- Sample Rates to 4GS/s
- 4 Input Channels
- InstaVu™ Acquisition Mode
- Pulse Width, 1 ns Glitch, Runt, Pattern and State, Setup & Hold Violation, and Slew Rate Triggering
- HDTV Video Triggering
- 1 mV/div to 10 V/div Sensitivity
- Infinite and Variable Persistence Displays
- Record Lengths to 500,000 Points
- 8-Bit Vertical Resolution and up to 13-Bit Resolution with Hi-Res Acquisition Mode
- Vertical Accuracy to 1%
- FFT, Integration and Differentiation
- 25 Automatic Measurements
- High Resolution Color Monitor
- 3.5 in. DOS Format Floppy Drive
- VGA-Output to External Monitor
- Waveform Pass/Fail Testing
- 1 ns Peak Detect
- FastFrame™ Acquisition Mode
- 3 Year Warranty

Applications

- Digital Design and Debug
- Analog Design and Debug
- Research and Development



TDS 784A

Characteristics

SIGNAL ACQUISITION SYSTEM

	TDS 744A	TDS 784A
Channels	4	4
Samplers	4	4
Bandwidth	500 MHz	1 GHz
Maximum Sample Rate		
1 Channel	2 GS/s	4 GS/s
2 Channels	1 GS/s	2 GS/s
3, 4 Channels	500 MS/s	1 GS/s

MAXIMUM RECORD LENGTH

TDS 744A/784A	Standard	Optional
1 Channel	50,000 pts	500,000 pts
2 Channels	50,000 pts	250,000 pts
3, 4 Channels	50,000 pts	130,000 pts

TIME BASE SYSTEM

Time Bases – Main, Delayed.

Time/Division Range –
TDS 744A: 500 ps to 10 s/div.
TDS 784A: 200 ps to 10 s/div.

Time-base Accuracy – ±25 ppm over any interval ≥1 ms.

Pre-trigger Position – 0 to 100% of record.

Delay Between Channels – ≤50 ps between any two channels with equal V/div and coupling.

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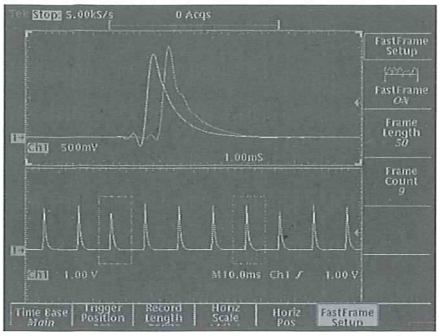
Test & Measurement World BEST IN TEST 1995 AWARD WINNER

EDN INNOVATION '94 GRAND WINNER

ELECTRONIC PRODUCTS 1994 PRODUCT OF THE YEAR AWARD

R&D 100

Digitizing Oscilloscopes
TDS 784A • TDS 744A



Dual window zoom is effective for managing the 500 K acquisition memory. FastFrame™ allows you to capture multiple events in a single record.

VERTICAL SYSTEM

DC Gain Accuracy – ±1.0%.

Vertical Resolution – 8-Bits (256 levels over 10.24 vertical divisions), >13-Bits with Hi-Res, 11-Bits with averaging.

Analog Bandwidth Selections – 20 MHz, 100 MHz, and full.

Input Coupling – AC, DC or GND.

Input Impedance Selections – 1 MΩ in parallel with 10 pF, or 50 Ω (AC and DC coupling).

Maximum Input Voltage – ±400 V (DC + peak AC). Derate at 20 dB/decade above 1 MHz. 1 MΩ or GND coupled.

Channel Isolation – >100:1 at 100 MHz and >30:1 at bandwidth for any two channels having equal V/div settings.

AC Coupled Low Frequency Limit – ≤10 Hz when AC 1 MΩ coupled. ≤200 kHz when AC 50 Ω coupled.

Effective Bits –
TDS 784A: 6.0-Bits (1 GHz at 4 GS/s), 9.3-Bits with Hi-Res (1 MHz at 25 MS/s).
TDS 744A: 6.6-Bits (500 MHz at 2 GS/s); 9.3-Bits with Hi-Res (1 MHz at 25 MS/s).

Step Response Setting – ≤0.5% error within 20 ns of a ≤2 V step.

Sensitivity – 1 mV to 10 V/div.

Position Range – ±5 Divisions.

Offset – ±1 V from 1 to 100 mV/div. ±10 V from 101 mV to 1 V/div. ±100 V from 1.01 to 10 V/div.

ACQUISITION MODES

1 ns Peak Detect, Sample, Single Sequence, Envelope, Average, Hi-Res, FastFrame™, InstaVu™ acquisition.

TRIGGERING SYSTEM

Triggers – Edge (main and delayed), Pulse (Width, 1 ns Glitch, Runt and Slew Rate), Logic (Pattern, State, and Setup & Hold Time Violation), HDTV Video (optional).

Main Trigger Modes – Auto, Normal, Single.

Delayed Trigger – Delay by time, events, or events and time.

DISPLAY

Monitor – 7 in. NuColor™ liquid crystal full-color shutter, 256 levels.

Waveform Style – Dots, vectors, variable persistence with color grading, infinite persistence, and intensified real samples.

Format – YT, XY, Zoom, Fit-to-Screen, Zoom, Dual Window Zoom.

Waveform Capture Rate –
InstaVu™ acquisition: >400,000 wfm/sec.
Infinite persistence (500 pts): 150 wfm/sec.

MEASUREMENT SYSTEM

Automatic Measurements – 25 (on entire record or in gated region).

Measurement Accuracy – TDS 744A: <80 ps typical @ 2 GS/s single shot; TDS 784A: <38 ps typical @ 4 GS/s single shot.

Cursors Measurements – Absolute, Delta; volts, time, frequency. NTSC IRE units and line number with video trigger option.

WAVEFORM PROCESSING

Waveform Functions – Interpolation (sin(x)/x or linear), Average, Envelope, Autosetup.

Advanced Waveform Functions – FFT, Integration, Differentiation, Waveform (math or acquired) Limit Testing.

Arithmetic Operations– Add, Subtract, Multiply, Divide, Invert.

HARDCOPY/DESKTOP PUBLISHING

Hardcopy Ports – GPIB, RS-232, Centronics.

Hardcopy Formats – Epson, ThinkJet, DeskJet, LaserJet, PostScript, TIFF, PCX, BMP, DPU 411/412, RLE, HPGL, Interleaf.

Floppy Drive – 3.5 in. 1.44 MB or 730 KB DOS compatible.

DATA FORMATS

MathCAD and spreadsheet.

COMPUTER INTERFACE

GPIB (IEEE 488.2) – Full Programmability.

AUXILIARY INPUTS/OUTPUTS

Video output (15-Pin VGA, full color); External Trigger input; Main and Delay Trigger outputs; CH 3 Signal output.

STORAGE

Waveform Storage – NVRAM: Four 50 K pt. waveforms. Two full 130 K pt., one full 250 K pt., or one compressed 500 K pt. waveform with Option 1M. 1.44 MB Floppy Disk: 1,436 50 K pt. to 119,008 500 pt. waveforms.

AutoSave – Automatic storage of single sequence waveforms to NVRAM.

Setup Storage – 10 front panel setups.

POWER REQUIREMENTS

Line Voltage Range – 90 to 250 V RMS.

Line Frequency – 45 to 440 Hz.

Power Consumption – 300 W.

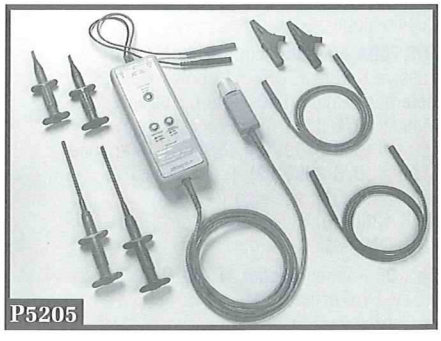
PROBES

Passive P6139A (Standard with TDS 744A) – 10 X, 8 pF, 500 MHz.

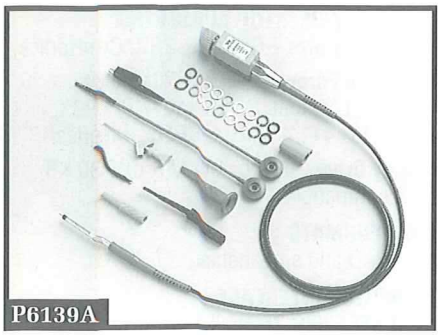
Accessory

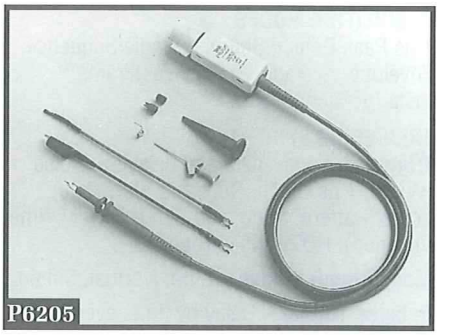
P5205

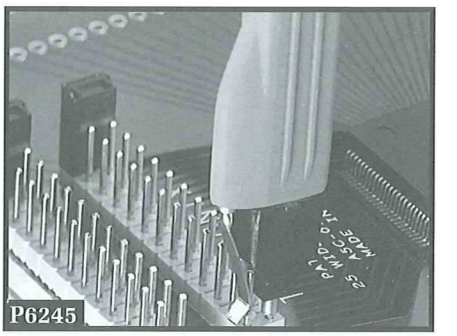
- 100 MHz Active Differential Probe
- Power from TEKPROBE™ Interface
- 1300 V Differential



Digitizing Oscilloscopes
TDS 784A • TDS 744A


P6139A


P6205


P6245

Accessory

P6139A
Passive Probing
- 500 MHz
- 10X, 8 pF/1 MΩ
- 1.3 m

Accessory

P6205
Active Probing
- 750 MHz
- 10X, 1 pF/1 MΩ
- 1.5 m

Accessory

P6245
Active SMD Probing
- 1 GHz (System TDS 784A)
- 10X, 1 pF/1 MΩ
- 1.3 m

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TDS 784A
Four-channel Color 1 GHz Digitizing Oscilloscope.

TDS 744A
Four-channel Color 500 MHz Digitizing Oscilloscope.

TDS 700A includes: Four each P6139A Passive Probes (TDS 744A only); Quick Reference Guide (070-8999-01); User Manual (070-8991-01); Programmer's Manual (070-8709-06); Technical Reference Manual (070-8990-02); Front Cover (200-3696-01); Accessory Pouch (016-1268-00); U.S. Power Cord (161-0230-01).

Opt. 05 – Video Trigger, NTSC, PAL, HDTV, FlexFormat™.

Opt. 1K – K420 Scope Cart.

Opt. 1M – 500 K Memory Length.

Opt. 1R – Rackmount.

Opt. 23 – (TDS 744A only) Additional Two each P6205 Active Probes.

Opt. 24 – (TDS 784A only) Four each P6139A 10 X Passive Probes.

Opt. 26 – (TDS 784A only) Four each P6245 Active Probes.

Opt. 3P – (110 V) Phaser® 140 Color Printer.

Opt 3I – (220 V) Phaser® 140 Color Printer.

Opt. 95 – NIST, MIL-STD-45332A, and ISO 9000 Calibration Certification.

Opt. 96 – Calibration Data.

RECOMMENDED ACCESSORIES
Also see pages 68 and 434.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – A5.

See General Customer Information Section for additional description.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*

Digitizing Oscilloscopes

New TDS 684B • TDS 680B • TDS 644B • TDS 620B

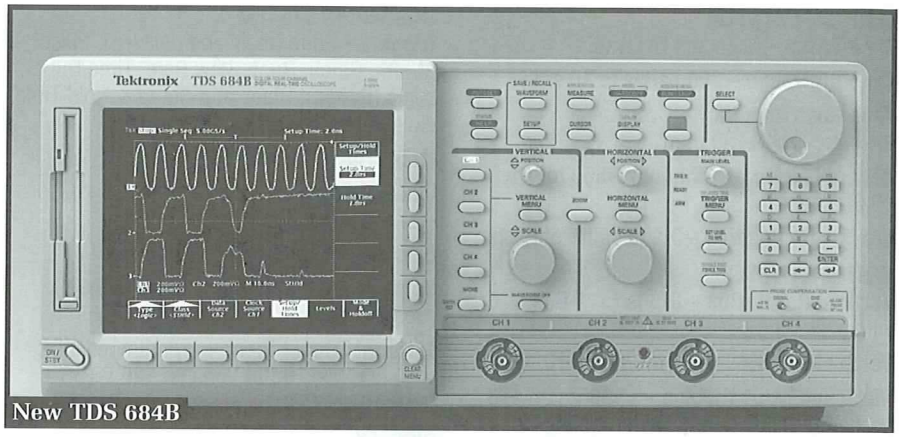
Features

TDS 684B/TDS 680B/
TDS 644B/TDS 620B

- 1 GHz and 500 MHz Bandwidth
- 5 GS/s and 2.5 GS/s Sample Rates
- 4 and 2 Input Channels
- 8-Bit Vertical Resolution
- Greater than 11-Bits with Averaging
- Record Length to 15,000 Points
- 1 mV/div to 10 V/div Sensitivity
- 1.5% Vertical Accuracy
- Waveform Math and Advanced Waveform DSP
- 1 ns Peak Detect
- Channel Deskew
- Fully Automated Measurement System
- Waveform Pass/Fail Template Testing
- Color VGA Display
- 3.5 in. DOS Format Floppy Drive
- RS-232, Centronics, GPIB and VGA I/O Ports

Applications

- Digital Design and Debug
- Telecommunications
- Transient Event Capture
- High Energy Physics



New TDS 684B

Your designs may be digital but at today's speeds, many of your toughest problems aren't. Crosstalk noise. Transmission effects. Ground bounce. Not to mention sub-nanosecond edges. Today's design problems require high bandwidth oscilloscopes that can measure up. The Digital Real-Time architecture of the TDS 600B Series simplifies capturing intermittent signals or non-recurring problems like glitches or metastables caused by setup and hold time violations.

Additional features and specifications of the TDS 600B Series are explained in the TDS Reference section beginning on page 57.

Characteristics

	TDS 620B	TDS 644B	TDS 680B	TDS 684B
Total Channels	2 + 2 aux.	4	2 + 2 aux.	4
Sample Rate (all channels simultaneously)	2.5 GS/s	2.5 GS/s	5 GS/s	5 GS/s
Real Time Bandwidth	500 MHz	500 MHz	1 GHz	1 GHz
Maximum Record Length per Channel	15,000 pts	15,000 pts	15,000 pts	15,000 pts
Vertical Resolution	8-Bits; >11-Bits with averaging			
Time Measurement Accuracy	<100 ps @ 2.5 GS/s	<100 ps @ 2.5 GS/s	<50 ps @ 5 GS/s	<50 ps @ 5 GS/s
Advanced Waveform DSP/Math	Opt.	Std.	Opt.	Std.
Standard Probes	2 P6243	4 P6243	None	None
Display Type	7 in. mono	7 in. color	7 in. mono	7 in. color
Disk Drive	Opt.	Std.	Opt.	Std.
GPIB Port	Std.	Std.	Std.	Std.
RS-232 & Centronics Printer Ports	Opt.	Std.	Opt.	Std.
VGA I/O Port	Std. Mono	Std. Color	Std. Mono	Std. Color

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*

Digitizing Oscilloscopes

New TDS 684B • TDS 680B • TDS 644B • TDS 620B

TIME BASE SYSTEM

Time Bases – Main and Delayed.

Time/div Range – 20 ps/div to 10 s/div.

Time Base Accuracy – Over Any Interval >1ms ±100 ppm.

Record Length per Channel – 500 to 15,000 pts.

Pre-Trigger Position – 0% to 100% of Record.

VERTICAL SYSTEM

Vertical Resolution – 8-Bits (>11-Bits with averaging).

Vertical Sensitivity – 1 mV/div to 10 V/div.

Maximum Input Voltage – ±400 V (DC + peak AC). Derate at 20 dB/decade above 1 MHz.

DC Gain Accuracy – 1.5%

Position Range – ±5 divs.

Offset – Primary channels: ±1 V from 1 to 99.5 mV/div, ±10 V from 100 mV to 995 mV/div, ±100 V from 1 V to 10 V/div. Aux. 1, Aux. 2 (TDS 620B, TDS 680B only): same as primary channels.

Bandwidth Selections – 20 MHz, 250 MHz, and Full.

Input Impedance Selections – 1 MΩ in parallel with 10 pF or 50 Ω (AC and DC coupling).

Input Coupling – AC, DC or GND.

AC Coupled Low Frequency Limit – <10 Hz when AC , 1 MΩ coupled. <200 kHz when AC, 50 Ω coupled.

Channel Isolation – >100:1 at 100 MHz and >30:1 at BW for any two channels having equal V/div settings.

ACQUISITION MODES

Peak Detect (TDS 620B, TDS 644B: 1 ns; TDS 680B, TDS 684B: <1 ns), Sample, Single Sequence, Envelope, Average.

TRIGGERING SYSTEM

Triggers – Edge (main and delayed); Pulse (Width, Glitch, Runt, Slew Rate, Time Out); Logic (Pattern, State, and Setup & Hold Time Violation); HDTV Video (optional).

Main Trigger Modes – Auto, Normal, Single.

Delayed Trigger – Delay by time, events, or events and time.

Delay by Time Range – 16 ns to 250 s.

Delay by Events Range – 1 to 9,999,999 events.

External Trigger Input – Input Impedance: ≥1.5 kΩ; Max. Input Voltage: ±20 V (DC + peak AC).

DISPLAY

Color CRT Monitor (TDS 644B/684B) – 7 in. diagonal NuColor™ liquid crystal full-color shutter, 256 levels.

Monochrome CRT Monitor (TDS 620B/680B) – 7 in. diagonal, magnetic deflection. Horizontal raster-scan. P4 white phosphor.

MEASUREMENT SYSTEM

Automatic Measurements – 25 (on entire record or gated region).

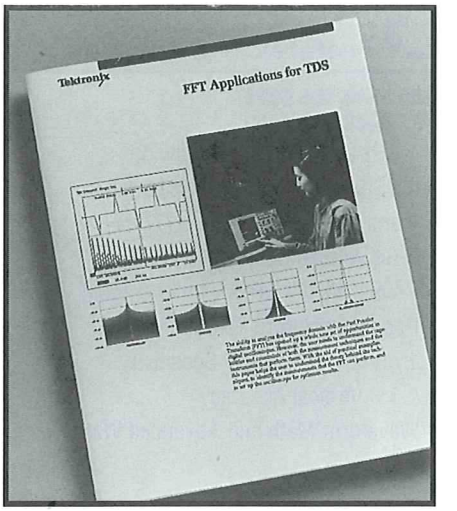
Measurement Accuracy – TDS 680B/684B: <50 ps typical @ 5 GS/s single shot; TDS 620B/644B: <100 ps typical @ 2.5 GS/s single shot.

Cursors Measurement – Absolute, Delta; volts, time, frequency, NTSC IRE units and line number with Video Trigger Option.

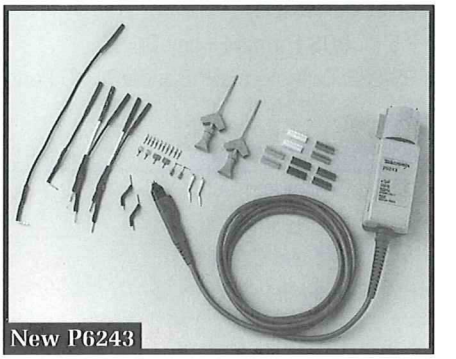
WAVEFORM PROCESSING

Waveform Functions – Interpolation (sin(x)/x or linear), Average, Envelope, Auto Setup.

Advanced Waveform Functions (Optional on TDS 620B/680B) – FFT, Integration, Differentiation, Waveform (math or acquired) Limit Testing.



A wide selection of application notes and technical briefs have been written to help ease your understanding and use of specific instrument features. Contact your local sales office for details.



Accessory

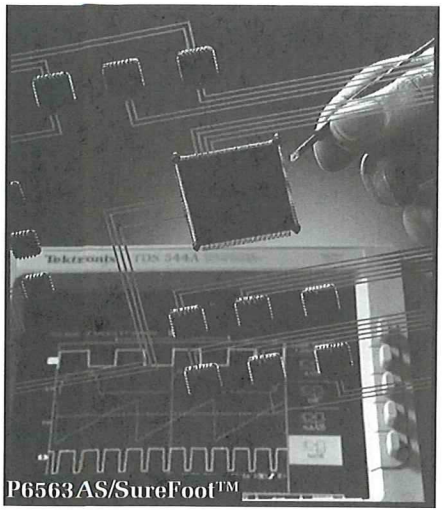
P6243

- Standard on TDS 620B and TDS 644B
- Active FET Probes for SMDs
- FET Probe performance at a lower cost
- <1 pF/1 MΩ provides lower circuit loading than conventional passive probes
- Low mass probe head/cable
- Wide bandwidth (DC to 1 GHz)

For complete selection information on all Accessory products, see page 434.

Digitizing Oscilloscopes

New TDS 684B • TDS 680B • TDS 644B • TDS 620B



Accessories

P6563AS

- Direct Access to SMD Packages
- SMD package support: 50 mil, 25 mil JEDEC, 0.65 mm, 0.5 mm EIAJ
- Low mass probe body and cable system
- DC to 500 MHz bandwidth, 5 pF/9.5 MΩ loading, 20X attenuation

SureFoot™

- Easier Access to SMT Circuitry
- Handheld probing made easier
- No shorting
- No slipping off
- Direct tip connection

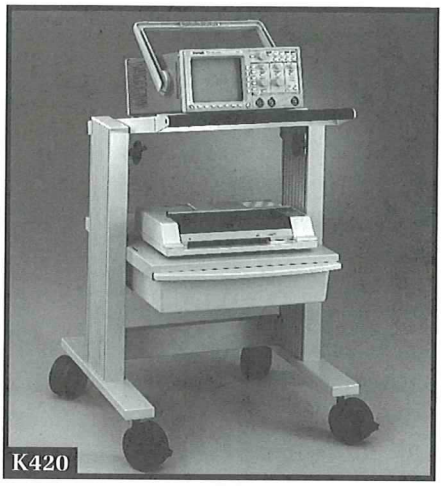
P6245

- Active FET Probe for SMDs
- Low DUT loading (≤1 pF/1 MΩ)
- Low mass probe head/cable
- 1.5 GHz bandwidth

For complete selection information on all Accessory products, see page 434.

K420 INSTRUMENT CART

- Ergonomic design
- Durable steel and aluminum construction
- Large diameter smooth-rolling casters
- Heavy duty nylon instrument straps
- Simple height, angle and shelf adjustment



ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TDS 684B
Four-channel Color 1 GHz, 5 GS/s Digital Real Time Oscilloscope.

TDS 680B
Two-channel Monochrome 1 GHz, 5 GS/s Digital Real Time Oscilloscope.

TDS 644B
Four-channel Color 500 MHz, 2.5 GS/s Digital Real Time Oscilloscope.

TDS 620B
Two-channel Monochrome 500 MHz, 2.5 GS/s Digital Real Time Oscilloscope.

All Include (except where noted):
Four Each P6243 FET Probes (TDS 644B); Two Each P6243 FET Probes (TDS 620B); User Manual (070-9383-00); Quick Reference Guide (070-9382-00) Programmer's Manual (070-9385-00); Technical Reference Manual (070-9384-00); Front Cover (200-3696-00); North American Power Cord (161-0230-01); Accessory Pouch (TDS 644B/TDS 684B: 016-1268-00).

Opt. 05 – Video Trigger, NTSC, PAL, HDTV, FlexFormat™.

Opt. 13 – (TDS 620B/680B only) RS-232C/Centronics Hardcopy Ports.

Opt. 1F – (TDS 620B/680B only) 3.5 in. 1.44 MB Floppy Drive.

Opt. 1K – Model K420 Instrument Cart.

Opt. 1R – Rackmount Kit.

Opt. 2D – (TDS 620B only) Delete Standard two P6243 Probes.

Opt. 24 – Add four P6139A 10X Passive Probes.

Opt. 26 – (TDS 684B only) Add four P6245 1.5 GHz, 1pF FET Probes.

Opt. 27 – (TDS 680B only) Add two P6245 1.5 GHz, 1 pF FET Probes.

Opt. 2F – (TDS 620B/680B only) Advanced Waveform DSP Math.

Opt 3I – (220 V) Phaser® 140 Color Printer.

Opt. 3P – (110 V) Phaser® 140 Color Printer.

Opt. 4D – (TDS 644B only) Delete Standard four P6243 Probes.

Opt. 95 – Calibration Data Report.

Opt. 96 – Calibration Certificate.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – UK 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.

See General Customer Information Section for additional description.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

PRODUCT UPGRADES

Disk Drive – 3.5 in., 1.44 MB DOS Format. For TDS 620/620A/620B, TDS 640/640A, TDS 680B. Order TDSXFIF.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*

Digitizing Oscilloscopes

TDS 540A • TDS 524A • TDS 520A

Features

TDS 540A/TDS 524A/TDS 520A

- 500 MHz Bandwidth
- Sample Rates to 1 GS/s
- 2 and 4 Input Channels
- Pulse Width, 2 ns Glitch, Runt, Pattern and State Triggering
- HDTV Video Triggering
- 1 mV to 10 V/div Sensitivity
- Infinite and Variable Persistence Displays
- Record Lengths to 50,000 Points
- 8-Bit Vertical Resolution and up to 12-Bit Resolution With Hi-Res Acquisition Mode
- 1% Vertical Accuracy
- FFT, Integration and Differentiation
- 25 Automatic Measurements
- 500 MHz Standard Probes (P6139A)
- Color Monitor
- 3.5 in. DOS Format Floppy Drive
- VGA-Output to External Monitor
- Waveform Pass/Fail Testing
- 3 Year Warranty

Applications

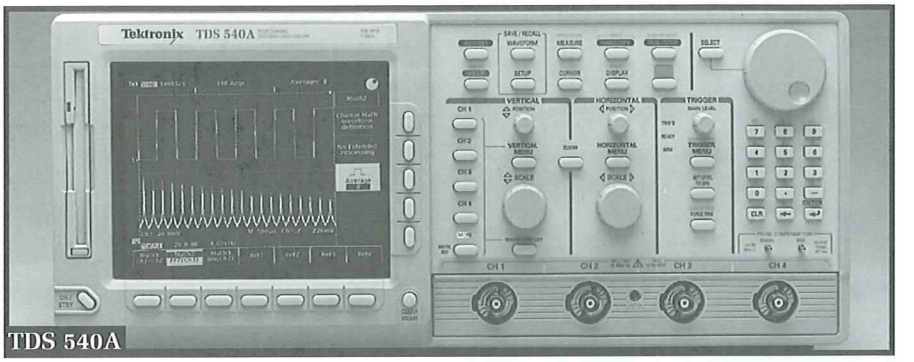
- Digital Design and Debug
- Analog Design and Debug
- Manufacture Testing
- Research

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*



TDS 500A Series

The TDS 500A is the world standard for digitizing oscilloscopes, having been awarded EDN magazine's prestigious 1993 Product of the Year award. The TDS 500A Series is excellent for circuit design, R&D, manufacturing test, and telecommunication applications.

Characteristics

SIGNAL ACQUISITION SYSTEM

	TDS 520A/524A	TDS 540A
Channels	2 + 2 auxiliary	4
Samplers	2	4
Bandwidth	500 MHz	500 MHz
Sensitivity		
CH 1, CH 2	1 mV to 10 V/div	1 mV to 10 V/div
CH 3, CH 4	–	Same as CH 1 and CH 2
AUX 1, AUX 2	100 mV, 1.0 V, 10 V/div	–
Position Range	±5 Divisions	±5 Divisions
Offset		
CH 1, CH 2	±1 V from 1 to 99.5 mV/div ±10 V from 100 mV to 995 ±100 V from 1 to 10 V/div	±1 V from 1 to 99.5 mV/div ±10 V from 100 mV to 995 ±100 V from 1 to 10 V/div
AUX 1, AUX 2		
CH 3, CH 4	–	Same as CH 1 and CH 2
AUX 1, AUX 2	100 ±5 V 1 V/div ±5.0 V; 10 V/div ±50 V	–

MAXIMUM SAMPLE RATE

	TDS 520A/524A	TDS 540A
Single Channel	500 MS/s	1 GS/s
Dual Channels	250 MS/s	500 MS/s
Four Channels		250 MS/s

CONFIGURATION

Feature	TDS 520A/540A	TDS 524A
Monitor	Mono	Color
VGA-Out	Mono	Color
Floppy Drive	Optional	Standard
DSP Math	Optional	Standard
RS-232 and Centronics	Optional	Standard

TIME BASE SYSTEM

Time Bases – Main, Delayed.

Time/Division Range – 500 ps to 10 s/div.

Time Base Accuracy – ±25 ppm over any interval ≥1 ms.

Record Length – TDS 520A/524A: 500 to 15,000 pts. (50 K pts. optional). TDS 540A: 500 to 50,000 pts.

Pre-Trigger Position – 0 to 100% of record.

Delay Between Channels – ≤250 ps (Any two channels with equal V/div and coupling).

VERTICAL SYSTEM

DC Gain Accuracy – ±1.0%.

Vertical Resolution – 8-Bits (256 levels over 10.24 vertical divisions). >12-Bits with Hi-Res mode, 11-Bits with averaging.

Analog Bandwidth Selections – 20 MHz, 100 MHz, and full (except Aux. 1 and Aux. 2 on TDS 520A/524A are full BW only).

Input Coupling – AC, DC or GND.

Digitizing Oscilloscopes
TDS 540A • TDS 524A • TDS 520A

Input Impedance Selections – 1 MΩ in parallel with 10 pF, or 50 Ω (AC and DC coupling).

Maximum Input Voltage – ±400 V (DC + peak AC). Derate at 20 dB/decade above 1 MHz. 1 MΩ or GND coupled.

Channel Isolation – >100:1 at 100 MHz and >30:1 at bandwidth for any two channels having equal V/div settings.

AC Coupled Low Frequency Limit – ≤10 Hz when AC 1 MΩ coupled. ≤200 kHz when AC 50 Ω coupled.

Effective Bits – 5.0 (500 MHz @ 1 GS/s). Hi-Res: 6.7 (1 MHz @ 20 MS/s).

Step Response Settling – ≤0.5% Error within 20 ns of a ≤2 V step.

ACQUISITION MODES
4 ns Peak Detect, Sample, Single Sequence, Envelope, Average, Hi-Res, and FastFrame™.

TRIGGERING SYSTEM
Triggers – Edge (main, delayed), Pulse (width, 2 ns glitch, and runt), Logic (pattern and state), HDTV Video Optional.

Main Trigger Modes – Auto, Normal, Single.

Delayed Trigger – Delay by time , events, or events and time.

External Rear Input – (except TDS 520A/524A) >1.5 kΩ; Max input voltage is ±20 V (DC + AC peak).

DISPLAY
Waveform Style – Dots, vectors, variable persistence (color graded with TDS 524A, grey scaled with TDS 520A/540A), infinite persistence, and intensified real samples.

Waveform Capture Rate – (For 500 point waveforms with infinite persistence display mode selected) 130 waveforms per sec.

Format – YT, XY, ZOOM, and Fit-to-Screen.

Monochrome CRT Type (TDS 520A/540A) – 7 in. diagonal, magnetic deflection. Horizontal raster-scan. P4 White phosphor.

Color CRT Type (TDS 524A only) – 7 in. diagonal NuColor™ liquid crystal full-color shutter with 256 levels.

MEASUREMENT SYSTEM
Automatic Waveform Measurements – 25 (on entire record or in gated region).

Time Measurement Accuracy –
TDS 540A: <160 ps @ 1 GS/s.
TDS 520A/524A: <305 ps @ 500 MS/s.

Cursor Measurements – Absolute, Delta; volts, time, frequency. NTSC IRE units and line number with video trigger option.

WAVEFORM PROCESSING
Waveform Functions – Interpolation (sin(x)/x or linear), Average, Envelope, Autosetup.

Advanced Waveform Functions (Optional on TDS 520A/540A) – FFT, Integration, Differentiation, Waveform (math or acquired) Limit Testing.

Arithmetic Operations– Add, Subtract, Multiply, Divide, Invert.

HARDCOPY/DESKTOP PUBLISHING
Auxiliary Inputs/Outputs – Video output (15-Pin VGA, full color on TDS 524A, mono on TDS 520A/540A); External Trigger input; Main and Delay Trigger outputs; CH 3 Signal output (TDS 540A only).

Hardcopy Ports – GPIB, RS-232, Centronics.

Hardcopy Formats – Epson, ThinkJet, DeskJet, LaserJet, PostScript, TIFF, PCX, BMP, DPU 411/412, RLE, HPGL, Interleaf.

Floppy Drive (optional on TDS 520A/540A) – 3.5 in. 1.44 MB or 730 kB DOS compatible.

COMPUTER INTERFACE
GPIB (IEEE 488.2) – Full Programmability.

STORAGE
Waveform Storage – NVRAM: Four 50 K pt. waveforms. 1.44 MB Floppy Disk: 1,436 50 K pt. to 119,008 500 pt. waveforms.

Setup Storage – 10 front panel setups.

POWER REQUIREMENTS
Line Voltage Range – 90 to 250 V RMS.

Line Frequency – 45 to 440 Hz.

Power Consumption – 300 W.

PROBES
Passive P6139A –
10 X, 8 pF, 500 MHz.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TDS 540A
Four-channel Digitizing Oscilloscope.

TDS 524A
Two-channel Color Digitizing Oscilloscope.

TDS 520A
Two-channel Digitizing Oscilloscope.
All include: Four Each P6139A 10X Passive Probes (TDS 540A); Two P6139A 10X Passive Probes (TDS 524A/TDS 520A); Quick Reference Guide (070-8711-02); User Manual (070-8710-01); Programmer's Manual (070-8709-01); Performance Verification Document (070-8712-01); Front Cover (200-3696-00); U.S. Power Cord (161-0230-01).

Opt. 05 – HDTV Video Trigger.

Opt. 13 – (TDS 540A/TDS 520A only) RS-232/Centronics Hardcopy Port.

Opt. 1F – (TDS 540A/TDS 520A only) 3.5 in. 1.44 MB Floppy Disk Drive.

Opt. 1K – K420 Scope Cart.

Opt. 1M – (TDS 524A/TDS 520A only) 50 K Point Record Length.

Opt. 1R – Rackmount Kit.

Opt. 2D – (TDS 524A/TDS 520A only) Delete Two Standard P6139A Probes.

Opt. 2F – (TDS 520A/TDS 540A only) Advanced Waveform DSP Math.

Opt. 4D – (TDS 540A only) Delete Four Standard P6139A Probes.

Opt. 22 – (TDS 524A/TDS 520A only) Add Two Each P6139A Probes.

Opt. 23 – Add Two P6205 Probes.

Opt. 3P – (110V) Phaser® 140 Color Printer.

Opt. 3I – (220V) Phaser® 140 Color Printer.

Opt. 95 – Calibration Certificate.

Opt. 96 – Calibration Data.

RECOMMENDED ACCESSORIES – Also see page 434.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

INTERNATIONAL POWER PLUG OPTIONS
See General Customer Information Section for additional description.

PRODUCT UPGRADES
DSP Math – FFT, Integration, Differentiation TDS 500A/TDS 500. Order TDS5F2F.

Hardcopy Ports – RS-232/Centronics TDS 500A/TDS 500. Order TDS5F13.

Disk Drive – 3.5 in. Floppy TDS 500A. Order TDSXFIF.

Video Trigger – TDS 500A. Order TDS5F05.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.*

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*

Digitizing Oscilloscopes

New TDS 460A • New TDS 420A • New TDS 410A

Features

TDS 410A/TDS 420A/TDS 460A

- 200 and 400 MHz Bandwidths
- 100 MS/s Sampling Rate on 4 Channels
- 30 K Records Standard, 120 K Optional
- 3.5 inch DOS format floppy drive
- 1.5% Accuracy 1 – 10 V/div
- Proprietary Hi-Res Mode for up to 12-Bits of Single Shot Vertical Resolution
- Extended Waveform Math/FFT (Option)
- 10 ns Peak Detect Mode for Glitch Capture
- 25 Automatic Measurements
- Pass/Fail (Template) Waveform Testing
- Roll and Triggered Roll Modes
- RS-232 and Centronics Type Interfaces
- Tek Secure®

DIFFERENTIAL MEASUREMENTS

- ADA400A Analog Differential Amplifier (10 µV/div sensitivity)
- P5200/P5205 High Voltage Differential Probes (up to 1300 V) for Floating Measurements

(Please see pages 493 and 494 for details on ADA400A, P5200 and P5205)

Applications

- Biophysical Research
- Biomedical Research
- Electrophysical and Electromechanical System Design
- Audio System Measurement and Analysis
- Manufacturing Test and Quality Control
- Power Supply and Power-related Design
- Product Service and Maintenance

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

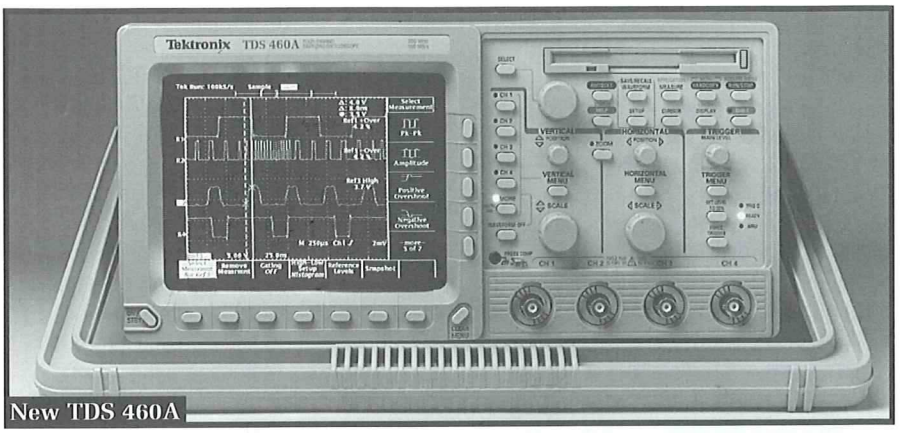
GPIB IEEE-488

Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

See Tektronix on the World Wide Web: http://www.tek.com

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Tektronix Measurement products are manufactured in ISO registered facilities.



The TDS 460A 400 MHz, four channel, Personal Lab Scope.

TDS 400A Personal Lab Oscilloscopes

For professionals who demand high precision and fidelity from their measurements, the TDS 400A Personal Lab Scopes combine excellent performance and a broad feature set, all at affordable prices. A choice of 2 and 4 channel models ranging from 200 MHz to 400 MHz with 100 MS/s on all channels makes the TDS 400A Series a worthy fit for a variety of demanding applications.

Characteristics

SIGNAL ACQUISITION SYSTEM

Bandwidth – 200 MHz (TDS 410A, TDS 420A), 350 MHz (TDS 460A).

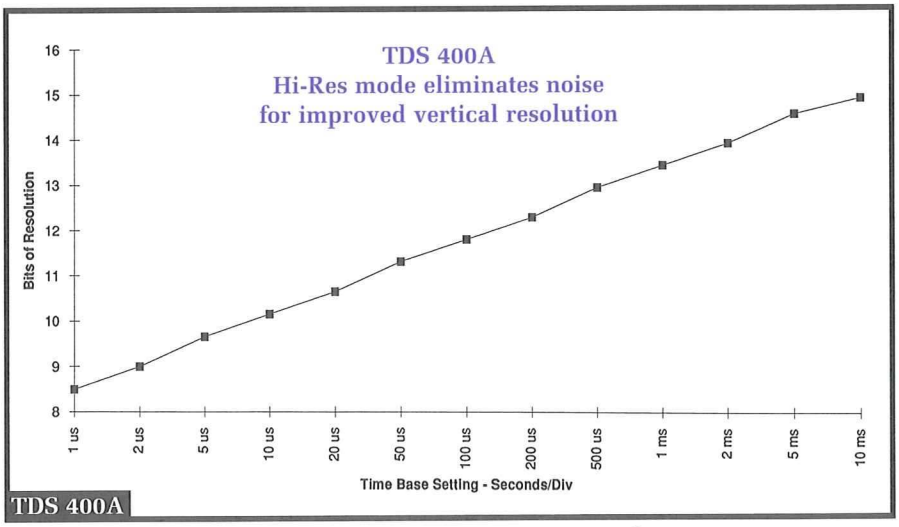
Channels – 4 (2 on TDS 410A).

Digitizers – 4 (2 on TDS 410A).

Sample Rate – 100 MS/s on all channels.

Sensitivity – 1 mV to 10 V/div (with calibrated fine adjust).

Position Range – ±5 Divisions.



Theoretically achieveable resolution with TDS 400A Hi-Res Mode.

Digitizing Oscilloscopes

New TDS 460A • New TDS 420A • New TDS 410A

Offset Range – ±1 V from 1 to 99.5 ; ±10 V from 100 mV to 995 ; ±100 V from 1 to 10 V/div.

DC Gain Accuracy – ±1.5%.

Vertical Resolution – 8-Bits (256 levels over 10.24 vertical divisions).

Analog Bandwidth Selections – 20 MHz, 100 MHz, and full.

Input Coupling – AC, DC or GND.

Input Impedance Selections – 1 MΩ in parallel with 15 pF, or 50 Ω (AC and DC coupling).

Maximum Input Voltage – ±400 V (DC + peak AC). Derate at 20 dB/decade above 1 MHz. 1 MΩ or GND coupled.

Channel Isolation – >100:1 at 100 MHz for any two channels.

AC Coupled Low Frequency Limit – ≤10 Hz when AC 1 MΩ coupled. ≤200 kHz when AC 50 Ω coupled.

ACQUISITION MODES

Peak Detect – High frequency and random glitch capture. Captures glitches of 10 ns using acquisition hardware at all real-time sampling rates.

Sample – Sample data only.

Envelope – Max/min values acquired over one or more acquisitions, selectable from 2 to 2000, infinite.

Average – Waveform averages selectable from 2 to 10,000.

Hi-Res – Vertical resolution improvement and noise reduction on low-frequency signals, e.g. 12-Bits at 10 ms/div and slower. Enhanced vertical resolution (>12-Bits) for noise reduction, on low frequency signals. Make precise low-level signal measurements (up to 5 µV) with differential amplifier (ADA400A).

TIME BASE SYSTEM

Time Bases – Main, Delayed.

Time/Division Range – 1 ns to 20 s/div.

Time Base Accuracy – 0.005% over any interval ≥1 ms.

Record Length (real time and equivalent time) – Sample points per channel: 500 to 15,000. Opt. 1M offers 60,000 points.

Pre-Trigger Position – Selectable from 0 to 100% of record.

TRIGGERING SYSTEM

Triggers – Main, Delayed.

Main Trigger Modes – Auto, Normal, Single Sequence.

Delayed Trigger – Delayed by time or events.

Time Delay Range – 0 ns to 20 s.

Events Delay Range – 2 to 10,000,000 events.

External Rear Input – >1.5 kΩ; Max input voltage is ±6 V (DC + AC peak).

Video Trigger Types – NTSC, PAL, SECAM, and Custom; TV Field, field 2 or both, Any line within a field. Line Rates –10 kHz to 64 kHz, interlaced, non-interlaced, composite.

Video Trigger Sensitivity – 0.6 divisions of composite SYNC will achieve a stable display.

DISPLAY

Waveform Style – Dots or vectors. Infinite and variable persistence from 250 ms to 10 s.

Gray Scaling – With variable persistence selected, waveform points gradually decay through 16 levels of intensity, providing "z-axis" information about rapidly changing waveforms.

Update Rate – 200 ea. 500 point waveforms per sec with infinite persistence mode selected.

Graticules – Full, grid, cross hair, frame.

Format – YT and XY.

VGA Out – Drives VGA display monitors.

ZOOM

The zoom feature allows waveforms to be expanded, compressed and positioned in both vertical and horizontal axes. Allows precise comparison and study of fine waveform detail without affecting ongoing acquisitions. When used with Hi-Res or Average acquisition modes, Zoom provides an effective vertical dynamic range of 1000 divisions or 100 screens.

MEASUREMENT SYSTEM

Automatic waveform measurements –

Period	Frequency
High	Low
+ Width	– Width
Maximum	Minimum
Rise	Fall
Peak to Peak	Amplitude
+ Duty cycle	– Duty cycle
+ Overshoot	– Overshoot
Propagation delay	Burst Width
Mean	Cycle Mean
RMS	Cycle RMS
Area	Cycle Area
Phase	

Continuous update of up to four measurements on any combination of waveforms.

Thresholds – Settable in percentage or voltage.

Gated – Any region of the record may be isolated for measurement using vertical bars.

Snapshot – Performs all measurements on any one waveform showing results from one instant in time.

Cursor Measurements – Absolute, Delta, Volts, Time, Frequency.

Cursor Types – Horizontal bars (volts); Vertical bars (time); paired; operated independently or in tracking mode.

WAVEFORM PROCESSING

Waveform Functions – Interpolate-selectable sin(x)/x or linear, Average, Envelope.

Advanced Waveform Functions – FT, Integration, Differentiation (optional).

Arithmetic Operators – Add, Subtract, Multiply, Invert.

Autosetup – Single button, automatic setup on selected input signal for vertical, horizontal and trigger systems.

Waveform Limit Testing – Compares incoming waveform to a reference waveform's upper and lower limits.

COMPUTER INTERFACE

GPIB (IEEE 488.2) Programmability – Full talk/listen modes. Control of all modes, settings, and measurements.

HARDCOPY/DESKTOP PUBLISHING

Printer – HP ThinkJet, Epson, PostScript, Interleaf, DeskJet, LaserJet, TIFF, PCX, BMP (Microsoft Windows).

Plotter – HPGL.

Interface – GPIB standard.

Optional Hardcopy Interface – Centronics Type and RS-232.

Optional Printer Pack – 4 in. thermal printer and storage pouch.

STORAGE

Waveforms – 30,000 waveform points of non-volatile storage, 120,000 points optional.

Floppy Drive – 3.5 in. 1.44 MB or 720 KB DOS compatible (store waveforms, screen data, and setups)*1

Setups – 10 front-panel setups.

CRT

Type – 7 in. diagonal, magnetic deflection. Horizontal raster-scan. P31 green phosphor.

Resolution – 640 horizontal by 480 vertical displayed pixels.

*1 *Waveforms can be stored to file in MathCAD and Spreadsheet (Excel, Lotus 1-2-3) formats for analysis.*

Digitizing Oscilloscopes

New TDS 460A • New TDS 420A • New TDS 410A

POWER REQUIREMENTS

Line Voltage Range – 90 to 250 V RMS.

Line Frequency – 48 to 63 Hz.

Power Consumption – 240 W max.

**1 Waveforms can be stored to file, in MathCAD and spreadsheet (Excel, Lotus 1-2-3) format for analysis.*

ENVIRONMENTAL AND SAFETY

Temperature – Operating: 0°C to +50°C. Nonoperating: –40°C to +75°C.

Humidity – Operating and nonoperating: Up to 95% relative humidity at or below +40°C; to 75% relative humidity from +41°C to +50°C.

Altitude – Operating: 15,000 ft., nonoperating: 40,000 ft.

Electromagnetic Compatibility – Meets MIL-STD-461C, CE-03, Part 4, Curve # 1, RE-02, Part 7; meets VDE 0871, Category B, FCC rules and regulations, Part 15, Subpart J, Class A.

Safety – Listed UL 1244, certified to CAN/CSA – C22.2 No. 231-M89; Tektronix self-certification to comply with IEC 348 recommendations.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	164	6.4
w/acc. pouch	177	7.5
Width	362	14.25
Depth		
w/front cover installed	491	19.25
w/handle extended	576	22.2
Weight	**kg**	**lb.**
Net ≈	9.1	22.5
Shipping ≈	12.5	32

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TDS 410A
Two-Channel, 200 MHz Digitizing Oscilloscope.

TDS 420A
Four-Channel, 200 MHz Digitizing Oscilloscope.

TDS 460A
Four-Channel, 400 MHz Digitizing Oscilloscope.
All include: Probe (2 P6138 10X Passive Probes); Reference Manual (070-8035-03); User Manual (070-8034-03); Programmer's Manual (070-8709-07); Performance Verification Document (070-8721-02); U.S. Power Cord (161-0230-01).

INSTRUMENT OPTIONS

Opt. 1K – K212 Cart.

Opt. 1M – 120,000 Point Record Length.

Opt. 1R – Rack Mount.

Opt. 02 – Front Cover and Accessories Pouch.

Opt. 1F – 3.5 in. DOS Floppy Drive.

Opt. 2A – Video Trigger and 120,000 Point Record Length.

Opt. 2F – Extended Waveform Math; FFT, Integration, Differentiation.

Opt. 3P – Printer Pack with Thermal Printer and RS-232C/Centronics Interfaces.

Opt. 05 – Video Trigger with Video Clamp Pod.

Opt. 13 – RS-232C and Centronics Hardcopy Interfaces.

Opt. 22 – Two Additional P6138 Probes.

Opt. 28 – ADA400A Analog Differential Amplifier.

Opt. 95 – NIST, MIL-STD-45662A and ISO 9000 Calibration Data Report.

Opt. 96 – Calibration Certificate.

Opt. J2 – 2 year Post Warranty Repair.

Opt. J5 – 5 year Calibration Services.

PROBES

Differential Probes –
100 MHz, –50 dB CMRR, 50X/100X. Order P5205.

High Voltage Probes –
2.5 kV, 25 MHz, 2.75 pF/10M, 100X. Order P5100.
20 kV, 75 MHz, 3pF/100M, 1000X, 3.1 m. Order P6015A.

High Voltage Differential Probe –
Up to 1300 V, 25 MHz. Order P5200.
Up to 1300 V, 100 MHz. Order P5205.

Passive Probe 1x – Order P6101B.

Passive Probe – Order P6138.

FET Probe – Order P6205.

SMT Probe – Order P6562A.

TTL Logic Probe – Order P6408.

Optical Converters –
500nm to 950nm. Order P6711.
1100 nm to 1700nm. Order P6713.

DC/AC Current Probe System – Order AM 503S.

RECOMMENDED ACCESSORIES – **See page 434**

Analog Differential Amplifier –
10 µV sensitivity. Order ADA400A.

Current Measurement Capability –
Order TDS 400A and AM 503S.

Plotter – GPIB and Centronics Standard. Order HC100.

Scope Cart – Order K212.

Rackmount Kit – Order 016-1166-00.

Soft-sided Carrying Case – Order 016-1158-00.

Transit Case – Order 016-1157-00.

SOFTWARE SUPPORT

DocuWave® – Data Management Software. Order S60DWAV.

LabWindows® – Order S3FG910.

CABLES

GPIB – 1 meter. Order 012-0991-01.
2 meters. Order 012-0991-00.

Service Manual.

INTERNATIONAL POWER OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – UK 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.
International power options required on instruments and selected accessories for operation outside U.S. For operation outside U.S., specify A1-A5 power options.
See General Customer Information Section for description.

WARRANTY INFORMATION

Three years warranty, covering all labor and parts, including CRT, and excluding probes.

REP 4400 – 1 Year Repair Protection.

CAL 4400 – 1 Year Calibration Service.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

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Personal Lab Scope Solutions

ADA400A • P5200 • AM 503S

Features

ADA400A DIFFERENTIAL PREAMPLIFIER

- 10 µV Sensitivity (with 12-Bits Resolution in Hi-Res Mode)
- Input R = 1 MΩ or Selectable for ∞
- CMRR: DC – 10 kHz, 100 dB (100,000:1); 100 kHz: 90 dB (31,000:1)

P5200 FLOATING MEASUREMENTS

- Maximum Differential Input Voltage: 1300 V
- Input R = 4 MΩ Each Input
- CMRR: DC: 60 dB (1,000:1); 1 MHz: 40 dB (100:1)
- Safety: UL 1244, CSA C22.2, IEC 1010
- No More Floating Your Scope
- Safe for User and DUT

AM 503S CURRENT MEASUREMENT SYSTEM

- DC to 50 MHz (20 A Continuous/100 A Peak) with A6302 Probe
- DC to 15 MHz (100 A Continuous/500 A Peak) with A6303 Probe
- DC to 2 MHz (500 A Continuous) with A6304XL Probe

Applications

BIOPHYSICAL/BIOMEDICAL
ADA400A Differential Preamplifier

- Medical/Biophysical Research
- Mechanical Analysis
- Medical Equipment Design
- Audio Design

DIFFERENTIAL INPUT
P5200 High Voltage Floating Measurements

- Switching Power Supply Design
- Control System Design
- Electric Vehicle Design
- Motor Drive Design

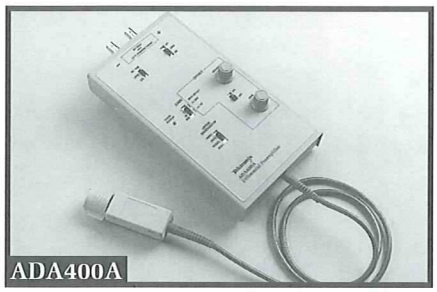
CURRENT MEASUREMENT SYSTEMS

- Broad Range of Current Measurements
- AC/DC Current

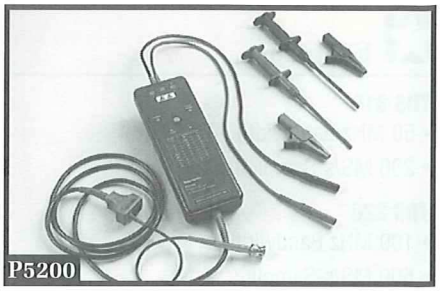
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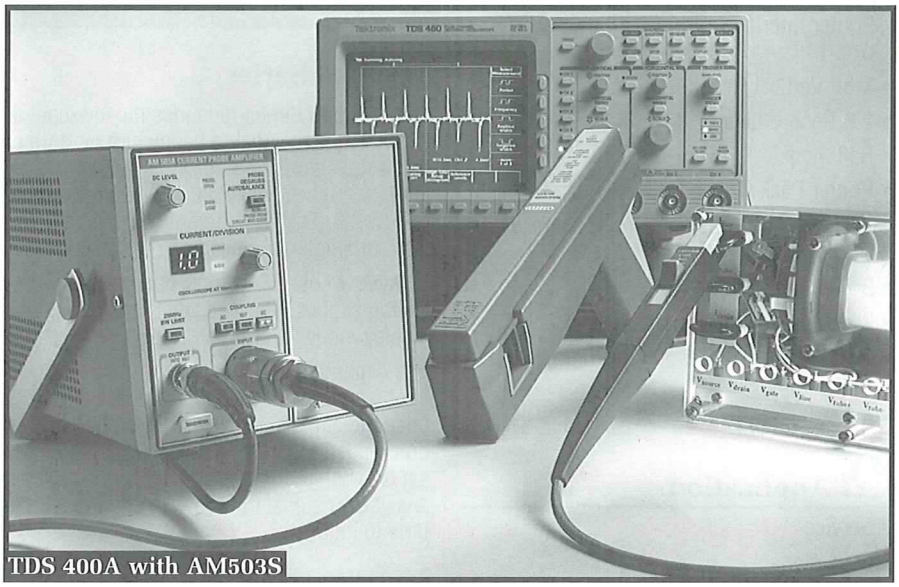
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ADA400A

The TDS 400A and ADA400A Analog Differential Amplifier enable microvolt signal measurements (10 µV/div sensitivity) in noisy environments. This combination is well suited for bioscience and mechanical research applications. (See page 493 for details.)


P5200

The TDS 400A and P5200 high voltage differential probe combination ensures safe floating measurements up to 1300 V. This combination eliminates the dangerous practice of floating an oscilloscope when making certain high voltage measurements. (See page 494 for details.)


TDS 400A with AM503S

The TDS 400A Digitizing Oscilloscopes and AM 503S Current Probe System. The AM 503S and TDS 400A combination are well suited for measuring currents in switching supplies.

Digital Real Time Oscilloscopes

TDS 310 • TDS 320 • TDS 350

Features

TDS 310
- 50 MHz Bandwidth
- 200 MS/s Sampling Rate

TDS 320
- 100 MHz Bandwidth
- 500 MS/s Sampling Rate

TDS 350
- 200 MHz Bandwidth
- 1 GS/s Sampling Rate

COMMON FEATURES
- Two Input Channels
- 2 mV to 10 V/div
- GPIB/RS-232 Programmability, Parallel Printer Interface and VGA Output with Opt. 14
- 8-Bit Vertical Resolution
- 1 K Record Length
- Roll Mode
- Printer Pack Option
- Vector Accumulate and Dot Accumulate Display Modes
- 2% Vertical Accuracy
- 21 Automatic Measurements
- 10 ns Peak Detect Mode for High-speed Glitch Capture
- Autosetup

Application

- Service
- Education
- Design
- Manufacturing Test

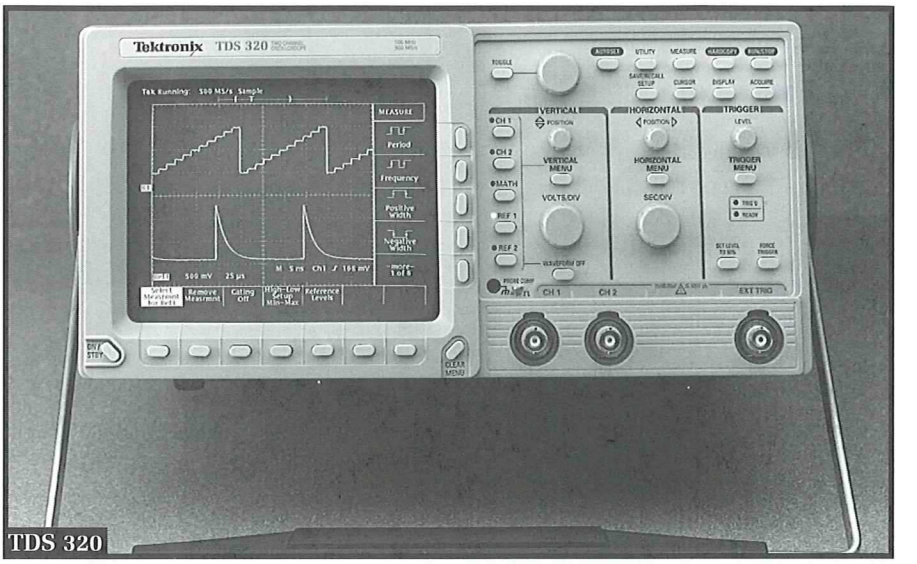
Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

The TDS Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

See Tektronix on the World Wide Web: http://www.tek.com

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TDS 320

TDS 300 Series

The TDS 300 Series redefines the low-cost digital oscilloscope. By sampling the signal at up to five times the analog bandwidth on both channels simultaneously, you can be assured of true acquisitions, minimizing aliasing or other digital sampling effects. Unlike other DSOs, the TDS 300 Series easily gathers enough samples to display waveforms accurately to their full bandwidth. They are the only scopes in their class that can reliably acquire high-speed transient or single-shot events to their fastest sweep speed.

Many low-cost DSOs offer only dot displays, which can be hard to interpret by those used to analog scopes. The TDS 300 Series has Dot, Dot Accumulate, Vector, and Vector Accumulate display modes – another advantage over the competition.

The Accumulate modes gather multiple waveforms for a user-defined time (500 ms to ∞), after which the screen is cleared. Vector Accumulate mode uses bright vectors to superimpose the current acquisition over the accumulated waveforms. Dot accumulate mode is recommended for viewing video and other complex waveforms. The display is erased at the time set or when the acquisition setting is changed. These modes are useful for doing worst-case analysis or signal monitoring. Long-term monitoring may be done easily by setting the erase time to infinity.

OVERSAMPLING MINIMIZES ALIASING

When aliasing occurs, the scope displays a waveform record with a lower frequency than the actual input signal. Aliasing occurs because the oscilloscope cannot acquire the signal fast enough to construct an accurate waveform record. To acquire a signal, it must be sampled at least twice as fast as the highest frequency component. For example, with a 500 MS/s sampling rate, the TDS 320 gathers two and a half times the number of samples needed to acquire a 100 MHz signal in real-time, assuring users of accuracy up to the fastest sweep speed. This degree of oversampling not only minimizes aliasing, it provides a higher resolution waveform.

ACQUISITION POWER

With edge triggering and basic video triggering as standard features, the TDS 300 Series can capture the waveforms that designers and service technicians most need to see. In addition to 21 automatic waveform measurements, the TDS 300 Series offers four acquisition modes: Sample, Peak Detect, Envelope, and Average. Sample mode provides real-time sampling and has the highest throughput rate. Peak Detect locates glitches as small as 10 ns and reveals aliasing. Envelope mode, by including the highest and lowest points over many acquisitions, shows variations in the signal over time. Average mode uses several acquisitions to calculate an average value for each waveform point, reducing random noise in repetitive signals.

Digital Real Time Oscilloscopes

TDS 310 • TDS 320 • TDS 350

ANALOG SIMPLICITY, DIGITAL PRODUCTIVITY
By balancing the use of on-screen menus with dedicated buttons and knobs, the user-friendly interface retains traditional analog simplicity yet gives quick access to the wide range of digital functions. Frequently used functions, like position and trigger level, are controlled directly with knobs; secondary functions are menu driven, eliminating the profusion of buttons found on most low-cost scopes.

This modern interface dramatically flattens the learning curve, appealing to users regardless of their digital experience. The TDS 300 Series' interface simplifies scope operation without limiting the instrument's capabilities.

COMMUNICATION OPTION
The I/O Interface (Option 14) includes GPIB, RS-232 I/O interface and a Centronics-type parallel printer port. With this option you can use a remote computer to control the scope for automated testing, or to exchange waveform or measurement data for documentation and analysis. In addition, a VGA monitor output is provided for classroom viewing or other applications requiring a monitor.

Interleaf (.img), TIFF, PCX, BMP, and EPS file formats allow screen captures to be placed directly into desktop publishing documents. Or, at the push of a button, a screen shot can be output directly to a variety of compatible printers.

The Printer Kit, provides a single-handle solution to the portable printer problem. A quiet thermal printer, mounted in a pouch attached to the scope, makes clear four-inch hardcopies while you continue working.

For service, education, and design work, the TDS 300 Series is without peer among low-cost DSOs.

Characteristics

SIGNAL ACQUISITION SYSTEM
Bandwidth – 50 MHz (TDS 310), 100 MHz (TDS 320), 200 MHz (TDS 350).

Sample Rate – 200 MS/s on each channel (TDS 310), 500 MS/s on each channel (TDS 320), 1 GS/s on each channel (TDS 350).

Channels – Two identical channels, each with invert function.

Sensitivity – 2 mV to 10 V/div (with calibrated fine adjust).

Position Range – ±5 divisions.

Calibrated Offset Ranges –

V/div setting	Offset Range
2 mV – 99.5 mV/div	±1 V
100 mV – 995 mV/div	±10 V
1 – 10 V/div	±100 V

DC Gain Accuracy – ±2%.

Vertical Resolution – 8-Bits (256 levels over 10.24 vertical divisions).

ACQUISITION MODES
Sample, Envelope, Average, Peak Detect – High frequency and random glitch capture. Captures glitches as narrow as 10 ns using acquisition hardware at all time/div settings between 25 µs/div and 2.5 s/div (inclusive).

TIME BASE SYSTEM (MAIN AND DELAYED)
Time/Division Range – 10 ns to 5 s/div (TDS 310), 5 ns to 5 s/div (TDS 320), 2.5 ns – 5 s/div (TDS 350).

Record Length – 1000 sample points per channel.

Time Base Accuracy – ±0.01%.

TRIGGERING SYSTEM (MAIN ONLY)
Trigger Types – Edge, Video.

Trigger Modes – Auto, Normal.

Video Trigger Types – Triggers on Field 1, Field 2, Any Field (non-interlaced systems), or Lines; from Sync-negative composite video. Triggers on broadcast standard NTSC, PAL, or SECAM video, and other interlaced and non-interlaced video with horizontal line rates from 15kHz to 65 kHz (in 5 ranges) and field rates from 50 to 60 Hz.

DISPLAY
Vector – Connects sample points to display a continuous waveform.

Dots – Displays sample dots only.

Vector Accumulate Mode – Accumulates waveform points over a pre-set period of time (500 ms to ∞) and superimposes the current waveform with bright vectors.

Dot Accumulate Mode – Accumulates waveform points over a pre-set period of time (500 ms to ∞).

Format – YT and XY.

AUTOMATIC MEASUREMENTS
Period, Frequency, + Width, – Width, Rise Time, Fall Time, + Duty Cycle, – Duty Cycle, + Overshoot, – Overshoot, High, Low, Max, Min, Pk-Pk, Amplitude, Mean, Cycle Mean, RMS, Cycle RMS, Burst Width.

Cursors – Horizontal bars, vertical bars, paired (volts @ time).

Readouts – Absolute volts, Δ volts, time, and frequency.

WAVEFORM PROCESSING
Arithmetic Operators – Add, Subtract, Multiply.

Autosetup – Single button automatic setup on selected input signal for vertical, horizontal, and trigger systems.

OPT. 14 (I/O INTERFACE): COMPUTER INTERFACE AND HARDCOPY CAPABILITY
GPIB (IEEE-488.2) Programmability – Full talk/listen modes. Control of all modes, settings, and measurements.

RS-232 Interface Programmability – Full talk/listen modes. Control of all modes, settings, and measurements. Baud rate up to 19,200. 9-Pin, DTE.

Video Output – Standard analog VGA output to external monitors.

Hardcopy Port – Centronics-type parallel or RS-232.

Graphics Interface File Formats – Interleaf (.img), TIFF, PCX (PC Paintbrush), BMP (Microsoft Windows), and Encapsulated Postscript (EPS).

Printer Formats – ThinkJet, DeskJet, LaserJet, Epson (9 & 24-Pin), Seiko DPU 411/II, DPU 412. DC power provided for Seiko printers.

WAVEFORM STORAGE
Waveforms – Two 1000 point reference waveforms.

Setups – 10 front-panel setups.

POWER REQUIREMENTS
Maximum Power Consumption – 65 watts.

MECHANICAL
Cooling Method – Forced air circulation with no air filter.

ENVIRONMENTAL AND SAFETY
Temperature –
–10°C to +55°C (operating);
–51°C to +71°C (nonoperating).

Humidity – Up to 95% RH at or below +40°C; up to 75% RH from 41°C to 55°C (operating and nonoperating).

Altitude – To 15,000 ft./4570 m (operating); To 40,000 ft./12,190 m (nonoperating).

Electromagnetic Compatibility – Meets EN50081-1; VFG 0243; FCC Rules and Regs, 47 CFR, Part 15, Subpart B, Class A.

Safety – UL 1244 Listed, Category Certified CAN/CSA C-22.2 no. 231 Series M89.

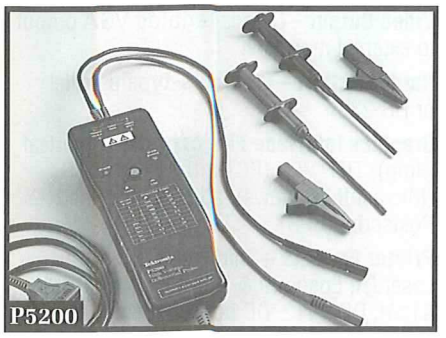
Digital Real Time Oscilloscopes

TDS 310 • TDS 320 • TDS 350

PHYSICAL CHARACTERISTICS

	TDS 310/TDS 320/TDS 350		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width with handle	362	14.25	483	19
Height with feet, pouch	191	7.5	–	–
without pouch	165	6.5	178	7
Depth (stand alone)	471	18.6	472	18.6
with front cover	490	19.3	–	–
with handle(s)	564	22.2	517	20.4
Weight	**kg**	**lb.**	**kg**	**lb.**
Stand alone	6.8	15	–	–
Net with accessories, cover and pouch	8.4	18.5	4.5*1	10*1
Domestic Shipping	12.7	28	14.5	32

*1 *Weight of conversion kit only.*



Accessory

P5200
- 25 MHz Active Differential Probe
- 1300 V Differential

Accessory

DOCUWAVE® SOFTWARE (S60DWAV)
- Easo to use – learn in less than 30 minutes
- Sends, receives, saves waveforms/settings for most Tektronix DSOs and Digitizers with GPIB or serial interfaces
- Sends formatted waveforms to: printer, spreadsheet, desktop publishing software

See page 85 for complete information on DocuWave®.

For complete selection information on all Accessory products, see page 434.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TDS 310 – 50 MHz Oscilloscope.

TDS 320 – 100 MHz Oscilloscope.

TDS 350 – 200 MHz Oscilloscope.
Includes: Two P6109B 10X Probes (P6111B – TDS 350), Instruction Manual, Reference Guide, US Power Cord.

INSTRUMENT OPTIONS
Opt. 14 – I/O Interface (includes GPIB, RS-232 interfaces, VGA output and Centronics-type parallel port, plus Programmer Manual).

SERVICE ASSURANCE OPTIONS
These products covered by the following service assurance option.

REP4300 – Provides one year of post-warranty Repair Protection.

CAL4300 – Provides one year of Calibration Services.

AVAILABLE ACCESSORIES
TD3F14A – Opt. 14 Field Upgrade Kit.

TDS4F5P – 120 V Printer Pack Field Upgrade Kit (includes Pouch, requires Opt. 14).

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz.
Opt. A2 – United Kingdom 240 V, 50 Hz.
Opt. A3 – Australia 240 V, 50 Hz.
Opt. A4 – North America 240 V, 60 Hz.
Opt. A5 – Switzerland 220 V, 50 Hz.

SOFTWARE
DocuWave® – See page 85. Order S60DWAV.

RECOMMENDED ACCESSORIES
PROBES
High Voltage – Order P5100.
1X Passive – Order P6101B.
1X-10X Switchable Passive – Order P6129B.
Differential Voltage – Order P5200.
TTL Logic – Order P6408.
SMD – Order P6561AS.
DC/AC Current Probe System – Order AM 503S.

CAMERAS/PRINTERS
Camera – C-9, Option 04 (includes 016-1154-00 Hood).
Bubble Jet Printer – Order HC220.
Thermal Printer Pack – Order TDS4F5P.

CART
Order K212.

ADDITIONAL ACCESSORIES
See page 434.
Soft-sided Carrying Case – Order 016-1158-00.
Transit Case – Order 016-0792-01.
Deluxe Transit Case with Retractable Wheels/Handle – Order 016-1157-00.
Front Cover– Order 200-3232-01.
Accessories Pouch – Order 016-1159-00.
Rackmount Kit – Order 016-1166-00.
Cables, RS-232 –
To connect to a computer with a 9-Pin RS-232 connector, 2M, null modem. Order 012-1379-00.
To connect to a computer with a 25-Pin RS-232 connector, 1M, null modem. Order 012-1380-00.
To connect to a RS-232 printer or plotter, 9ft., 25-Pin, straight through. Order 012-1398-00.

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

GPIB IEEE-488 *The TDS Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*

Scope Data Management Software

DocuWave®

Features

DocuWave®

- Publish Waveform Screen Images Easily
- Print Images to a Wide Variety of Printers and Plotters
- Read Waveforms from Most Tektronix Digital Scopes
- Save and Recall Waveforms
- Export Waveform Data for Easy Importation by Analysis and Spreadsheet Programs
- Save and Recall Scope Settings
- Display up to Four Waveforms on the PC Monitor with Cursors and Zoom

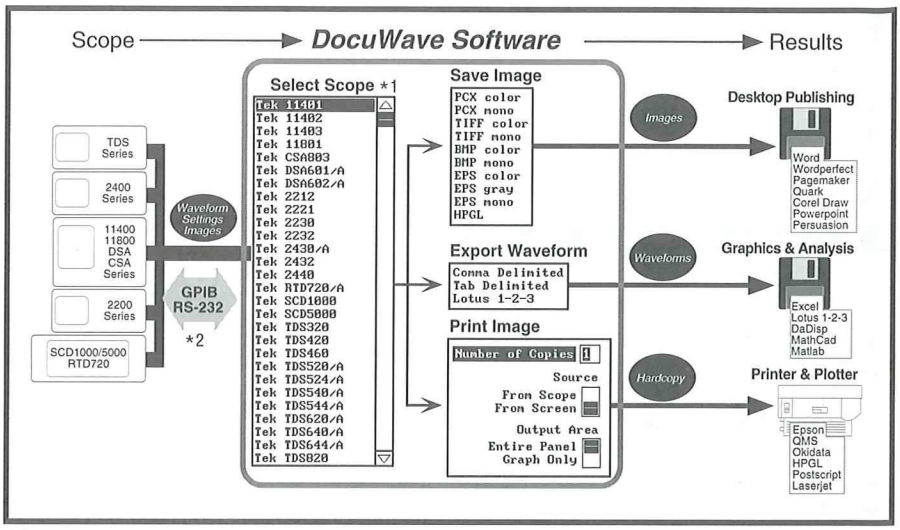


Figure 1.

DocuWave® Software

DocuWave makes publishing and archiving your waveform information simple. Using an intuitive user interface, turn waveforms captured on almost any Tektronix digital storage oscilloscope into a desktop publishing image, an export file that's readable by an analysis program, or a hardcopy. This DOS application will run on just about any PC compatible.

Images, waveforms, and scope setups can be stored and recalled with simple mouse selections. DocuWave provides six capabilities that are essential for documentation and archival of captured waveform data:

- Saves images for desktop publishing
- Outputs images to a printer or plotter
- Reads waveforms from most popular Tektronix digital scopes using GPIB or RS-232 interfaces with full Talk-Listen modes
- Exports waveforms to be imported by analysis and spreadsheet programs
- Displays up to four waveforms with cursors and graphic zoom
- Sends waveform settings back to the scope

DOCUMENT THE REAL WORLD
Image Is everything

The signals that you capture on your digital scope represent test results. They can be used as illustrations for articles, data sheet images or other important information that needs to be documented. DocuWave saves screen images in popular graphic formats including TIFF, PCX, BMP, HPGL, and PostScript®. If the scope has image formats (e.g., TDS Series), the scope image can also be saved from within DocuWave.

Many word processing, drawing, and presentation programs will directly import these images to be manipulated, stored and printed along with the rest of the document. Figure 1 shows a DocuWave image that was directly imported into a word processing program.

HARDCOPY THAT'S NOT HARD

DocuWave can print to popular printers like Epson, Okidata, HP, NEC and plotters, using the serial, parallel or GPIB port on your PC. If your scope has printer formats, you can also print the scope images through DocuWave.

SO MANY SCOPES, ONLY ONE SOFTWARE NEEDED

Changing from one scope to another is simple. Let's say that you have a 2340 and a TDS 320 scope. To switch between them, simply pull down a menu and select the scope you want. **GPIB and RS-232 interfaces with full Talk-Listen modes are supported;** you can select the instrument interface best suited for your application.

**1 Note: Please refer to the "Digital Oscilloscope Support" table for appropriate scope capabilities.*

**2 Instrument requires full Talk-Listen modes for proper operation.*

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

See Tektronix on the World Wide Web: http://www.tek.com

ScopeData Management Software

DocuWave®

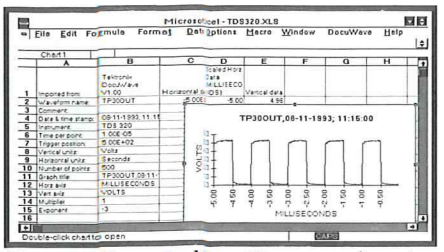


Figure 2. Exported DocuWave waveform in spreadsheet.

EXPORT WITH NO TARIFFS

Waveform data can be exported as tab/comma delimited ASCII text or Lotus 1-2-3 format for importation into analysis and graphics programs. These programs provide additional capabilities that manipulate, analyze and graph the data while providing additional measurements like Fast Fourier Transform (FFT), pulse parameter analysis, differentiation, and more. Figure 2 shows a waveform that was imported into a spreadsheet.

DISPLAY AND MEASURE WITH EASE

Up to four waveforms can be displayed on your PC screen. DocuWave's drag-zoom and absolute/delta cursors allow you to view and measure intricate details of the information you have captured. Each waveform can have an eight-character label attached to it so hard-copies and images have names you recognize.

CONCLUSION

DocuWave is the only software you need to turn the waveforms you have captured on your digital storage oscilloscope into the final result, be it a waveform image that's incorporated into a word processing document or waveform data that is imported into an analysis program.

Characteristics

Minimum Computer Configuration: IBM PC compatible with DOS 3.2 or greater, ≥540 K of free memory, ≥1 MB free hard disk space, EGA/VGA display. National Instruments IEEE-488.2 interface card if using GPIB.

Please Note: Older GPIB interface cards do not support the IEEE-488.2 standard. They can be traded in for a new card by calling National Instruments at 1-800-433-3488.

Instrument Interface Support: GPIB, National Instruments IEEE-488.2 and RS-232 interfaces with full Talk-Listen modes.

Desktop Publishing Formats: Monochrome and color TIFF, monochrome and color PCX, monochrome and color BMP, monochrome, greyscale and color EPS, and HPGL.

Printer/Plotter Support: A wide variety of popular printers and plotters are supported on RS-232 or parallel interfaces.

Waveform Export Formats: Tab delimited ASCII text (.TAB), Comma delimited ASCII text (.CSV) and Lotus 1-2-3 format (.WK1).

DIGITAL OSCILLOSCOPES SUPPORT

11K/DSA	GPIB	RS-232
11801/B	Y	Y
CSA 803	Y	Y
2200/2400	**GPIB**	**RS-232**
2212	Y/Opt. 10	Y/Opt. 12
2216	Y/Opt. 10	N
2221A	Y/Opt. 10	Y/Opt. 12
2230	Y/Opt. 10	Y/Opt. 12
2232	Y/Opt. 10	Y/Opt. 12
2430A	Y	N
2432	Y	N
2440	Y	N

DIGITAL OSCILLOSCOPES SUPPORT (CONTINUED)

RTD/SCD	GPIB	RS-232
RTD 720A	Y	N
SCD5000	Y	N
TDS	**GPIB**	**RS-232**
TDS 310	Y/Opt 14	Y/Opt 14
TDS 320	Y/Opt 14	Y/Opt 14
TDS 350	Y/Opt 14	Y/Opt 14
TDS 410/A	Y	N (Printer Port Only)
TDS 420/A	Y	N (Printer Port Only)
TDS 460/A	Y	N (Printer Port Only)
TDS 520A	Y	N (Printer Port Only)
TDS 524A	Y	N (Printer Port Only)
TDS 540A	Y	N (Printer Port Only)
TDS 544A	Y	N (Printer Port Only)
TDS 620A/B	Y	N (Printer Port Only)
TDS 640A	Y	N (Printer Port Only)
TDS 644A/B	Y	N (Printer Port Only)
TDS 680B	Y	N (Printer Port Only)
TDS 684A/B	Y	N (Printer Port Only)
TDS 744/A	Y	N (Printer Port Only)
TDS 784/A	Y	N (Printer Port Only)
TDS 820	Y	N (Printer Port Only)
THM	**GPIB**	**RS-232**
THM 550	N	Y/THMCOM1
THM 560	N	Y/THMCOM1
THM 565	N	Y/THMCOM1
THS710	N	Y
THS720	N	Y
THS7DMM	N	Y

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

S60DWAV
DocuWave Software on 3.5 in. and 5.25 in. Floppies with User Manual.

S60G210
DocuWave Software Bundled with National Instruments PC GPIB IEEE 488.2 Interface Card.

S60G220
DocuWave Software Bundled with National Instruments AT GPIB IEEE 488.2 Interface Card.

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

See Tektronix on the World Wide Web: http://www.tek.com

Digitizing Oscilloscopes
11800 Series • CSA Series

11800 Series

The Tektronix 11800 Series is a powerful set of analysis tools that alters your fundamental expectations of an oscilloscope. Most revolutionary is the simplification and automation of the entire measurement and analysis process. Accuracy, sensitivity, bandwidth, offset, and overdrive recovery are provided by a well-planned instrument family having plug-in versatility and performance. Multiprocessor architecture allows for simultaneous display of up to eight waveforms and up to six dynamic, "live" measurement readouts. The automation needs of scientific and production environments are easily met by integrating these instruments into a measurement system through RS-232-C or GPIB interfaces.

CSA Series

The Communications Signal Analyzer (CSA) offers signal analysis and the powerful measurement capabilities required to analyze high-speed digital communication signals. Features of the CSA 803A includes histograms, mask testing, and a color-graded display, allowing you to perform accurate measurements such as jitter, noise, and phase.

CONTENTS

11800 SERIES OSCILLOSCOPES/PLUG-INS

11801B 12.5 to 50 GHz Digital Sampling....90

IPA 510 Interconnect Parameter Analyzer....95

11801B/CSA 803A Sampling Heads....99

CSA SERIES COMMUNICATIONS SIGNAL ANALYZERS

CSA 803A up to 50 GHz Color....330

ACCESSORIES

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Probe and Instrument Accessories....476

Plotter/Printer....515

Cameras....518

Instrumentation Carts....520

High Performance Digitizing Oscilloscopes

11800 Series • CSA Series

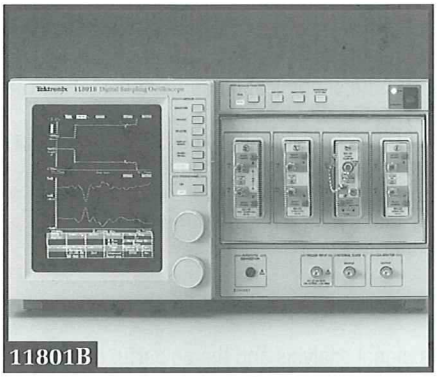
Features

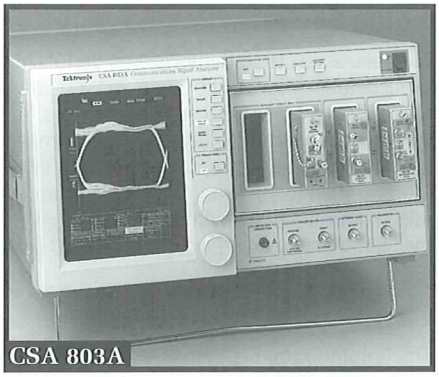
11801B

- DC to 50 GHz Bandwidth (7 ps Rise Time)
- 8 Channels, Expandable to 136
- Automatic Statistical Measurements, Histograms and Mask Testing

CSA 803A

- DC to 50 GHz Bandwidth (7 ps Rise Time)
- High Resolution and Repeatability
- Automatic Statistical Analysis
- 38 Standard Communication MASKS
- 10 GHz Triggering
- TDR and FFT





11801B

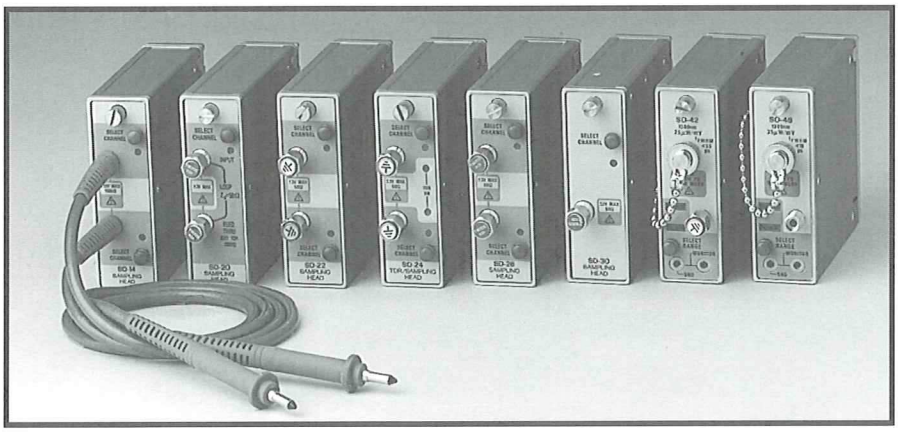
The 11801B uses sequential equivalent-time sampling technology to achieve bandwidths of up to 50 GHz. Sampling head modularity provides a variety of acquisition methods including TDR, optical coupling, loopthrough sampling, low-noise sampling, triggering, and probe sampling. Up to 136 channels of acquisition and TDR measurements can be achieved with an 11801B. The 11801B provides the highest timing resolution and measurement repeatability of any of the 11800 Series.

CSA 803A

The CSA 803A Communications Signal Analyzer is designed for viewing communication signals up to 50 GHz.

Histogram, masking testing, and a color-graded display are included to form an ideal tool for analyzing eye diagrams.

The CSA 803A provides many automatic measurements analyses, including Extinction Ratio, FFT, and Autoset to industry standard Masks. The CSA 803A offers TDR, 10 GHz triggering and 2.0 ps RMS jitter (1.3 ps typical).



High performance sampling heads provide high bandwidth sampling for a multitude of applications.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*

High Performance Digitizing Oscilloscopes

11800 Series • CSA Series

ACCURACY

Measurement accuracy sets the 11800 Series apart from all other oscilloscopes. The analog input circuitry is the most advanced in any oscilloscope – digital or analog. The plug-in amplifiers are built to maintain signal integrity over a wide dynamic range. The 11800 Series delivers accuracy across widely varying conditions of signals and settings; you don't have to worry about whether you're viewing your signal or seeing the oscilloscope's amplifier anomalies.

The Enhanced Accuracy feature of the 11800 Series provides worry-free and effortless automatic internal calibration of the instrument. The instruments continually monitor themselves for accuracy.

FLEXIBILITY AND POWER

The 11800 Series provides plug-in versatility. Nine plug-in amplifiers, ten sampling heads, and a variety of probes are currently available to tailor a signal conditioning solution to your measurement needs.

Whether it is multi-channel (up to 136), 50 Ω/1 MΩ inputs, differential, high bandwidth or optical, the 11800 Series of oscilloscopes offers more versatility than any other oscilloscope. No other oscilloscope can provide the performance, accuracy, sensitivity, bandwidth, filtering, offset, or overdrive recovery of the 11800 Series amplifiers and probes.True dual time bases let you view portions of a waveform at much higher resolution than the main trace. This provides measurement flexibility and improved accuracy. Record lengths can be specified separately for main waveforms and window waveforms, as the application dictates. Two windows allow you to view and measure two separate events at fast sweep speed, improving the accuracy of measurements of those events.

The CSA 803A offers histograms and mask testing to specifically perform the measurements on signals that are typical in communication applications. Histograms are powerful measurement tools for measuring jitter and noise. Mask testing is a very beneficial tool in ATE applications for measuring noise margin and jitter tolerance.

The CSA 803A includes outstanding analysis and acquisition capabilities including FFT, Extinction Ratio, 38 industry standard Masks (CCITT + ANSI), TDR, 10 GHz triggering and 1.3 ps RMS (typical) jitter.

DIGITAL SIGNAL PROCESSING

The 11800 Series provides capability far beyond the basic four math functions of +, –, x, and ÷. It also provides more complex waveform processing such as differentiation, integration, square root, logarithms and more. In all, more than ten different signal processing options are available.

The architecture has the power to display these defined waveforms in real time and make measurements directly on the complex waveforms.

AUTOMATION

Each 11800 Series Oscilloscope provides both RS-232-C and IEEE 488 Standard interfaces. The 11800 Series provides ideal solutions for both low cost benchtop automation and rackmount production applications.

Tektronix offers several compatible software packages to support the 11800 Series in scientific and production applications. Scientists will find that the series is supported by many of the most popular controllers and software packages. Template software from Tektronix supports both process and production environments.

HARDCOPY SUPPORT

You can also print date and timestamped copies of the screen at the push of a button or a bus command, using Tektronix color printers, Tektronix HC100 plotter, Epson printer, Centronics printer, HP Inkjet/Laserjet printers or HPGL plotters. Support for electronic import of hardcopies is also provided.

11800 SERIES SELECTION GUIDE

Instrument	Bandwidth	Maximum # of Channels	Sample Rate	Maximum Record Length	Vertical Resolution	Digitizing Technology
11801B	50 GHz	136	200 kS/s	5 K	8-Bits	sequential
CSA 803A	50 GHz	4	200 kS/s	5 K	8-Bits	equivalent time

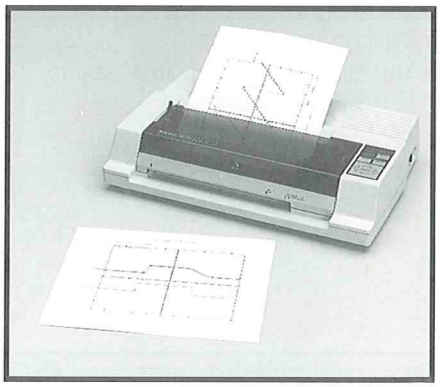
Accessory

HC100

Low-cost, Four-color Plotting

- Compatible with GPIB, RS-232, Centronics interfaces
- Plots both U.S. and A4 formats on paper, mylar and overhead material
- Graphics and text capability
- Compact package

For complete selection information on all Accessory products, see page 434.



Digital Sampling Oscilloscope
11801B

Features

11801B

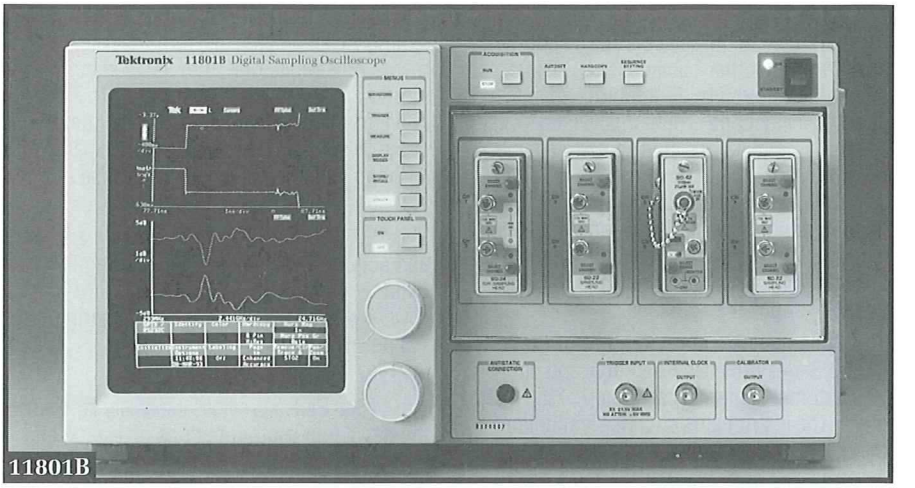
- DC to 50 GHz Bandwidth
- 7 ps Rise Time
- 8 Channels, Expandable to 136 (with SM-11)
- 10 fs Sampling Interval (0.01 ps)
- Modular Architecture
- 200 kS/s Sample Rate
- Triggering to 100 GHz (Prescaler)
- Dual Time Base
- Non-volatile Waveform and Setting Storage
- FFT
- Predefined Telecom Masks
- TDR
- Automatic Measurements:
  Jitter/ Noise,
  Statistical,
  Histograms,
  Mask Testing,
  Pulse with Statistics
- Programmable for ATE Applications
- Color Display

BENEFITS

- Comprehensive Waveform Processing

Applications

- Semiconductor Testing
- TDR Characterization of Circuit Boards, IC Packages and Cables



11801B Digital Sampling Oscilloscope

The 11801B Digital Sampling Oscilloscope offers the widest range of on-board measurement and waveform processing capabilities of any multi-gigahertz scope. With excellent measurement repeatability, exceptional vertical resolution and the fastest display update rate, the 11801B is a powerful measurement tool for semiconductor testing, TDR characterization of circuit boards, IC packages and cables, and high-speed digital data communications. An easy-to-use touch screen display gives you instant access to the 11801B's extensive waveform processing and measurement functions.

MODULARITY MEETS YOUR NEEDS NOW AND IN THE FUTURE

The modular microprocessor-based architecture of the 11801B not only allows you to select the right configuration for your application, but also allows expandability to meet your future measurement needs. The 11801B accepts up to four dual-channel sampling heads and can be expanded through the SM-11 Multi-channel Units to 136 channels.

There are currently ten sampling heads to choose from:

SD-14	3 GHz high impedance (100 kΩ/0.5 pF) dual-channel probe sampler
SD-20	20 GHz single-channel loopthrough head
SD-22	12.5 GHz dual-channel low noise head
SD-24	20 GHz dual-channel TDR/sampling head
SD-26	20 GHz dual-channel sampling head
SD-30	40 GHz single-channel sampling head
SD-32	50 GHz single-channel sampling head
SD-42	6.4 GHz O/E converter (55 ps optical pulse response FWHM)
SD-46	20 GHz O/E converter (22 ps optical pulse response FWHM)
SD-51	20 GHz trigger head

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*

Digital Sampling Oscilloscope
11801B

STATE-OF-THE-ART WAVEFORM ACQUISITION

The state-of-the-art timebase provides equivalent-time sweep rates from 1 ps/div to 5 ms/div, with record lengths from 512 points to 5120 points, and a sample interval of 10 femtoseconds (0.01 ps). The 11801B also offers true windowing, whereby sections of a main trace are re-acquired at higher resolution for close examination of details. The windows are not just a digital zoom as in some competitive instruments. Only Tektronix sampling scopes offer such high resolution viewing of the main acquisition. The acquisition system provides 8-Bit vertical resolution at all deflection factors (78 µV/LSB at 2 mV/div). Powerful on-board waveform processing allows usable deflection factors down to 100 µV/div, giving resolution well beyond the basic 2 mV/div sensitivity of the sampling system itself. The 11801B boasts the fastest sample rate among sampling scopes. The 200 kHz sampling rate gives "real-time" feel for waveform manipulation and increases throughput on data capture for histograms and measurements.

A POWERFUL MEASUREMENT TOOL ON YOUR BENCH

The 11801B offers a comprehensive, accurate and automatic measurement system. A total of 28 on-board measurements can be conveniently selected through the touch screen measurement menu. Results of up to six measurements may be simultaneously displayed on the screen, continuously updated to follow changing signal conditions. However, any number of measurements may be made over GPIB or RS-232-C interfaces. There are three different modes of measurements: hardware, software and statistics. Hardware mode allows high throughput on timing measurements and simultaneous measurements on up to 68 channels at once. Statistics mode uses the statistical database to make all the measurements based on the statistical distribution of the data over multiple acquisitions. It provides very stable and accurate measurements even in the presence of jitter or noise. With the statistical measurement mode, direct automatic jitter and noise measurements are possible (see Figure 1).

This eliminates the human judgment and error that comes with manual measurements from histograms. As in all the other 11000 Series instruments, software measurement mode uses IEEE algorithms to make measurements based on digitized waveforms. An alternate Tektronix proprietary algorithm that is optimized for pulses with ringing and other anomalies is also selectable.

FFT

The 11801B offers FFT display and measurements as a useful tool for the design engineer and scientist. FFT magnitude or phase displays can be created from the acquired waveform and the automatic Spectral Frequency, Spectral Magnitude, and THD (Total Harmonic Distortion) measurements can be used for a complete analysis (see Figure 2).

COLOR GRADING AND MASK/TEMPLATE TESTING

The power of the measurement capabilities of the 11801B can be extended even further with color graded display, histogramming capabilities and mask testing. Both vertical and horizontal histograms, with periodically updated measurements such as mean, RMS and peak-to-peak allow statistical distributions to be analyzed at any point on the signal. The statistical database, available in the color graded display, not only adds a third dimension to your waveforms (by showing a point density of the samples), but also avoids time consuming re-acquisitions or repeated histogram analysis and statistical measurements. The mask testing capability of the 11801B provides an easy, yet powerful and quantitative way to characterize metastability in your device or system. In addition to custom mask editing, the 11801B offers AutoMask – 38 standards-defined masks in memory for instant recall. This together with automatic waveform scaling, gives a rapid verification of a digital bit stream's conformance to pulse templates or eye pattern masks (see Figure 3, on following page).

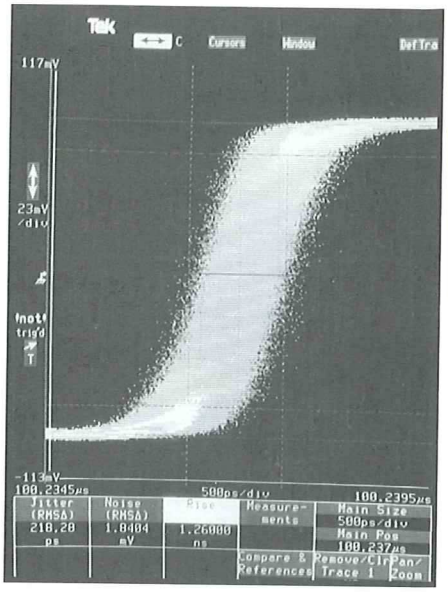


Figure 1. Direct and automatic jitter, noise and rise time measurement using the statistical measurement mode.

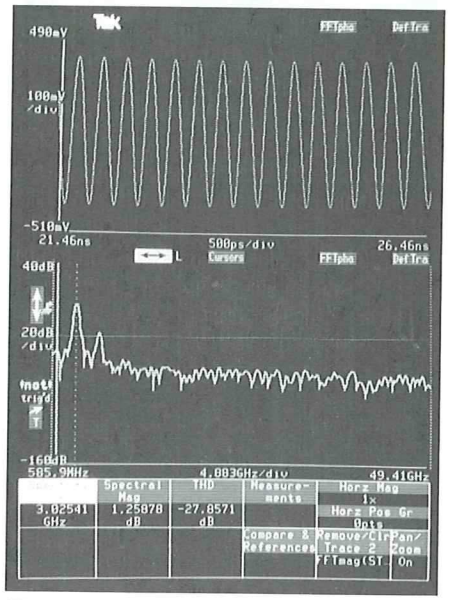


Figure 2. FFT display and measurements in the 11801B offer additional analysis power to the engineer or scientist.

Digital Sampling Oscilloscope
11801B

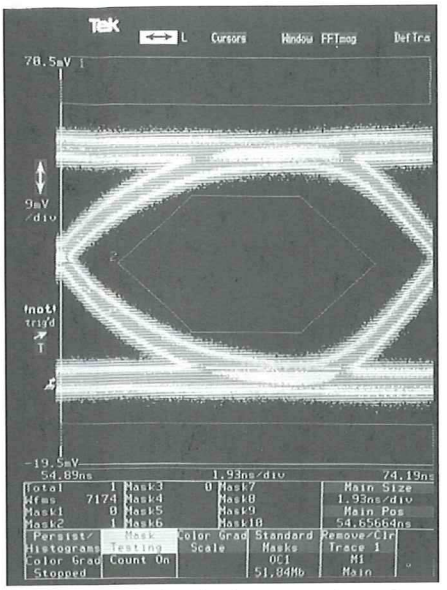


Figure 3. Predefined Telecom masks make verifying digital stream conformance simple.

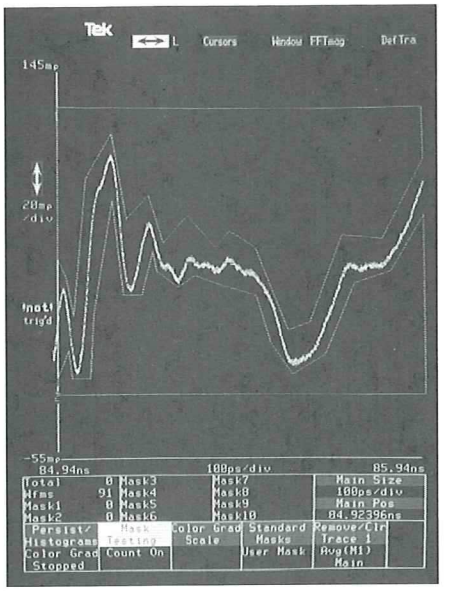


Figure 4. TDR go/no-go impedance measurement using masks.

UNMATCHED TDR CAPABILITIES

With the SD-24 dual-channel TDR/Sampling Head, the 11801B offers full 20 GHz acquisition and unmatched TDR performance on up to 136 channels. Each channel has an independent polarity-selectable (positive-going or negative-going) TDR step generator. The TDR outputs can also be precisely matched at a reference plane, providing the only true integrated differential TDR system available today. Differential TDR offers an accurate picture of the performance of balanced or unbalanced differential systems such as twisted pair cables, coupled microstrips, or differential inputs in active devices. Tektronix' differential TDR system is the only system available today that offers true differential TDR with live waveform updates and simple direct readout of impedance. Other systems require complex and error-prone computations and do not provide direct readout in ohms.

The step generator of the SD-24 also represents state-of-the-art technology, offering unmatched 35 ps reflected rise time*1, with the flattest step in the industry. TDR is also simple to use, with one-touch preset functions for both single-ended and differential TDR. There is direct readout of impedance in rho and ohms, as well as readout of one way or round trip distance in meters, feet, or inches. Using the mask testing capability of the 11801B, you can perform go/no-go testing of impedances in circuit board runs, IC packages and cables (see Figure 4).

Single-ended and differential TDT (Time Domain Transmission) is also possible with the 11801B and SD-24. This type of testing may involve transmission testing (an end-to-end measurement through a cable or conductor), or crosstalk testing (signals induced on one or more adjacent cables or conductors). The ability to apply a step on any channel of the 11801B means that both forward and reverse testing is possible without switching test channels or relay multiplexing, which can be prone to errors. Any of the above measurements may be performed single-ended or true differential.

The 11801B allows quick real-time viewing of the TDR response to a user-selected rise time with the filter function. Simply enter the filter rise time, and the 11801B displays a live trace that shows the response at the filtered rise time. Waveform math can also be used to subtract a reference trace acquired with a 50 Ω terminator for removal of unwanted aberrations due to cabling and fixturing.

WAVEFORM MEMORY AND NON-VOLATILE STORAGE

The 11801B is equipped with 512 KB of volatile waveform acquisition and display memory, and 256 KB of non-volatile memory for storage of waveforms and settings. These memories are independent; that is, the number of waveforms being acquired has no impact on the memory available for stored waveforms and settings.

MULTI-CHANNEL CAPABILITIES

The SM-11 Multi-channel Unit provides the means of expanding the 11801B's measurement system to 136 channels. Each SM-11 accepts up to 16 SD-Series sampling heads for 32 channels (with dual-channel heads). An 11801B mainframe with Option 1M is capable of driving up to four SM-11s. The entire system can then be driven through a single GPIB address. The 11801B acquisition system is designed to simultaneously 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. All channels, whether in the 11801B or SM-11 mainframes, offer the full specified performance. There is no loss of performance throughput or reliability as is the case in relay-multiplexed systems.

EASY-TO-USE HUMAN INTERFACE

The power of the 11801B is accessed through a simple menu structure with pop-up menus and two control knobs. In addition, common functions such as time/div and volts/div, are accessed through on-screen icons which are always accessible. For ATE applications, the 11801B is completely programmable through its IEEE 488 and RS-232-C interfaces.

DOCUMENTATION

The 11801B provides extensive hardcopy support. Documenting your results, complete with labels and time and date stamp, is as easy as pressing the HARDCOPY button. A variety of printers and plotters, including Tektronix color printers, are supported. TIFF (Tagged Image File Format) output is also supported for exporting hardcopy to word processors.

**1 The observed rise time of a reflection from a short circuit.*

Digital Sampling Oscilloscope
11801B

Characteristics

VERTICAL SYSTEM*1

Rise Time/Bandwidth – Determined by the sampling head used.

Vertical Resolution – 8-Bits full screen (78 µV/LSB at 2 mV/div deflection factor).

Amplifier Gain Accuracy – ±1% of all settings.

Deflection Factors – 2 to 255 mV/div in 1 mV/div increments.

Offset Range – ±2 V.

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.

Record Length – 512, 1024, 2048, 4096, and 5120 samples.

Windows – Any number of window records may be placed on any number of main records, up to a 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.

Maximum Sample Rate – 200 kS/s.

TRIGGER SYSTEM*2

Trigger Bandwidth (Direct) – 3 GHz; 2-10 GHz (Prescaled).

Trigger Sensitivity (Direct) –
DC, 1X ≤3 GHz: 100 mV;
AC, 1X 300 kHz to 3 GHz: 100 mV;
DC, 10X ≤3 GHz: 1 V;
AC, 10X 300 kHz to 3 GHz: 1 V.

Delay Jitter – 1.3 ps +4 ppm of a position typical. 2.0 ps +5 ppm of position maximum (RMS).

Internal Clock – 100 kHz (drives TDR, Internal Clock Output, and Calibrator).

Trigger Level Range (Direct) – ±1.0 V (±10 V with 10X trigger attenuator activated).

Trigger Input Range (Direct) – ±1.5 V (+15 V, 5 V RMS maximum with 10X).

Trigger Holdoff – 5 µs to 2.5 s.

MEASUREMENT SYSTEM

Waveform Processing Functions – Add, subtract, multiply, divide, absolute, average, differentiate, envelope, exponent, integrate, natural log, log, signum, square root, smoothing, and filter.

Measurement Set – Max, min, mid, p-p, mean, RMS, amplitude, extinction ratio, overshoot, undershoot, noise*5, rise, fall, spectral magnitude, spectral frequency, THD, SNR, frequency, period, prop delay, cross, width, phase, duty cycle, jitter*5, area +, area –, and energy. Measurements are constantly updated; mean and standard deviation available on all measurements.

Measurement Parameters – (Proximal, mesial, distal, and start/stop levels). May be set to absolute levels.

Cursors – Paired or split dots, vertical bars, and horizontal bars.

TDR SYSTEM (SD-24 ONLY)

Combined TDR/Acquisition Reflected Rise Time – 35 ps or less.

TDR Step Amplitude – Adjustable to ±250 mV (polarity of either step may be inverted).

Time Coincidence Between TDR Steps – Adjustable to less than 1 ps.

Source Resistance – 50 ±0.5 Ω.

Typical Aberrations – (at ±250 mV Amplitude) 10 ns to 20 ps before step: ±3% or less; Less than 300 ps after step: +10%, –5% or less; 300 ps to 5 ns after step: ±3% or less; Elsewhere: ±1% or less.

CRT AND DISPLAY FEATURES

CRT – 9 inch diagonal, magnetic deflection, vertical raster scan orientation. Color.

Colors – Eight-color default color set included; or colors are user-selectable from palette of 262,144 colors.

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°C to +50°C; Nonoperating: –40°C to +75°C.

Humidity – Operating and Nonoperating: Up to 95% relative humidity, up to 50°C. Per MIL-T-28800E, Type III, Class 5.

Altitude, Vibration, Shock Nonoperating, Bench Handling – Meets MIL-T-28800E, Type III, Class 5.

Electromagnetic Compatibility – (with sampling heads or optional blank panels installed in all sampling head compartments) Meets the Requirements of: MIL-STD-461B; FCC Part 15, subpart J, Class A; VDE 0871/6.78 Class B.

Safety – Listed UL 1244, CSA Bulletin 556B September 1973.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
11801B				
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	599	23.6	550	21.6
SM-11				
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	558	22.0	550	21.6
Weight	kg	lb.	kg	lb.
11801B				
Net	22.3	49	23.2	51
Shipping	25.9	57	26.8	59
SM-11				
Net	20.0	44	20.9	46
Shipping	23.6	52	24.5	54

**1 Vertical system specifications of 11801B with SD-14 non-applicable. See 11800 Series Sampling Head specifications.*

**2 11801B external trigger requires 23 ns pre-trigger or DL 11 Delay Lines to view trigger point (45.5 ns with Option 1M).*

**3 For intervals <100 ps, the above holds for time/div ≤20 ps/div.*

**4 For other intervals not listed above, linearly interpolate the cardinal points.*

**5 Available only in statistical measurement mode.*

TIME BASE ACCURACY – TYPICAL SPECIFICATIONS

Range*3, *4	Base	+	Interval Specification	+	Position Specification
Interval ≥1 ns	4 ps		0.004%* Interval		0.0004%* Position
Interval =100 ps	2.5 ps		–		0.0004%* Position
Interval ≤10 ps	1 ps		–		0.0004%* Position

Digital Sampling Oscilloscope
11801B

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

11801B
Digital Sampling Oscilloscope.
Includes: User Manual (070-8783-00), Programmer Manual (070-8784-00), Service Manual (070-8781-00), 12 inch SMA-SMA Cable, 2 ea. 8 1/2 inch SMA-SMA Cable, 1 Wrist Strap.

Opt. 1R – Rackmount.
Includes: Hardware, tooling, and instructions for converting Bench Model to Rackmount Configuration. Available with 11801B and SM-11.

Opt. 1M – Multi-channel Conversion. Modifies 11801B to permit operation with up to four SM-11 Multi-channel Units.

SM-11
Multi-channel Unit.
Includes: Installation/User Manual (070-7048-01), Service Reference (070-7049-01), Power Cord, U.S., 120 V (161-0066-00).

DL-11
Delay Line.
Includes: Installation/User Manual (070-7050-01), Instruction Sheet (070-7051-01), 20 in. Coaxial Cable, RF 50 Ω (174-1427-00), 60 in. Coaxial Cable, RF 50 Ω (174-1428-00).

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – United Kingdom 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.

See Customer Information Section for additional information.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES – Also see pages 434.

PROBES
50 Ω Divider (Z0) Probe – 9 GHz.
Order P6150.

Active Probes
(requires 1103 power supply) –
10X, DC – 1 GHz, ≥10 MΩ Input Impedance, 1.9 pF. Order P6204.
10X, DC – 4 GHz, ≥100 kΩ Input Impedance, 0.4 pF. Order P6217 .
1103 Power Supply.

Current Probe – (requires BNC to SMA Adapter) DC – 50 MHz, 0-20 A (DC + peak AC). Order AM 503S.
DC – 15 MHz, 0-100 A (DC + peak AC). Order AM 503S Opt. 03.
25 kHz-1 GHz, Max Current of 0.5. A RMS. Order CT-1.

Optical-to-Electrical Converters – (See page 334)
DC – 6.4 GHz, 1000-1700 nm.
Order SD42*1.
DC – 20 GHz, 1200-1650 nm.
Order SD46*1.
DC – 1 GHz, 1100-1700 nm.
Order P6703A*2.
DC – 700 MHz, 450-1050 nm.
Order P6701A*2.
DC – 300 MHz, 1000-1700 nm, High Gain.
Order P6713*2.
DC – 250 MHz, 450-1050 nm, High Gain.
Order P6711*2.

CALIBRATION STEP GENERATOR
U.S. – Order 067-1338-00.
Includes: Instruction Sheet; Test Report; SMA Female Short-circuit Termination.

Universal European – (240 V, 50 Hz).
Order 067-1338-01.

UK – (240 V, 50 Hz). Order 067-1338-02.

Australia – (240 V, 50 Hz).
Order 067-1338-03.

Switzerland – (240 V, 50 Hz).
Order 067-1338-05.

Japan – (100 V, 50-60 Hz).
Order 067-1338-06.

CART
Order K465.

ADDITIONAL ACCESSORIES – Also see page 434.
Power Strip – Four Outlet, 6 ft., Noise/Surge Suppression. Order 131-5342-01.

SMA Accessory Kit – 2 ea. 2X and 5X Attenuators; 2 ea. SMA Terminations, Male Short Circuit, Female Short Circuit, Male 50 Ω, Female 50 Ω, 2 ea. 50 Ω Signal Cables (2 ns), 2 ea. 500 ps Semi-rigid Cable, 2 ea. Male-to-Male adapters, 2 ea. SMA Male-to-BNC Female, 2 ea. Female-to-Female, 1 ea. 50 Ω Power Divider, 1 ea. Combination Wrench (.312, 6 point). Order 020-1693-00.

**1 See page 99 for complete selection information.*

**2 Requires 1103 TEKPROBE™ power supply for use with 11800 and CSA 800 Series.*

3.5 mm Accessory Kit – 1 ea. 50 Ω Reference Air Line, 1 ea. Male-to-Male Adapter, 1 ea. Female-to-Female Adapter, 1 ea. 26.5 GHz 50 Ω Terminator (Male), 1 ea. 26.5 GHz 50 Ω Terminator (Female), 1 ea. 26.5 GHz Short Circuit (Male), 1 ea. 26.5 GHz Short Circuit (Female), 2 ea. 50 Ω Attenuators (6 dB 26.5 GHz, 2.9 mm), 2 ea. 50 Ω Attenuators (20 dB 26.5 GHz, 2.9 mm), 1 ea. Power Divider (26.5 GHz, 2.9 mm), 2 ea. Flexible Signal Cables (2 ns, Male-to-Male), 2 ea. Signal Cables (500 ps, Male-to-Male, 2.9 mm Semi-rigid), 1 ea. Torque Wrench, 1 ea. Combination Wrench (0.312, 6 point), 1 ea. Combination Wrench (0.281, 6 point). Order 020-1692-00.

2X Attenuator – SMA Male-to-Female. Order 015-1001-00.

5X Attenuator – SMA Male-to-Female. Order 015-1002-00.

Power Divider – Order 015-1014-00.

Blank Sampling Head –
Order 200-3395-00.

ECL Terminator – Provides the bias and termination for ECL device outputs. At 10 GHz bandwidth and 1% precision attenuation, accurate AC and DC measurements are ensured. Attenuation: 10X ±1.0% @ DC, 20 dB ±3 dB, DC to 10 GHz aberrations: ±3% max with 100 ps rise time. Order 015-0558-00.

DC Block (Coupling Capacitor) –
Order 015-1013-00.

Slip-on Connector – Order 015-0553-00.

Connector Savers –
(SMA) Order 015-0549-00.
(APC) Order 015-0552-00.

DL-11 Service Manual –
Order 070-7050-01.

SM-11 Service Manual –
Order 070-7049-01.

CABLES AND EXTENDERS
Sampling Head Extender Cable –
1 m. Order 012-1220-00.
2 m. Order 012-1221-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*

Interconnect Parameter Analyzer

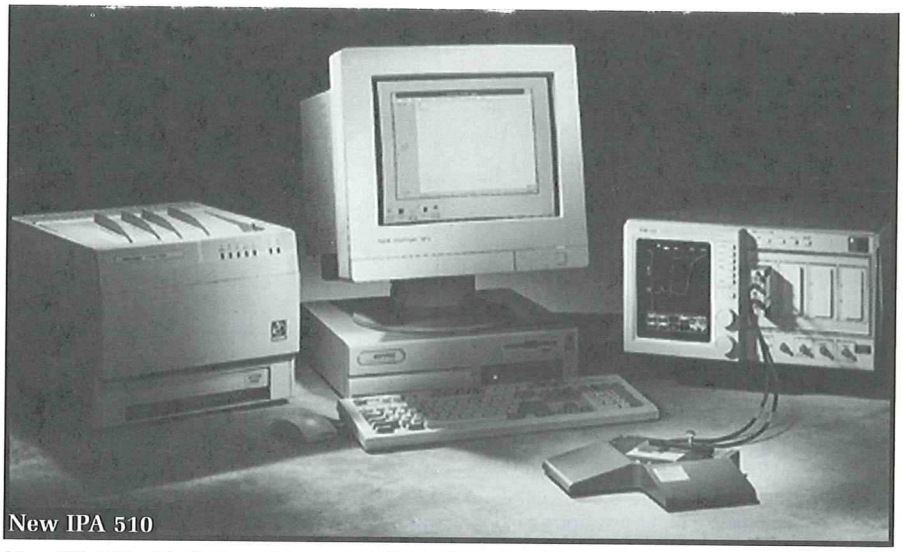
New IPA 510

Features

- Enhanced Accuracy TDR Impedance Measurements for Results to Within 1.5%
- Enhanced Accuracy Measurements Provide Time- and Frequency-domain Display Capability
- Z-Profile™ Algorithm Reduces Effects of Multiple Reflections and Improves Resolution
- Direct Readout of Inductance, Capacitance, and Impedance vs. Time
- SPICE Compatible LC Circuits, Piece-wise Linear Sources, and Composite Files with No Direct Netlist Editing Required
- Direct Graphical Comparison of Simulated and Measured Time-domain Waveforms
- Supports Extraction of Lumped, Distributed, Mixed, Coupled, and Lossy-line Models
- Powerful Waveform Math and Signal Processing Capabilities
- Base Instrument Performance (11801B): 35 ps Rise Time, Fully-differential, Multi-channel TDR
- Fixturing Support for Many Popular IC Packaging Styles
- Compatible with a Large Variety of Fixturing and Probing Stations
- Microsoft Windows® Environment

Applications

- A Fully Integrated Environment for the Time or Frequency Domain:
  - Measuring
  - Modeling
  - Simulating
  - Verifying High-speed Electrical Interconnect Systems



New IPA 510 with Options 28, 15 and Phaser® 200e Color Printer.

IPA 510 Interconnect Parameter Analyzer

Faster clock speeds, denser packaging, more complex systems, faster time-to-market, increased price competition. These are but a few of the parameters driving the demand for easier, faster, and more accurate electrical interconnect characterization and modeling.

By integrating the measurement, model extraction, simulation, and verification domains into a single system, the Tektronix IPA 510 Interconnect Parameter Analyzer system allows interconnect design and modeling in just minutes rather than days. With the IPA 510, you can easily optimize your design and simulate the results early in the design process – before building costly prototypes. It provides the ideal "what if…" platform to allow you to actually observe the results of various design choices with minimal time and expense.

When your design is optimized and you're ready to build a physical prototype to test real-life results, the IPA 510 is again the best tool to get the answers you need to "fine-tune" your design and get it ready for production. With a full complement of available fixturing options – from the IPA Nexus PGA-package test fixture to the PPMS-100 probe station – you can measure the actual performance of your prototype and compare it to the simulated response. Using the resultant measured parameters, you can optimize your model to produce the desired results as you commit your design to production.

As you build confidence in the IPA 510 simulation, modeling, and measurement capabilities, you can go from idea to reality with fewer design "turns", improved accuracy, and optimum quality. The result is reduced time-to-market, reduced expense, and an improved competitive position.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

Interconnect Parameter Analyzer

New IPA 510

THE IPA 510 – ENHANCEMENTS BUILT ON THE IPA 310A METHODOLOGY

With the IPA 510, you perform all steps for the development and verification of interconnect models in the familiar time domain using just one system and outputting Berkeley SPICE compatible models.

As an example, the IPA 510 measures the actual response of the interconnect via standard Time-domain Reflectometry and Transmission (TDR/TDT). Using a unique Z-Profile™ algorithm to enhance its TDR capabilities, the IPA 510 translates the response into a true impedance profile expressed in ohms.

Then, the IPA 510 automatically creates a lumped, distributed, or mixed SPICE model from the displayed Z-Profile™ waveform. If you want to do it manually, you can use the LCZ cursor to obtain a direct readout of the waveform's inductance, capacitance, impedance, and delay over any section of the impedance profile. In a similar manner, the IPA 510 supports Z-Profile™ for symmetric coupled lines enabling the accurate simulation of coupling effects.

Also, in a process similar to the above, unique Tektronix methods for extracting single-lumped, lumped coupled, asymmetric-coupled lines, and lossy transmission line models can be used and verified at the rise time of the particular logic family.

All methods use graphical dialog boxes to guide the user through the extraction processes. The SPICE netlist of these individual models and the composite model (see Figure 1) can be edited through these graphical interfaces and launched for successive simulations, enabling the immediate and direct comparison of simulated and measured results.

BEYOND TRADITIONAL TDR

Traditional TDR is effective in measuring single discontinuities; making measurements via a voltage reflection waveform is usually adequate. However, most TDR measurements of interconnects with multiple discontinuities render these traditional methods ineffective. Multiple small discontinuities which are not observable on traditional TDR can be made easily observable with Z-Profile™ processing. The IPA 510 Z-Profile™ algorithm minimizes the effects of multiple reflections and produces an output scaled in ohms. The output of the Z-Profile™ algorithm can be used to automatically extract lumped inductance and capacitance values for a SPICE model. To streamline manual adjustment of model values, the IPA 510 also provides

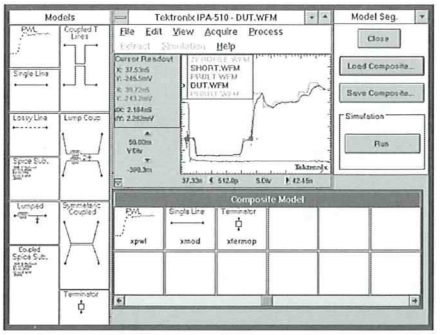


Figure 1. Composite model window.

cursors with direct readout of inductance, capacitance, and impedance. The end result is faster model development and more accurate models, verified with actual measurements.

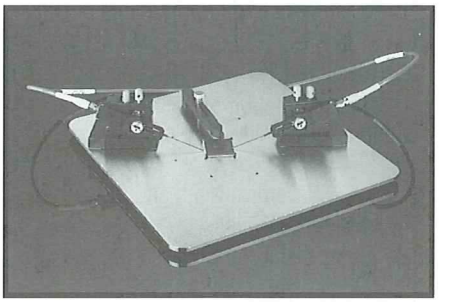
DEVICE-UNDER-TEST INTERFACES

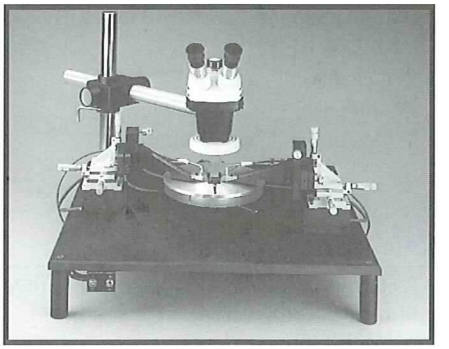
One of the most challenging aspects of measuring high-speed digital interconnects is obtaining a reliable and high-fidelity connection to the Device-Under-Test (DUT). Measurement accuracy and repeatability depend on the clean transmission of sub-nanosecond voltage steps to and from the DUT. The IPA 510 provides a number of DUT interface options depending on the particular size and geometry of your interconnect.

- **IPA Nexus with QFP Adapter.** A precision multi-line interface to larger PGA and QFP packages.
- **PPMS-100 Probing Station.** A highly flexible optional accessory that can be configured to meet specific needs. The PPMS-100 (See page 472) provides precision 50 Ω capability when used with industry-standard microwave probes. The PPMS-100 is used when component geometries are very small and the highest performance measurements need to be made.
- **Simple Coax Probe Kit.** Provides a starter kit of 12 semi-rigid, 50 Ω coax probes with the following number/inch diameter (4/0.047, 4/0.085, 4/0.141) for general use in probing ECBs and ECB-mounted connectors. These probes can easily be modified and soldered directly into circuits to meet your specific measurement requirements.
- **SMA Adapter Kit.** Provides high-performance cabling (2), simple coax probes, differential calibration tee, male/female terminations, male/female shorts, and wrenches. This kit enables standard SMA connection to DUT fixturing or probes.

Coax Positioning System

Provides very flexible probing of smaller as well as larger IC packages such as QFPs, LCCs, SOICs, and SOTs. One to four 0.047 mil diameter, 50 Ω probes can be manually positioned at one time with lead spacing down to 15-mil pitch.





Accessory

PPMS 100
HIGH RESOLUTION PROBING STATION

- Conveniently Position Microwave or Conventional Oscilloscope Probes
- HANDS-Free Access to MCM's, Hybrids, Interconnects, SMT Packages and IC's

AVAILABLE DUT TEST FIXTURES FOR THE NEW IPA 510

DUT Test Fixture	IC Packages	MCMs	ECBs	Connectors	Cables
Nexus + QFP	√				
Simple Coax Probe Kit	√	√	√	√	
Coax Positioning System	√	√			
PPMS-100 Probe Station	√	√	√		
SMA Adapter Kit	√	√	√	√	√

Interconnect Parameter Analyzer

New IPA 510

IPA 510 System Overview

INSTRUMENT INTERFACE TYPES

- 11801A/B or CSA 803/A Digital Sampling Oscilloscope with SD-24 Dual-Channel TDR Sampling Head
- HP8510 Option 010 Network Analyzer with time-domain option (recommended only for existing HP8510 installations)

ENHANCED ACCURACY TIME DOMAIN REFLECTION/TRANSMISSION (EA-TDR/TDT)

- Higher accuracy TDR impedance measurements
- Highly repeatable user-specified TDR step rise time (30 ps typical at calibration reference plane)
- Aberrations due to source and DUT cable and connector interfaces practically eliminated
- EA-TDR/TDT data can be displayed in several network analyzer frequency domain formats from DC to 12.5 GHz
- Optional 3.5 mm calibration kit available

MODEL TYPES

- Models built from either LC and/or transmission line segments
- Lumped coupled models
- Lumped coupled LC and coupled transmission line models for simulating crosstalk
- Lossy transmission line models using standard RLC SPICE components (includes DC, skin loss, and dispersion effects)
- Automatic piece-wise linear voltage source waveforms
- Termination model to emulate actual measured response
- Automatic generation of composite SPICE files for two- and four-port interconnects with terminations
- Multiple interconnect models can be linked to simulate more complex two- and four-port interconnect networks
- Berkeley SPICE compatible subcircuits from other field solvers

PROCESSING CAPABILITIES

- Z-Profile™ for enhanced TDR resolution and true impedance profile vs. time
- Filtering to view measured and simulated response at user-specified rise time
- Waveform math includes integration, add, subtract, multiply, and divide on two waveforms
- Flip waveform for analysis of longer interconnect structures from both ends

ENHANCED ACCURACY MODE CHART

	[dB Typical]		
	<2.0 GHz	2 GHz to 5 GHz	5 GHz to 10 GHz
System Dynamic Range	70	60	50
Source Match	45	38	38
Isolation	90	80	70
Transmission Tracking	0.05	0.15	0.15

- Calculation of self-inductance, mutual inductance, total capacitance, and mutual capacitance

DISPLAY FORMATS

- Volts vs. time
- Log or linear mag vs. frequency
- Real or imaginary part vs. frequency
- Polar frequency
- Smith chart and Inverted Smith chart

CURSOR CAPABILITIES

- Volts, time, Δ V, Δ t
- Amplitude (linear, log, mag) vs. frequency, Δ amplitude, Δ frequency
- Impedance (real, imaginary, R + –jX, G + –jB), Δ impedance, Δ conductance, Δ frequency

SIMULATOR SUPPORT

- Integrated interface for simulator launch and display of output
- Supports PSPICE and Contec SPICE

USER INTERFACE

- Annotation labels for waveforms and comments
- Cut and paste waveform display for use in other applications
- Microsoft Windows environment
- Frequency-domain data savable to Touchstone exportable file format
- Time-domain data savable to file
- Complete SPICE netlists generated from high-level graphical dialogue interfaces – no direct netlist editing required

Individual IPA 510 System Component Characteristics

ENHANCED ACCURACY MODE (OPTIONS 2S, 1U, OR 2U)

Reflected Step Response –
Thru Rise Time: 30 ps ±1.5 ps.
Reflected Rise Time: 30 ps ±1.5 ps.
Aberration Thru and Reflected Aberrations:
<±1.0%, 10 ns to 20 ps before step.
<±1.5%, less than 200 ps after step.
<±0.75%, 200 ps to 100 ns after step.
<±0.75% elsewhere.

Reflected Impedance at Reference Calibration Plane: 50 Ω ±1.5%.

Displayed Frequency Domain Bandwidth – 12.5 GHz.

Test Environment – ±5°C.

IPA NEXUS CHARACTERISTICS (OPTION 28)

Number of High Speed Lines – 12.

Reflected Open Circuit Rise Time – <50 ps measured with SD-24, t_r 20 to 80%.

Electrical Length – <±20 ps delta.

Maximum Reflection at DUT – ≤±55 millirho.

DUT Connection Repeatability – <–30 dB difference between repeated connections.

QFP ADAPTER CHARACTERISTICS WHEN INSTALLED ON NEXUS (OPTIONS 29, 30, 31, 32, 33, 34)

Number of High Speed Lines – 2 or 4.

Reflected Open Circuit Rise Time – <55 ps measured with SD-24, t_r 20 to 80%.

Electrical Length – <±20 ps delta.

Maximum Reflection at DUT – ≤±55 millirho.

COAX POSITIONING SYSTEM CHARACTERISTICS (OPTION 35)

Number of High Lines – One to four 0.047 in. diameter probes.

Reflected Open Circuit Rise Time – <50 ps measured with SD-24, t_r 20 to 80%.

Maximum Reflection at SMA Connector – ≤±40 millirho.

SIMPLE COAX PROBE KIT CHARACTERISTICS (OPTION 36)

Number of High Speed Lines –
Four each 0.141 in., 0.086 in., 0.047 in. diameter probes.

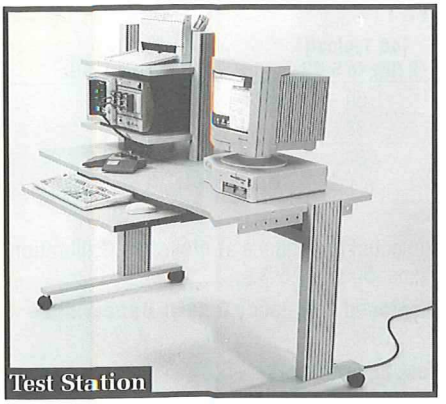
Reflected Open Circuit Rise Time – <50 ps measured with SD-24, t_r 20 to 80%.

Electrical Length (nominal) – 950 ps.

Maximum Reflection at SMA Connector – ≤±40 millirho.

Interconnect Parameter Analyzer

New IPA 510


Test Station

Accessory

TEST STATION

- System Mobility and Work Space Functionality

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

IPA 510
Interconnect ParameterAnalyzer.
Includes: IPA Interconnect Parameter Analyzer Software, IPA Quick Start Demo Board, Coax Adapter Kit Torque Wrench, evaluation copy of PSPICE, and Manuals.

Analysis Software Related Options –
Opt. 2E – Add Enhanced Accuracy Coaxial Calibration Kit. Contains: Microwave Standards, 1 ea. Female and Male Open, Short, and 50 Ω Termination, Female-to-Female thru Adapter; 7.5 cm 50 Ω Reference Airline.

Add Enhanced Accuracy TDR/TDT Software (EA-TDR/TDT) –
Opt. 2S – When Opt. 2E Selected.
Opt. 1U – For Owners of Existing 11800 Mainframes.
Opt. 2U – For Owners of Existing CSA803 Mainframes.

Add Contec SPICE Simulator Software Plus 1 Year Annual Support Fee –
Opt. 3S – US.
Opt. 4S – Europe.
Opt. 5S – Japan.
Opt. 6S – International.

Add Contec RLGC Field Solver Software Plus 1 Year Annual Support Fee –
Opt. 3S – US.
Opt. 4S – Europe.
Opt. 5S – Japan.
Opt. 6S – International.

Measurement Hardware Related Options –
Opt. 26 – Add 11801B Oscilloscope.
Opt. 27 – Add SD-24, TDR/Sampling Head.
Opt. 1E – Additional Coax Adapter Kit.
Opt. 1R – Add 11801B Rackmount Kit.
Opt. 1M – Add 11801B SM-11 Compatibility.

Fixturing Related Options –
Opt. 28 – Add IPA Nexus PGA Fixture.
Opt. 29 – Add QFP2-25 Adapter.
Opt. 30 – Add QFP4-25 Adapter.
Opt. 31 – Add QFP2-50 Adapter.
Opt. 32 – Add QFP4-50 Adapter.
Opt. 33 – Add QFP4-20 Adapter.
Opt. 34 – Add QFP4-15 Adapter.
Opt. 35 – Add Coax Positioning System.
Opt. 36 – Add Simple Coax Probe Kit.

System Integration Options –
Opt. 1S –
Add System Integration and Computer.
Opt. 02 – Add NEC SVGA 17 in. Display.
Opt. 03 – Add NEC SVGA 15 in. Display.
Opt. 04 – Add NEC SVGA 15 in. Display (240 V, Europe only).
Opt. 1C – Add Test Station Table.
Opt. 1G – Add S3FG220 GPIB Card/Cable.

RECOMMENDED ACCESSORIES
SD-14 Sampling Head –
2.5 GHz High-impedance (100 kΩ/0.47 pf) Dual-channel Probe Sampler.

SD-20 Sampling Head –
20 GHz Single-channel Loop-through Sampling Head.

SD-22 Sampling Head –
12.5 GHz Dual-channel Low-noise Sampling Head.

SD-26 Sampling Head –
20 GHz Dual-channel Sampling Head.

SD-30 Sampling Head –
40 GHz Single-channel Sampling Head.

SD-32 Sampling Head –
50 GHz Single-channel Sampling Head.

SIU 800 Static Isolation Unit –
Input Protection Relay.

1 Meter Sampling Head Extender Cable –
Order 012-1220-00.

2 Meter Sampling Head Extender Cable –
Order 012-1221-00.

Color Printer – Tektronix Phaser® 200 or 300 Series Color Printer.

Coax Adapter KII – Order 020-2122-00.

Test Station – Order 016-1239-00.

AT-GPIB Card and Software – Order S3FG220.

RLGC SW –
U.S. – Order 063-2274-00.
Euro – Order 063-2350-00.
Japan – Order 063-2351-00.
ROW – Order 063-2352-00.

CONTEC SPICE – U.S. – Order 063-2273-00.
Euro – Order 063-2349-00.
Japan – Order 063-2353-00.
ROW – 063-2354-00.

Adapters –
QFP2-25. Order 015-0653-00.
QFP4-25. Order 015-0653-01.
QFP2-50 Order 015-0653-02.
QFP4-50. Order 015-0653-03.
QFP4-20. Order 015-0653-04.
QFP4-15. Order 015-0653-05.

EA-TDR/TDT Cal. Kit – Order 020-2129-00.

Coax Probe Positioning System – Order 020-2123-00.

Coax Probe Kit – Order 020-2124-00.

IPA Nexus Fixture – Order 067-1438-00.

Note: To add EA-TDR/TDT Option at a later date, contact Tektronix service request quote for Options 1U and 2U.

RECOMMENDED ACCESSORIES
Probing Station/Articulated Arms –
For complete information see page 472.

Contact Tektronix Account Manager for name and location of local printer distributor.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

Sampling Heads

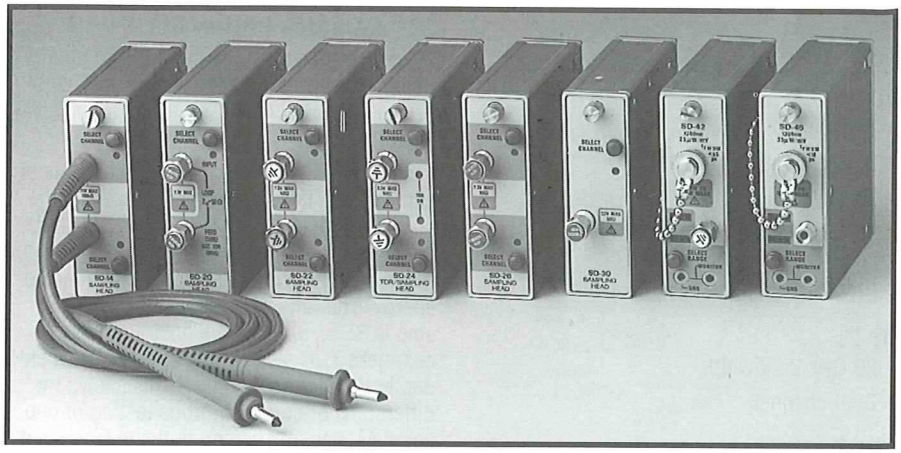
SD-14/-20 • SD-22/-24 • SD-26/-30 • SD-32/-42 • SD-46/-51

Features

SD-14
- 100 kΩ, 0.5 pF Typical
- 7 V p-p Dynamic Range
- 3 GHz Bandwidth
- ECL, CMOS and GaAs Device Characterization

SD-20
- Loopthrough Sampling Head
- Non-terminated
- General-purpose TDR

SD-22
- 12.5 GHz Bandwidth
- Low-noise
- Digital Data Communications
- Dual-channel



SD-14 High Impedance Probe Sampler

The SD-14 is a dual-channel, 3 GHz probe sampler designed for high impedance signal acquisition where a 50 Ω acquisition system is not the optimal solution. The SD-14 is ideal for high-speed device characterization such as ECL, CMOS, ACL, and GaAs testing. The 100 kΩ input impedance and 0.5 pF capacitance results in very low loading of the device under test. The 7 V dynamic range and ±3.5 V offset range, makes the SD-14 suitable for testing all digital logic families as well as most analog circuits.

The SD-14 consists of two samplers, each attached at the end of a 1.0 meter cable for easy circuit probing. The modular architecture of the CSA 803A/11801B enables the use of extended samplers, bringing a new level of performance to sampling scopes. In conjunction with the 11801B and SM-11 multi-channel unit, it is possible to configure up to 136 channels of high-impedance, high-bandwidth acquisition with measurement accuracy approaching 140 ps.

SD-14 Option 01 adds a longer probe tip, two probe-to-ECB (etched circuit board) adapters, and two probe-to-SMB adapters. These ease probing of plated holes (as found in Outboards for IC testers) and semi-permanent connections.

SD-20 Loopthrough Sampling Head

The SD-20 is a single-channel, 20 GHz loopthrough sampling head designed for low-loss testing in applications such as microwave systems research and development, digital device characterization, and high-speed digital communications circuit design. It provides an acquisition rise time of 17.5 ps, with typically 750 µV RMS of noise (350 µV with smoothing) to ensure clean, undistorted signals.

The SD-20 is non-terminated and keeps losses to a minimum by routing the signal of interest directly through the sampling head without the need of a power divider. The SD-20 can also be used for customized TDR measurements of transmission lines and controlled impedance devices. An external signal generator may be used, instead of the SD-24 step generator, to tailor the TDR stimulus to fit a particular situation. For instance, slower slew rates or higher amplitude may be utilized, or you may perform half-sine or impulse testing.

In digital communications, the SD-20 is useful for viewing and triggering on the clock signal without the use of a power divider.

SD-22 Low-noise Sampling Head

The SD-22 is a dual-channel, 12.5 GHz sampling head specifically designed for low-noise measurement in digital communications and device characterization applications. It provides an acquisition rise time of 28 ps, and typically 450 µV RMS of displayed noise. With smoothing, noise levels are 180 µV RMS.

In order to precisely capture and display the switching characteristics of high-speed communications circuits, to make accurate statistical measurements of signal noise and signal timing jitter, or to obtain stable timing measurements of fast digital ICs, the noise floor of the test equipment must be kept to a minimum. The SD-22 is the ideal instrument for these low-noise applications.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

Sampling Heads

SD-14/-20 • SD-22/-24 • SD-26/-30 • SD-32/-42 • SD-46/-51

Features

SD-24
- TDR/Sampling Head
- Dual-channel, Differential TDR
- 20 GHz Bandwidth
- 35 ps Reflected Rise Time
- Line Impedance and Crosstalk Characterization

SD-26
- 20 GHz Bandwidth
- Dual-channel

SD-30
- 40 GHz Bandwidth
- Single-channel
- High Bandwidth Communications and Microwave Applications
- 2.9 mm Connector

SD-32
- 50 GHz Bandwidth
- Single-channel
- 2.4 mm Connector

SD-42*1
- Optical-to-Electrical Converter
- DC to 6.4 GHz Optical Bandwidth
- 1000-1700 nm Wavelength Range

SD-46*1
- Optical-to-Electrical Converter
- 20 GHz Optical Bandwidth
- 1200 nm to 1650 nm Spectral Response

SD-51
- Trigger-countdown Head
- 1 to 20 GHz Bandwidth
- Less Than 6 ps RMS Jitter

*1 For more information on this product, see the Telecommunications Products section of this catalog.

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See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

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SD-24 TDR/Sampling Head

The SD-24 is a dual-channel TDR/Sampling Head. This sampling head has a rise time of 17.5 ps or less, with a typical 20 GHz equivalent bandwidth.

Each channel of the SD-24 is also capable of generating a fast rising step for use in Time Domain Reflectometry (TDR). In TDR mode, the acquisition portion of the sampling head monitors the incident step and any reflected energy. The reflected rise time of the TDR step is 35 ps or less. The polarity of each channel's TDR step can be selected independently of the other channel. This allows for differential or common-mode testing of two coupled lines, in addition to the independent testing of isolated lines. The SD-24 can be used to characterize crosstalk by using the TDR step to drive one line while monitoring a second with the other channel.

The "filter" function on the CSA 803A/11801B can be used with TDR or crosstalk measurements to characterize a system at a slower rise time.

SD-26 Sampling Head

The SD-26 is a dual-channel, 20 GHz equivalent bandwidth sampling head. This sampling head has the same acquisition capability as the SD-24 TDR/Sampling Head but does not include the TDR step generators.

SD-30 Sampling Head

The SD-30 is a single-channel, 40 GHz bandwidth sampling head for use in high bandwidth applications. This sampling head was specifically designed for characterizing high-speed devices used in advanced data communications and microwave systems research. This performance is available for any new or existing CSA 803A/11801B mainframe without having to upgrade to a new system, a result of the modular architecture of the CSA 803A/11801B family. The SD-30 has a measured bandwidth of greater than 40 GHz and a calculated rise time of less than 8.8 ps.

SD-32 Sampling Head

The SD-32 is a single-channel, 50 GHz bandwidth sampling head. The SD-32 performance is available for any new or existing CSA 803A/11801B mainframe. The SD-32 has measured bandwidth of greater than 50 GHz and calculated rise time less than 7.0 ps.

The front-panel connector is female 2.4 mm, and an adaptor is provided (011-0157-00; 2.4 mm male to 2.92 mm female) in order to maintain compatibility with SMA connector systems.

SD-42 Optical-to-Electrical Converter*1

The SD-42 Optical-to-Electrical Converter head can be used to analyze optical signals in the 1000 nm to 1700 nm wavelength range. The pulse response of the measurement system is less than 55 ps FWHM (Full-width, Half-maximum), which is equivalent to a calculated bandwidth of DC to 6.4 GHz. The electrical output on the front panel is coupled to the adjacent sampling head via the semi-rigid coaxial link provided.

The SD-42 is also equipped with an optical power meter for average power monitoring through a pair of voltage outputs on the front panel. Power from 5 nW to 5 mW can be measured.

SD-46 Optical-to-Electrical Converter*1

The SD-46 is an Optical-to-Electrical converter for use with the CSA 803A/11801B Series Oscilloscopes equipped with an SD-22, SD-24, SD-26, SD-30, or SD-32 Sampling Head. The SD-46 is linear up to 25 mW peak input with a calibrated deflection factor from 50 µW/div to 5 mW/div at 1300 nm. This head has a 25 ps optical pulse response (maximum FWHM) with the SD-24 and SD-26.

SD-51 Trigger Head

The SD-51 Trigger-countdown Head provides stable displays of signals from 1 to 20 GHz with less than 6 ps RMS jitter.

The SD-51 is a free-running tunnel diode oscillator with a front-panel control to synchronize the oscillator to a subharmonic of the input signal and the output oscillator to a subharmonic of the input signal. The output from the SD-51 is coupled to the CSA 803A/11801B Series trigger input connector. The output signal is a direct countdown of the input (and the input connector) and permits triggering by the sampling time base unit.

Sampling Heads

SD-14/-20 • SD-22/-24 • SD-26/-30 • SD-32/-42 • SD-46/-51

SAMPLING HEAD CHARACTERISTICS

	Channels	Bandwidth	Rise Time	Impedance	Noise	Applications (Typical)
SD-14	2	3 GHz (typical)	140 ps	100 kΩ/0.5 pF 0.55 pF Opt. 01	2 mV	ECL, CMOS, ACL GaAs Dev. Characterization
SD-20	1	20 GHz	17.5 ps	50 Ω unterm.	750 µV	Special TDR, Communications
SD-22	2	12.5 GHz	28 ps	50 Ω	450 µV	Communications
SD-24	2	20 GHz	17.5 ps	50 Ω	750 µV	TDR/TDT Crosstalk
SD-26	2	20 GHz	17.5 ps	50 Ω	750 µV	Device Characterization
SD-30	1	40 GHz	8.8 ps	50 Ω	1.8 mV	High Bandwidth Communications & Microwave
SD-32	1	50 GHz	7.0 ps	50 Ω	1.8 mV	High Bandwidth Communications & Microwave
SD-42	1	6.4 GHz	–	–	–	Optical-to-Electrical
SD-46	1	20 GHz	–	–	–	Optical-to-Electrical
SD-51	–	20 GHz	–	50 Ω	–	Trigger Countdown Head

Characteristics

Acquisition System – SD-14, SD-22, SD-24, SD-26: dual channel; SD-20, SD-30, SD-32: single channel.

Rise Time – SD-14: 140 ps; SD-20, SD-24, SD-26: 17.5 ps; SD-22: 28 ps, all from 10% to 90%.

Bandwidth – 3 GHz (typical) for the SD-14; 20 GHz for the SD-20, SD-24, and SD-26; 12.5 GHz for the SD-22; 40 GHz for the SD-30; 50 GHz for the SD-32.

Dynamic Range – 1 V p-p within a ±1.6 V range for the SD-20, SD-22, SD-24, SD-30, SD-32; 7 V p-p within a ±3.5 V offset range for the SD-14.

Dot Transient Response – Accuracy after calibration at operating temperature is ±5% for signals up to 0.5 V p-p. Adjustable to unity for signals up to 1.0 V p-p.

Input Impedance – SD-22, SD-24, SD-26, SD-30, SD-32: 50 Ω ±0.5 Ω. SD-14 is 100 kΩ and 0.5 pF (0.55 pF for Option 01). SD-20 is not terminated and not rated.

Displayed Noise –

With unity dot response:	Maximum	Typical
SD-20, SD-24, SD-26	1.2 mV	750 µV
SD-22	800 µV	450 µV
SD-14	8 mV	7 mV
SD-30	2.3 mV	1.8 mV
SD-32	2.3 mV	1.8 mV
With smoothing:		
SD-20, SD-24, SD-26	550 µV	350 µV
SD-22	400 µV	180 µV
SD-30	1 mV	700 µV
SD-32	1 mV	700 µV

Aberrations (typical) (SD-20, SD-22, SD-24, SD-26 only) – The following are acquisition aberrations. 10 ns to 20 ps before step: ±3% or less. <300 ps after step: +10%, –5% or less. 300 ps to 5 ns after step: ±3% or less. 300 ps to 5 ns after step: ±4 or less (SD-20 only). 5 ns to 100 ns after step: ±1% or less. Elsewhere: ±0.5% or less.

Aberrations (typical) (SD-14 only) – <1.5 ns after step: +12%, –25%, 1.5 ns to 4 ns after step: +1%, –3%, 4 ns to 30 ns after step: ±2%. Elsewhere: ±1%.

Maximum Input Voltage – ±3 V. SD-14: ±15 V; SD-30, SD-32: ±2 V.

Isolation Between Channels – 1% p-p voltage transmission from the channel driven by the 067-1338-00, to the quiescent channel (see page 104 in this catalog).

Time Coincidence Between Channels – 10 ps accuracy; <0.2 ps/°C stability.

TDR SYSTEM (SD-24 ONLY)
Displayed Rise Time.

Incident – 28 ps typical, 10% to 90%, at +250 mV or –250 mV output, elsewhere ±1%.

Reflected – 35 ps or less, 10% to 90%, at +250 mV or –250 mV output.

TDR Step Amplitude – Adjustable to ±250 mV (polarity of either step may be inverted).

Time Coincidence Between TDR steps – Adjustable to less than 1 ps.

Source Resistance – 50 Ω ±0.5 Ω.

Aberrations (at ±250 mV amplitude) – The following are TDR aberrations. 10 ns to 20 ps before step: ±3% or less. <300 ps after step: +10%, –5% or less. 300 ps to 5 ns after step: ±3% or less. Elsewhere: ±1% or less.

ENVIRONMENTAL AND SAFETY CHARACTERISTICS
(11801B, CSA 803A, SM-11, SD-Series Heads)

Temperature – Operating: 0°C to +50°C; Nonoperating: –40°C to +75°C.

Altitude, Vibration, Shock, Bench Handling – Operating and nonoperating: meets MIL-T-28800C, Type III, Class 5.

Safety – Listed UL 1244 (not SD-14, SD-30, SD-32, SD-42, SD-46), CSA Bulletin 556B, September 1973.

Electromagnetic Compatibility (not SD-14) – Meets the following requirements of MIL-STD-461C: CE-03 Pt 4 Curve 1, CS-01 Pt 7, CS-02 Pt 4, CS-06 Pt 5, RE-02 Pt 7, RS-01 Pt 4, RS-02 Pt 5, RS-03 Pt 7 (limited to 1 GHz). Meets FCC Part 15, subpart J, Class A. For Germany: Meets VDE 0871/6.78 Class B. (Not all for SD-14.)

Humidity – To 95% RH at up to 50°C.

Characteristics (SD-51)

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 max.

Input Characteristics – 50 Ω SMA (3 mm) connector. Open termination paralleled by 1 pF.

Trigger Output – Approximately 200 mV into 50 Ω. Jitter is 6 ps RMS or less with signals from 5 to 20 GHz; 7 ps RMS or less with signals from 1 to 5 GHz. Kickout at signal input is 180 mV peak; kickout occurs between successive samples.

Sampling Heads

SD-14/-20 • SD-22/-24 • SD-26/-30 • SD-32/-42 • SD-46/-51

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

SD-14
High Impedance Probe Sampler.
Includes: Installation/User Manual (070-8286-01); Service Manual (070-8285-01); 4-post ECB Mount Ground Socket; Edge Tab Ground Socket; 10 ea. Wire-form Ground, .050 Spacing; 10 ea. Wire-form Ground, .040 Spacing; Plastic Accessories Case.
Opt. 01 – Longer Probe Tip, Probe to ECB Adapters, Probe to SMB Adaptors.

SD-20
Loopthrough Sampling Head.
Includes: Installation/User Reference (070-7531-01), Service Reference (070-7528-01), Precision 3.5-mm Termination (011-0155-00), 2 SMA Short-circuit Terminations (015-1020-00).

SD-22
Low-Noise Sampling Head.
Includes: Installation/User Reference (070-7226-02), Service Reference (070-7227-02), 2 SMA Short-circuit Terminations (015-1020-00).

SD-24
Dual TDR/Sampling Head.
Includes: Installation/User Reference (070-7052-01), Service Reference (070-7053-01), SMA Short-circuit Terminations (015-1020-00).

SD-26
Dual Sampling Head.
Includes: Installation/User Reference (070-7226-02), Service Reference (070-7227-02), 2 SMA Short-circuit Terminations (015-1020-00).

SD-30
Sampling Head.
Includes: Installation/User Manual (070-7904-01); Service Manual (070-7905-01); 1 SMA Short-circuit Termination (015-1020-00).

SD-32
Sampling Head.
Includes: Installation/User Reference (070-8268-01); Service Reference (070-8269-01); 1 SMA Short-circuit Termination (015-1020-00); 2.4 mm Male to 2.92 mm Female Adapter (011-0157-00).

SD-42
Optical-to-Electrical Converter.
See the Telecommunication Instruments section for complete information.

SD-46
Optical-to-Electrical Converter.
See the Telecommunication Instruments section for complete information.

SD-51
Trigger Head.
Includes: Installation/User Manual (070-7338-01), Service Reference (070-7339-01), 12 in. SMA Male-to-Male (174-1364-00).

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection SD-14, SD-20, SD-22, SD-26.
SD-24, SD-30, SD-32.

Opt. C5 – Adds five years of Calibration Services SD-14, SD-20, SD-22, SD-26.
SD-24, SD-30, SD-32.

RECOMMENDED ACCESSORIES – Also see page 434.
PROBES
50 Ω Divider Probes –
2 tips: 1X, 10X. 1X: 3 GHz, 50 Ω; 10X. 9 GHz, 0.15 pF/500 Ω, 1 m. Order P6150.
3.5 GHz, 1 pF/500 Ω, 10X 3 GHz, 1.1 pF/ 5000 Ω, 100X, 1.5 m. Order P6156 Opt. 25.
Optional Tips: 1X, 10X, 20X, 100X, see page 455.
Requires SMA Male-to-BNC female adapter when attached to SMA-type inputs.
Order 015-0554-00.

ADDITIONAL ACCESSORIES – Also see page 434.
2X Attenuator – SMA Male-to-Female. Order 015-1001-00.

5X Attenuator – SMA Male-to-Female. Order 015-1002-00.

75 Ω to 50 Ω Min Loss Attenuator – BNC. Order 011-0112-00.

Power Divider – Order 015-1014-00.

Blank Sampling Head – Order 200-3395-00.

SMA Accessory Kit – 2 ea. 2X and 5X Attenuators; 2 ea. SMA Terminations, Male Short Circuit, Female Short Circuit, Male 50 Ω, Female 50 Ω, 2 ea. 50 Ω Signal Cables (2 ns), 2 ea. 500 ps Semi-rigid Cable, 2 ea. Male-to-Male Adapters, 2 ea. SMA Male-to-BNC Female, 2 ea. Female-to-Female, 1 ea. 50 Ω Power Divider, 1 ea. Combination Wrench (.312, 6 point). Order 020-1693-00.

3.5 mm Accessory Kit – 1 ea. 50 Ω Reference Air Line, 1 ea. Male-to-Male Adapter, 1 ea. Female-to-Female Adapter, 1 ea. 26.5 GHz 50 Ω Terminator (Male), 1 ea. 26.5 GHz 50 Ω Terminator (Female), 1 ea. 26.5 GHz Short Circuit (Male), 1 ea. 26.5 GHz Short Circuit (Female), 2 ea. 50 Ω Attenuators (6 dB 26.5 GHz, 2.9 mm), 2 ea. 50 Ω Attenuators (20 dB 26.5 GHz, 2.9 mm), 1 ea. Power Divider (26.5 GHz, 2.9 mm), 2 ea. Flexible Signal Cables (2 ns, Male-to-Male), 2 ea. Signal Cables (500 ps, Male-to-Male, 2.9 mm Semi-rigid), 1 ea. Torque Wrench, 1 ea. Combination Wrench (0.312, 6 point), 1 ea. Combination Wrench (0.281, 6 point). Order 020-1692-00.

ECL Terminator – Provides the bias and termination for ECL device outputs. At 10 GHz bandwidth and 1% precision attenuation, accurate AC and DC measurements are ensured. Attenuation: 10X ±1.0% @ DC, 20 dB ±3 dB, DC to 10 GHz. Aberrations: ±3% max with 100 ps Rise Time. Order 015-0558-00.

DC Block (Coupling Capacitor) – BNC. Order 015-1013-00.

Slip-on Connector – Order 015-0553-00.

Connector Savers – (SMA) Order 015-0549-00. (APC) Order 015-0552-00.

CABLES AND EXTENDERS
Sampling Head Extender Cables – (1 m) Order 012-1220-00. (2 m) Order 012-1221-00.

Acquisition Extender – Order 067-1324-00.

Acquisition System Extender – Order 067-1323-00.

Card Cage Extender – Order 067-1267-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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Tektronix Measurement products are manufactured in ISO registered facilities.

Multi-channel Unit Delay Line

SM-11 • DL-11 • SIU 800

Features

SM-11

- Multi-channel TDR and Simultaneous Acquisition
- Up to 136 Acquisition Channels When Connected to the 11801B Digital Sampling Oscilloscope

DL-11

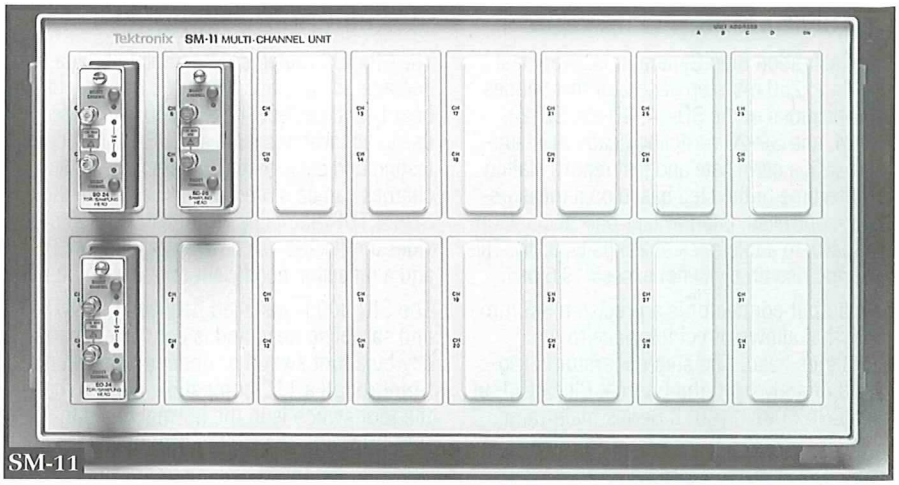
- 47.5 ns Compensated Dual Delay Line
- 5 GHz Bandwidth

CALIBRATION STEP GENERATOR

- 250 mV
- Verifies Specifications of SD-14, SD-20, SD-22, SD-24, SD-26 Sampling Heads

SIU 800

- <40 PS Reflected Rise Time When Used with SD-24
- <80 mp Reflection Coefficient



The SM-11 Multi-channel Unit can accept up to 16 SD-Series Sampling Heads.

SM-11 Multi-channel Unit

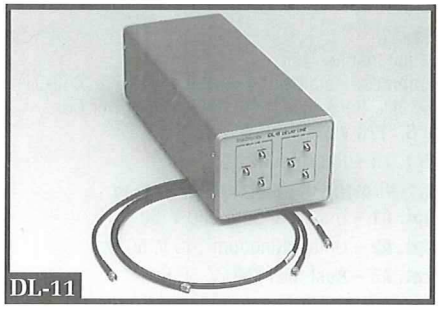
The SM-11 Multi-channel Units expand the 11801B Digital Sampling Oscilloscope to 136 channels. Each SM-11 accepts up to 16 of the SD-Series Sampling Heads; an 11801B mainframe, with Option 1M added, is capable of driving up to four SM-11 Units. The entire system can then be driven through a single GPIB address.

The 11801B/SM-11 acquisition system is designed to acquire up to 68 channels in a single acquisition. Thus, in two acquisition cycles, all 136 channels can be acquired.

The hardware measurement capability of the 11801B 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.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	558	22	550	21.6
Weights	**kg**	**lb.**	**kg**	**lb.**
Net	20.0	44	20.9	46
Shipping	23.6	52	24.5	54



DL-11 Delay Line

The DL-11 Delay Line provides approximately 47.5 ns of delay from the signal input to the signal output. The DL-11 contains two delay lines that, when connected, allow you to view the triggering event through the 11801B or CSA 803A. The DL-11 has approximately 5 GHz bandwidth and attenuates the signal by 50%.

A delay line can reduce horizontal jitter and provide more accurate measurements, because it lets you take measurements on the first rising edge of the triggering event.

The DL-11 Delay Line contains two delay lines each with 47.5 ns delay. The DL-11 is used for showing the triggering event of a signal displayed on an 11801B or a CSA 803A.

PHYSICAL CHARACTERISTICS

Dimensions	**mm**	**in.**
Width	159	6.3
Height	119	4.7
Depth	356	14.0
Weight	**kg**	**lb.**
Net	2.2	10
Shipping	3.08	14

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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Tektronix Measurement products are manufactured in ISO registered facilities.

Static Isolation Unit/Calibration Step Generator

SM-11 • DL-11 • SIU 800

Calibration Step Generator

The Calibration Step Generator is a very fast rise time, 250 mV step generator that verifies specifications of the SD-14, SD-20, SD-22, SD-24, and SD-26 sampling heads. It is supplied with a certificate and test report, stating the rise time of the step based on a measurement-controlled, internal Tektronix acquisition standard, to a tolerance of 2.5 ps typically. This reported rise time will not exceed 19.5 ps.

The output connector is a precision 3.5 mm male that allows direct interface to the SD-Series head. The step generator is triggered directly from the Internal Clock Output on a CSA 803A/11801B Series mainframe.

SIU 800 Static Isolation Unit

The SIU 800 protects the sampling bridge from damage due to static discharge from circuit boards and cables. The SIU 800 is intended for use in applications such as TDR circuit board testing and cable testing where large static charges can be stored. When used with the SD-24 TDR/Sampling Head, the SIU 800 provides a reflected rise time of less than 40 PS and a reflection coefficient of less than 80 mp.

The SIU 800 is installed between the DUT and sampling head and is controlled manually by a foot switch or under program control through a TTL-compatible input. When the foot switch is in the normal position (not pressed), the DUT is grounded through a 50 Ω termination resistor. This will discharge any static charge stored in the DUT. Pressing the foot switch connects the DUT to the sampling head input, allowing a measurement to be made. Both channels are controlled simultaneously by the foot switch or TTL input.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	23.28	0.95
Height	71.05	2.9
Depth	91.39	3.8
Weight	**kg**	**lb.**
Net	0.205	0.69
Shipping	0.441	2.0

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

SM-11
Multi-channel Unit.
Includes: Installation/User Manual (070-7048-01), Service Reference (070-7049-01), Power Cord, U.S., 120 V (161-0066-00).

Opt. 1R – Rackmount.

INTERNATIONAL POWER PLUG OPTION
Opt. A1 – Universal Euro 220 V, 50 Hz.
Opt. A2 – United Kingdom 240 V, 50 Hz.
Opt. A3 – Australian 240 V, 50 Hz.
Opt. A4 – North American 240 V, 60 Hz.
Opt. A5 – Switzerland 220 V, 50 Hz.
See Customer Information Section for additional description.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES – Also see page 434.
PROBES
50 Ω Divider –
10X, DC to 9 GHz. Order P6150.3.5 GHz, 1 pF/500 Ω, 10X, 3 GHz, 1.1 pF/ 5000 Ω, 100X, 1.5 m. Order P6156 Opt. 25. Requires SMA Male-to-BNC Female Adapter when attached to SMA-type inputs. Order 015-0554-00.

ADDITIONAL ACCESSORIES – Also see page 434.
SMA Accessory Kit – 2 ea. 2X and 5X Attenuators; 2 ea. SMA Terminations, Male Short Circuit, Female Short Circuit, Male 50 Ω, Female 50 Ω, 2 ea. 50 Ω Signal Cables (2 ns), 2 ea. 500 ps Semi-rigid Cable, 2 ea. Male-to-Male Adapters, 2 ea. SMA Male-to-BNC Female, 2 ea. Female-to-Female, 1 ea. 50 Ω Power Divider, 1 ea. Combination Wrench (.312, 6 point). Order 020-1693-00.

3.5 mm Accessory Kit – 1 ea. 50 Ω Reference Air Line, 1 ea. Male-to-Male Adapter, 1 ea. Female-to-Female Adapter, 1 ea. 26.5 GHz 50 Ω Terminator (Male), 1 ea. 26.5 GHz 50 Ω Terminator (Female), 1 ea. 26.5 GHz Short Circuit (Male), 1 ea. 26.5 GHz Short Circuit (Female), 2 ea. 50 Ω Attenuators (6 dB 26.5 GHz, 2.9 mm), 2 ea. 50 Ω Attenuators (20 dB 26.5 GHz, 2.9 mm), 1 ea. Power Divider (26.5 GHz, 2.9 mm), 2 ea. Flexible Signal Cables (2 ns, Male-to-male), 2 ea. Signal Cables (500 ps, Male-to-male, 2.9 mm Semi-rigid), 1 ea. Torque Wrench, 1 ea. Combination Wrench (0.312, 6 point), 1 ea. Combination Wrench (0.281, 6 point). Order 020-1692-00.

2X Attenuator – SMA Male-to-Female. Order 015-1001-00.

5X Attenuator – SMA Male-to-Female. Order 015-1002-00.

Power Divider – Order 015-1014-00.

Blank Sampling Head – Order 200-3395-00.

ECL Terminator – Provides the bias and termination for ECL device outputs. At 10 GHz bandwidth and 1% precision attenuation, accurate AC and DC measurements are ensured. Attenuation: 10X ±1.0% @ DC, 20 dB ±3 dB, DC to 10 GHz. Aberrations: ±3% max with 100 ps Rise Time. Order 015-0558-00.

DC Block (Coupling Capacitor) – Order 015-1013-00.

Slip-on Connector – Order 015-0553-00.

Connector Savers –
(SMA) Order 015-0549-00.
(APC) Order 015-0552-00.

CABLES AND EXTENDERS
Sampling Head Extender Cables
(1 m) Order 012-1220-00.
(2 m) Order 012-1221-00.

Acquisition Extender – Order 067-1324-00.

Acquisition System Extender –
Order 067-1323-00.

Card Cage Extender – Order 067-1267-00.

DL-11
Delay Line.
Includes: Installation/User Manual (070-7050-01), Instruction Sheet (070-7051-01), 20 in. Coaxial Cable, RF 50 Ω (174-1427-00), 60 in. Coaxial Cable, RF 50 Ω (174-1428-00).

CALIBRATION STEP GENERATOR
U.S. – Order 067-1338-00.
Includes: Instruction Sheet, Test Report, SMA Female Short-circuit Termination.

Universal Euro – 220 V, 50 Hz – Order 067-1338-01.

United Kingdom – 240 V, 50 Hz – Order 067-1338-02.

Australia – 240 V, 50 Hz – Order 067-1338-03.

Switzerland – 240 V, 50 Hz – Order 067-1338-05.

Japan – 100 V, 50-60 Hz – Order 067-1338-06.

SIU 800
Static Isolation Unit.
Includes: 12 V DC Power Supply, Two SMA, Male-to-female Adapters, Foot Switch, Two 50 Ω Terminators, and an Instruction/Performance Verification Manual.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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Tektronix Measurement products are manufactured in ISO registered facilities.

Digital/Analog Real Time Oscilloscopes

How to Choose the Right Portable Scope for Your Measurement Needs

To choose the right scope, first characterize your signal and decide if you need full-featured advanced performance or economical standard performance. An advanced 150 MHz oscilloscope is the most popular choice for most service and repair needs. With the addition of digital display technology, you can capture and analyze more types of signals. Finally, select a product class that meets your productivity needs and offers features to improve your measurement confidence. These enhancements make it easy to get fast and accurate results. The best in class products represent the latest offerings in each performance level.

The oscilloscope reference section provides additional information to assist you in your selection process.

ANALOG PLUS DIGITAL OSCILLOSCOPES

Model	Bandwidth	Sample Rate	Record Length	Vertical Resolution	Channels	Interfaces	Time Bases	Page
2430A*[1]	150 MHz	100 MS/s	1 K	8-Bits	2	GPIB	Dual	106
2440*[1]	300 MHz	500 MS/s	1 K	8-Bits	2	GPIB	Dual	106

*[1] *See page 106 for replacement products for 2430A and 2440.*

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2430A 150 MHz 106
2440 300 MHz.....106

200 SERIES

224 60 MHz.....108

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SMD Probes/Adapters.....470
Probe and Instrument Accessories 476
Plotter/Printer 515
Cameras.....518
Instrumentation Carts 520

Digitizing Oscilloscopes

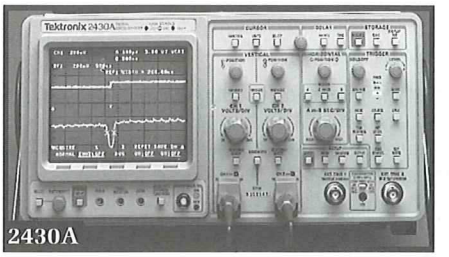
TDS 420A • TDS 520A • 2430A • 2440

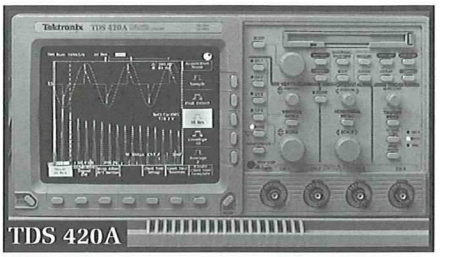
Note to our Valued 2430A and 2440 DSO Customers:

The 2430A and 2400 DSOs have served their markets very well and have been replaced by the new generation of TDS Series. The TDS Digitizing Oscilloscopes offer numerous performance advantages over the 2400 Series in terms of Accuracy, Acquisition Flexibility, Input/Output Capability, Easy-to-use Graphical User Interface, and Lower Price!

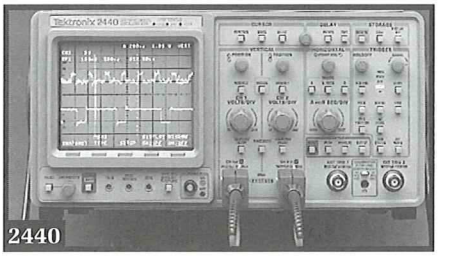
The following summary tables highlight the key performance differences between the TDS family and 2400 Series DSOs. We at Tektronix are proud to continually deliver superior value to our customers.

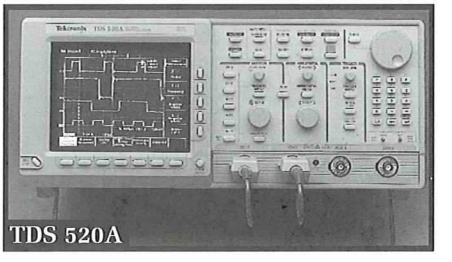
Please contact us for any assistance you require in making your Digitizing Oscilloscope selection. In U.S., call toll free: 1-800-835-9433, Ext. 2400 or contact your nearest Tektronix representative. Please refer to the pages in the back of the catalog for Tektronix contacts in your region.





	2430A	→	TDS 420A
Bandwidth	150 MHz		200 MHz
Sample Rate	100 MS/s		100 MS/s
Channels	2 Channels		4 Channels
Vertical Accuracy	2% Vertical Accuracy		1.5% Vertical Accuracy
Single Shot BW	40 MHz		40 MHz
Auto Measure	21 Auto Measurements		25 Auto Measurements
Auto Setup	Yes		Yes
Record Length	1 K		30K (120 K Optional)
Update Rate	30 Hz		150 Waveforms/sec
I/O Transfer	GPIB only		GPIB, RS-232, Centronics
Roll Mode	Yes		Yes + Triggered Roll
Horizontal Range	5 ns to 5 seconds		1 ns to 20 seconds
Display Size	5 in. CRT Size		7 in. CRT Size
User Interface	Normal		Graphical User Interface
Advanced Math	None		FFT, Differentiate, Integrate (Optional)
Printer Pack	None		Optional





	2440	→	TDS 520A
Bandwidth	300 MHz		500 MHz
Sample Rate	500 MS/s		500 MS/s
Channels	2 Channels		2 + 2 Channels
Vertical Accuracy	1.5% Vertical Accuracy		1% Vertical Accuracy
Single Shot BW	200 MHz		200 MHz
Auto Measure	21 Auto Measurements		25 Auto Measurements
Auto Setup	Yes		Yes
Record Length	1 K Memory		15 K (50K Optional)
Update Rate	30 Hz		200 Hz
I/O Transfer	GPIB only		GPIB, RS-232, Centronics
Roll Mode	Yes		No
Horizontal Range	5 ns to 5 seconds		1 ns to 20 seconds
Display Size	5 in. CRT Size		7 in. CRT Size
User Interface	Normal		Graphical User Interface
Advanced Math	None		FFT, Differentiate, Integrate (Optional)

Analog Oscilloscopes

2465B • 2467B

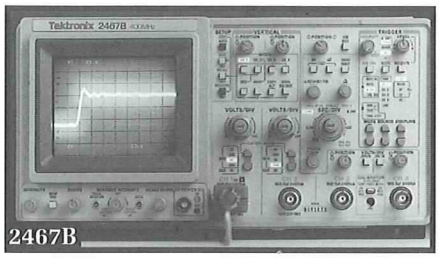
Note to Tektronix 2465B and 2467B Customers.

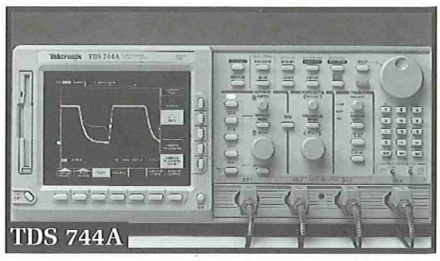
The 2465B/2467B analog oscilloscopes continue to solve complex measurement problems. While a preferred measurement tool for many of our valued customers, digitizing storage oscilloscopes (DSO's) continue to steadily replace analog oscilloscopes in most applications. Today Tektronix' TDS Series digitizing oscilloscopes offer most of the capabilities our customers have come to expect on analog models.

The adjoining tables illustrate some of Tektronix' very popular digitizing oscilloscopes. These four channel TDS Series oscilloscopes come closest to the current 2467B and 2465B in overall performance. The TDS 744A with 400,000 waveform acquisitions per second (using InstaVu™ acquisition) is the recommended choice for the fast writing rate 2467B oscilloscope. The TDS 640A and TDS 460A are likely alternatives for the 2465B oscilloscopes.

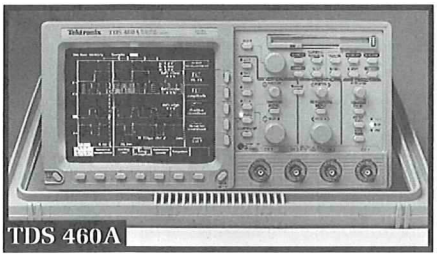
We recommend you call your local Tektronix representative to discuss the best alternative for your measurement situation. In the U.S. call toll free 1-800-835-9433, Ext. 2400.

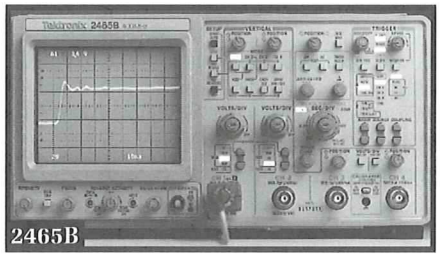
Please refer to pages in the back of this catalog for Tektronix contacts in your region.





	2467B →	TDS 744A
Technology	Analog Micro Channel Plate	Digital Storage with InstaVu™
Bandwidth	400 MHz	500 MHz
Channels	2 + 2	4 Full Channels
Vertical Accuracy	±2%	±1%
Auto Measure	8 Measurements	25 Measurements
Auto Setup	Yes	Yes
Waveform Storage	None	500,000 points/channel
Update Rate	>400,000 Waveforms/sec	>400,000 Waveforms/sec
I/O Transfer	GPIB	GPIB, RS-232, Centronics
Horizontal Range	5 ns to 500 ms/div	500 ps to 10 sec/div
Display Size	5 in. CRT Size	7 in. CRT Size
User Interface	Normal	Graphical User Interface
Advanced Math	None	FFT, Differentiate, Integrate
Printer	None	Optional
Floppy Drive	None	Standard 3.5 in. FD







	← TDS 460A*1	2465B	→ TDS 640A*1
Technology	Digital Storage	Analog	Digital Real Time
Bandwidth	400 MHz	400 MHz	500 MHz
Channels	4 Full Channels	2 + 2	4
Vertical Accuracy	±1.5%	±2%	±1.5%
Auto Measure	25 Measurements	8 Measurements	25 Measurements
Auto Setup	Yes	Yes	Yes
Waveform Storage	120,000 points/channel	None	2,000 points/channel
I/O Transfer	GPIB, RS-232, Centronics	GPIB	GPIB, RS-232 Centronics (Optional)
Roll Mode	Triggered and Untriggered Roll	None	None
Horizontal Range	1 ns to 20 sec/div	5 ns to 500 ms/div	500 ps to 5 sec/div
Display Size	7 in. CRT Size	5 in. CRT Size	7 in. CRT Size
User Interface	Graphical User Interface	Normal	Graphical User Interface
Advanced Math	FFT, Differentiate, Integrate (Optional)	None	FFT, Differentiate, Integrate (Optional)
Printer Pack	Yes (Optional)	None	Yes (Optional)
Floppy Drive	3.5 in. DOS FD (Optional)	None	3.5 in. DOS FD (Optional)

**1 Products available through your local Tektronix distributor.*

Handheld Digitizing Oscilloscope

224

Features

224

- Isolated Channel™ Architecture
- Floatable to ±850 V/channel
- 60 MHz Bandwidth
- 100 ns Glitch Capture
- 6 kV Peak Surge Rating
- Video Line Trigger
- Auto Trigger
- Save Reference Memory
- Dual 10 MS/s Digitizers
- Programmable via RS-232-C
- Auto Setup
- Save Setup
- Detachable 1X/10X Probes
- Rugged Construction
- Battery Operated
- 4.4 lbs

Applications

- Power Measurements
- Electronic Device Debug
- TV and Video Signal Troubleshooting
- Safe High-voltage Measurements
- Remote Signal Monitoring and Service (with CAT200 software)
- Useful in Low Temperature Environments



224

224

The 60 MHz 224 samples at 10 MS/s for each channel has an RS-232-C interface and is fully programmable. Internal batteries eliminate the need for external power. This handheld scope can also charge and operate from 12-28 V DC or 16-20 V AC.

UNMATCHED SAFETY

To ensure ultimate operator safety, the channels are fully isolated from each other, and the casing is double insulated. Because it is floatable to ±850 V per channel, the 224 can make measurements safely on industrial power systems. It is the first scope to be UL listed for line voltage measurements to 600 V AC, and is specified to withstand peak surges as high as 6 kV.

UNMATCHED VERSATILITY

The 224, because of its size, bandwidth, and portability, is a perfect tool for high-speed electronics that can't be easily returned to a repair shop, such as ATMs or avionics. The 224's exclusive TV trigger makes it just the thing for servicing medical imaging systems or closed-circuit surveillance equipment.

UNMATCHED FEATURES

Auto Setup and Save/Recall limit the need for manipulation of the front panel. Pushing the Auto Setup button selects all the input parameters for you. Save/Recall boosts productivity in repetitive testing at different locations by saving up to four front-panel setups.

After you've acquired a waveform using Auto Setup, you may save it in one of four 512 byte records. Then, recall a known good signal for comparison and make the necessary adjustments to bring the equipment on line.

To make a permanent record, simply connect the scope to your PC via the RS-232-C interface and transfer waveforms and setups using the optional CAT200 Software. Send them back to the scope when that same job is due again. With CAT200 Software, you can control the entire front panel from a remote location using the RS-232-C port, a modem, and a phone line.

The WP200 Intelligent Printer Interface allows you to make a hardcopy of a displayed waveform on an Epson-compatible printer – without using a PC and dedicated software.

UNMATCHED RUGGEDNESS

The 224 is packaged in impact-resistant plastic, capable of withstanding 50 g's of shock. It can operate accurately to temperatures as low as –10°C. The batteries allow a minimum of three hours of operation. Each scope comes complete with a ballistic nylon carrying case with a neck strap for hands-free operation.

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

See Tektronix on the World Wide Web: http://www.tek.com

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Tektronix Measurement products are manufactured in ISO registered facilities.

Handheld Digitizing Oscilloscopes
224

Characteristics

Bandwidth – 60 MHz.
Digitizers/Channels – 2.
Rise Time – 5.8 ns.
Sample Rate (each channel) – 10 MS/s.
Vertical Resolution – 8-Bit.
Vertical Sensitivity – 50 mV to 500 V/div.
Sweep Speed – 5 ns to 20 s/div.
Time Base – Single.
Acquisition Modes – Normal, Averaging, Peak Detect, Accumulated Peak.
Peak Detect/Glitch Capture – 100 ns.
Record Length – 512 bytes.
Independently Floatable Isolated Channels – ±850 V (DC or pk AC) or 600 V AC.
Video Field and Line Trigger – Yes.
I/O Interface – RS-232-C.
Minimum Battery Life – 3 hours.
Battery Charge Time – 3 hours.
Warranty – 3 years.
Safety Certification – UL, CSA.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

224
60 MHz Handheld DSO.
Includes: Operator's Manual, Quick Reference Guide, RS-232-C Guide, AC Adapter, Two P850 Replaceable Probes, Pouch, Feet, Probe Accessory Kit.
Opt. 02 – Delete AC Adapter.
Opt. 03 – Substitute P850 Probes for P400 (222A only).

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz.
Opt. A2 – United Kingdom 220 V, 50 Hz.

SERVICE ASSURANCE OPTIONS
These products covered by the following service assurance options:
REP4200 – Provides one year of post-warranty Repair Protection.
CAL4200 – Provides one year of Calibration Services.

AVAILABLE ACCESSORIES
Virtual Instrument Software – Order CAT200.
External Battery Charger – Order BAT200.
Pouch for Battery/AC Adapter – Order 016-0993-00.
Viewing Hood – Order 016-1021-00.
Ext. Trig to BNC Adapter – Order 103-0090-00.
US 120 V Power Adapter – Order 120-1807-00.
Spare Battery – Order 146-0075-00.
RS-232 Cable – Order 174-1453-00.
Cigarette Lighter Adapter – Order 174-1734-00.
Intelligent Printer Interface – Order WP200.
X10 BNC Adapter – Order 206-0445-00.
Industrial Lead Set – Order 012-1392-00.
BNC Probe Head – Order 206-0451-00.

OPERATION VIDEOTAPE
NTSC – Order 068-0344-04.
PAL – Order 068-0344-06.
SECAM – Order 068-0344-07.

PROBES
Voltage –
1X. Order P400.
10X. Order P850.
Current – AC Current, 2000 A pk. Order A620.
External Trigger – Order P6122.

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

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TAS 200 Series

The Tektronix TAS 200 Series Portable Analog Oscilloscopes provide basic functionality and operate using direct access controls. This series of analog scopes addresses the basic needs in Education and other industries that require basic measurement performance for such applications as electronics training and basic troubleshooting.

2400 Series

The Tektronix 2400 Series Portable Analog Oscilloscopes represent the most widely used and accepted oscilloscope line in the industry. The 2467B BrightEye™ offers unsurpassed writing rate for the ultimate in fast event capture. The 2465B sets the standard against which other general-purpose portable scopes are measured.

Now the new Tektronix TDS Series offers DSO alternatives to users of the popular 2400 Series. Please refer to TDS page 107 for information on alternatives for the 2400 Series.

ANALOG OSCILLOSCOPES

Model	Bandwidth	Channels	Time Base	Cursors	Auto Setup	Computer Interfaces	Page
TAS 200	20 to 50 MHz	2	single	yes	no	no	111
2467B*1*2 2465B*1*2	400 MHz	2+2 aux.	dual	yes	yes	GPIB Opt.	107

**1 The 2467B provides a Microchannel Plate CRT for high writing rate.*
**2 See page 107 for replacement products for 2465B/2467B.*

Analog Oscilloscopes

TAS 220 • TAS 250

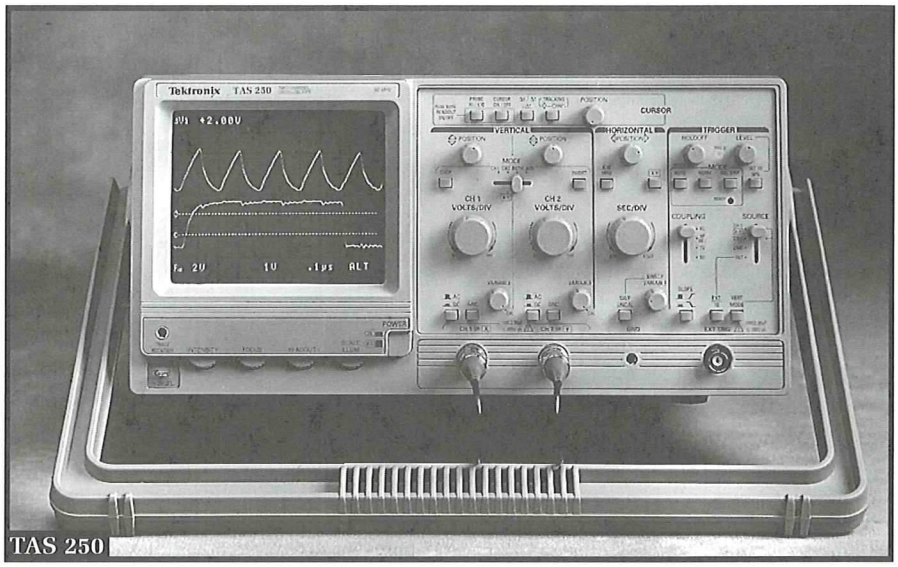
Features

TAS 200 SERIES

- 20 MHz TAS 220
- 50 MHz TAS 250
- Single Time Base
- Two Channels
- Measurement Cursors
- CRT Readout
- Channel 1 Output
- Video Trigger
- Direct Access Controls

Applications

- Training
- Field Repair
- Bench Calibration and Repair



TAS 250

Easy to Use Interface

The TAS 200 Series user interface simplifies scope operation. The front panels are designed for easy operation and the important, frequently used functions are controlled directly with knobs or buttons.

Productivity Features

The TAS 200 Series provides measurement cursors and readouts to improve user productivity. Refer to the key specification selection chart and choose the analog scope best suited for your performance needs. And buy with confidence that these products are backed by the leader in oscilloscope technology, Tektronix.

KEY CHARACTERISTICS

	TAS 220	TAS 250
Bandwidth	20 MHz	50 MHz
Input Channels	2	2
Rise Time	<17.5 ns	<7 ns
Time Base	single	single
Main Sweep Range	0.5 s/div to 0.1 µs/div	0.5 s/div to 0.1 µs/div
Vertical Accuracy	±3%	±3%
Vertical Sensitivity	5 mV to 5 V/div	5 mV to 5 V/div
Horizontal Accuracy	±3%	±3%
X10 Horizontal Accuracy	±5%	±5%
Sweep Speed (X10 Mag.), Main	10 ns	10 ns
Trigger Modes	AUTO, NORMAL, TV, SGL Sweep	AUTO, NORMAL, TV, SGL Sweep
Trigger Coupling (both Main and Delayed)	AC, DC	AC, DC
Cursors and Readouts	Yes	Yes
CRT	2 kV	12 kV
Warranty	One year	One year
Safety Certification	ETL, CSA	ETL, CSA

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

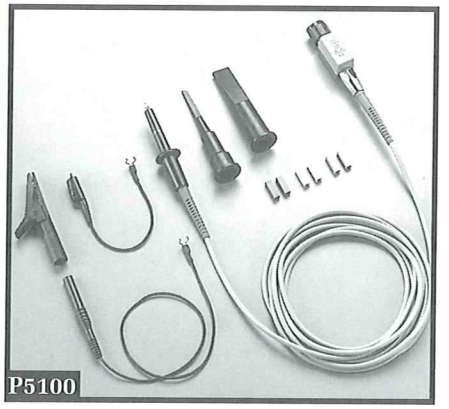
See Tektronix on the World Wide Web: http://www.tek.com

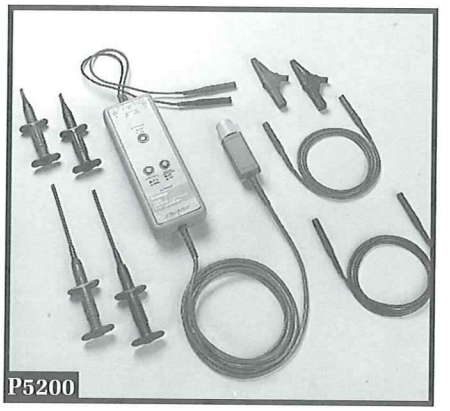
ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

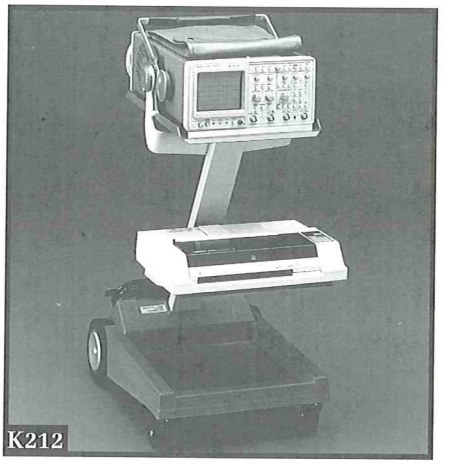
Tektronix Measurement products are manufactured in ISO registered facilities.

Analog Oscilloscopes

TAS 220 • TAS 250







Accessories

P5100

- High Voltage Measurements
- 2500 V DC + Peak AC
- DC to 250 MHz
- Safety: UL1244, IEC 1010

Accessories

P5200

- Safe and Accurate Elevated Differential Measurements
- 1300 V Differential
- 25 MHz
- Safety: UL1244, IEC 1010

Accessories

K212 INSTRUMENT CART

- Low Cost Portability
- Tiltable Top Tray
- Durable Aluminum and Thermoset Polyester Construction

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TAS 220
20 MHz Two Channel Oscilloscope.

TAS 250
50 MHz Two Channel Oscilloscope.
Both Include: Two 1X/10X 1.5 m Probes, Instruction Manuals.

SERVICE ASSURANCE OPTIONS
These products covered by the following service assurance options:

REP4200 – Provides one year of post-warranty Repair Protection.

CAL4200 – Provides one year of Calibration Services.

PROBES
Differential – 100 MHz, active differential, 6 ft. Order P6046.

High Voltage –
100X, 250 MHz, 2500 V, 2.75pf/10 MΩ, 10 ft. Order P5100.
100X, 120 MHz, 1500 V, 2.5 pF/10 MΩ, 9 ft. Order P6009.
1000X, 75 MHz, 20 kV, 3.0 pF/100 MΩ, 10 ft. Order P6015A.

General Purpose –
1X, 15 MHz, 100 pF/1 MΩ, 2 m. Order P6101B.
10X, 100 MHz, 13.2 pF/10 MΩ, 2 m. Order P6109B.
1X-10X Switchable, 1X: 10 MHz, 100 pF/1 MΩ; 10X: 100 MHz, 18 pF/10 MΩ, 2 m. Order P6129B.

Surface Mount – 10X, 200 MHz, SMD Probe (2 each). Order P6561AS.

Logic – 20 MHz, 17-Bit, word recognizer/trigger. Order P6408.

Current – 935 Hz to 120 MHz, 3 A continuous AC. Order P6022.
120 Hz to 60 MHz, 7.5 A continuous AC. Order P6021.
DC to 50 MHz System (includes AM503A, A6302 20A probe, TM502A). Order AM503S.

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

Digitizers

TVS600

High performance starts with acquiring the waveform. The TVS600 Series provides fast transient or repetitive events capture, with both high time and amplitude resolution. Supporting this high resolution waveform capture capability are high fidelity input signal conditioning and analog to digital conversion.

SCD 5000

The SCD Transient Waveform Digitizer provides the unique capability of high time and amplitude resolution single-shot capture of low nanosecond and picosecond events. This technology allows high time resolution even on the fastest events.

RTD720A

The 720A provides high fidelity capture of transient events. This high fidelity is maintained without the need for post acquisition correction, enhancement, filtering or averaging of the acquired waveform data. This quality of the acquired signal translates directly to the effective resolution that the acquisition system provides.

CONTENTS

DIGITIZERS

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SCD 5000 4.5 GHz, Transient Event 118
RTD 720A Transient Waveform 121

ACCESSORIES

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SMD/Adapter 470
Probe and Instrument Accessories 476
Plotter/Printer 515
Cameras 518
Instrumentation Carts 520

VXI Waveform Analyzers

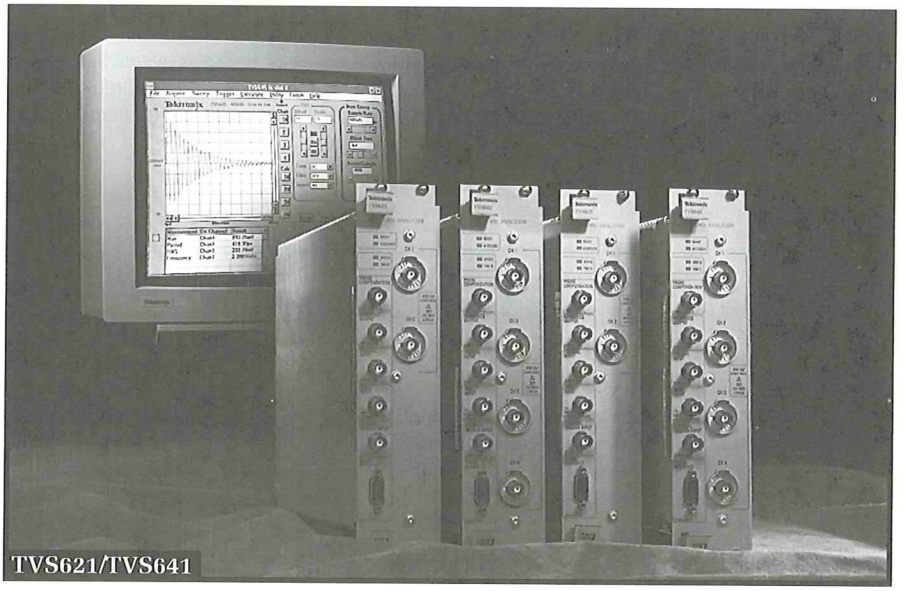
TVS621 • TVS625 • TVS641 • TVS645

Features

- 5 GS/s Single-shot Sample Rate
- 1 GHz Bandwidth
- 8-Bit Vertical Resolution (256 Digitized Levels)
- Record Lengths to 15 K
- High Throughput for Waveform Transfers, Settings Changes, and Measurements
- Extensive and Flexible Waveform Processing and Measurements
- FFT, Integration, and Differentiation
- Digital Filtering – Highpass, Lowpass, Bandpass, and Band Reject
- Auto-advance Acquisitions with Time Stamping
- "C" Size VXI
- Message Based
- VXI*plug&play* WIN Framework

Applications

- Manufacturing Test
  - Computers and Peripherals
  - Mil – Aero ATE Systems
  - Functional Board, Hybrid and Component Testing
  - Avionics
  - System and Device Characterization
- Research and Development
  - EMP and Radiation Simulators
  - Pulsed Power Sources
  - Electronic Warfare
  - Radar
  - Lidar
  - Accelerators
  - Intelligence Data Collection
  - Laser Induced Phenomena



TVS621/TVS641

TVS600 Series

These high performance waveform acquisition and analysis products are optimized for VXI system applications, in order to deliver on the promise of VXI.

- High Performance
- High Throughput
- Compact Physical Size
- Optimized for System Applications
- High Performance to Price Ratio

The Tektronix TVS600 Series of VXI Waveform Analyzer products delivers on the improved system performance promises of VXI.

HIGH PERFORMANCE INSTRUMENTS
High performance starts with acquiring the waveform. The TVS600 Series provides fast transient or repetitive events capture, with both high time and amplitude resolution.

Supporting this high resolution waveform capture capability are high fidelity input signal conditioning and analog to digital conversion.

The instruments' hardware and firmware flexibility assure successful waveform capture, thus delivering on the VXI promises of high performance instrumentation.

HIGH THROUGHPUT
The choice of VXI is a first step towards achieving high throughput, but the key to achieving success is an instrument optimized for VXI. The TVS600 Series uses throughput tuned capabilities such as Fast Data Channel, firmware and instrument architecture, and hardware to deliver on the VXI throughput promise.

COMPACT PHYSICAL SIZE
The TVS600 Series VXI "C" size format allows for high functional density, delivering on these promises of VXI.

OPTIMIZED FOR SYSTEM APPLICATIONS
VXI is a system environment. The TVS600 Series products are designed as system products. The use of industry standards, the attention to high throughput requirements, and support for VXI*plug&play* are examples of the way the TVS600 Series delivers on these promises of VXI.

HIGH PERFORMANCE-TO-PRICE RATIO
Please explore the following instrument specifications and characteristics to determine how well Tektronix has met these promises of VXI.

See Tektronix on the World Wide Web: http://www.tek.com

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

VXI Waveform Analyzers

TVS621 • TVS625 • TVS641 • TVS645

Characteristics

VERTICAL

Input Channels – Single ended BNCs with Tektronix TEKPROBE® Interface supporting Active, Passive, and Optical Probes. Multichannel acquisitions are acquired simultaneously.
TVS645: 4 acquisition channels
TVS641: 4 acquisition channels
TVS625: 2 acquisition channels
TVS621: 2 acquisition channels

Bandwidth – DC coupled.

TVS645 and TVS625:

Full Scale Input	Bandwidth
100 mV to 10 V	DC to 1 GHz
50 mV to 99.5 mV	DC to 900 MHz
20 mV to 49.8 mV	DC to 700 MHz
10 mV to 19.9 mV	DC to 500 MHz
10.1 V to 100 V	DC to 500 MHz

TVS641 and TVS621:

Full Scale Input	Bandwidth
10 mV to 100 V	DC to 250 MHz

Input Ranges – 10 mV to 100 V full scale in 1400 steps.

Vertical Resolution – 8 bits (256 digitized levels) Resolution can be increased with averaging or signal processing.

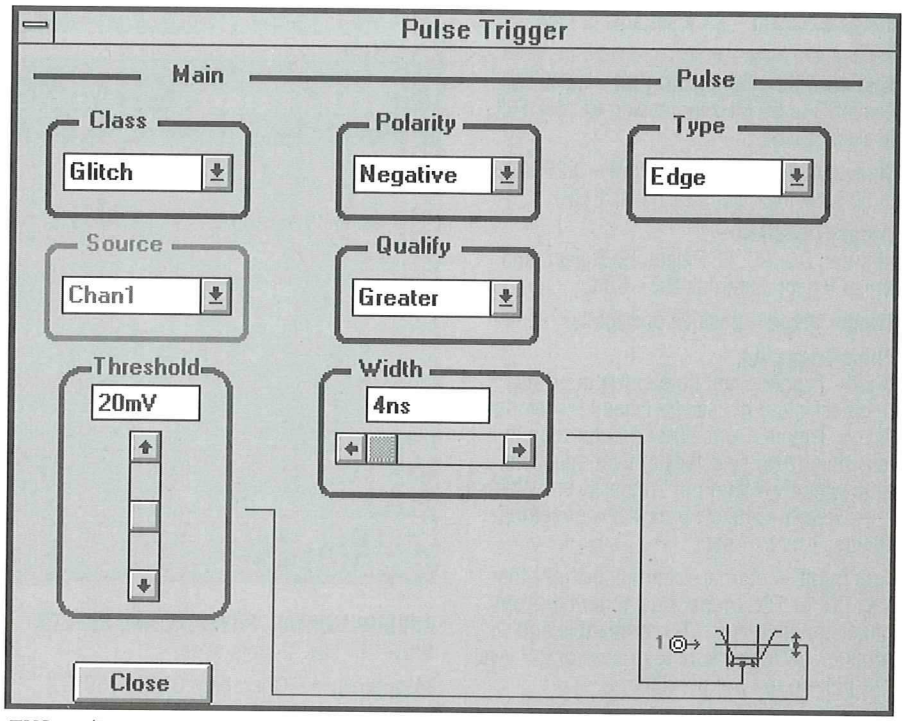
Input DC Gain Accuracy – 1.5% for input ranges ≥ 20 mV full scale. 2% for input ranges < 20 mV full scale.

Offset Range:

Full Scale Input	Offset Range
10 mV to 1 V	±1 V
1.01 V to 10 V	±10 V
10.1 V to 100 V	±100 V

Offset Accuracy

10 mV to 1 V	±(0.2% offset setting + 1.5 mV +0.6% full scale)
1.01 mV to 10 V	±(0.2% offset setting + 15 mV +0.6% full scale)
10.1 V to 100 V	±(0.2% offset setting + 150 mV +0.6% full scale)



TVS625/TVS645.

Input Impedance – 1MΩ – 50 Ω Switchable.

Input Coupling – DC, AC, or Off.

Input Noise Filter – Full, 250 MHz, and 20 MHz Bandwidth user selectable.

Delay Between Channels (at same input range and coupling) – ≤ 100 ps.

Fiducial Input – ≤ 2 ns rise time superimposed on channel 1 acquisition, for time aligning multiple acquisition units. AC coupled signal path. Highpass time constant 5 ns, attenuates signal below 100 MHz.

SAMPLE RATE

Maximum Single-shot
TVS645: 4 channels @ 5 GS/s
TVS641: 4 channels @ 1 GS/s
TVS625: 2 channels @ 5 GS/s
TVS621: 2 channels @ 1 GS/s

Real Time Acquisitions – From "Maximum Single-shot Sample Rate" to 5 samples per second in a 1, 2, 4 selection sequence.

Record Length Maximum –
TVS645: 4 channels to 15 K
TVS641: 4 channels to 15 K
TVS625: 2 channels to 15 K
TVS621: 2 channels to 15 K

30,000 points per channel for samples rates of 10 MS/s to 5 S/s.

Record Length Range – 256 points to maximum in sequence of 256, 512, 1024, 2048, 4096, 8192, 15000.

Internal Time Base Reference – 10 MHz ±100 ppm.

External Time Base – 10 MHz over the VXI backplane CLK10 line.

Pre & Post Trigger Acquisition – Pre-trigger: (capture of data prior to the trigger event) 0% to ≈ 100% of record length.
Post-trigger: (capture of data after the trigger event) 0 seconds to 250 seconds.

Acquisition Modes – Normal, Average, Envelope, Auto-advance.

Auto-advance Acquisition – 1087 records of 256 points to 34 records of 15 K points. Each record is Time Stamped to 125 ns resolution.

TRIGGERING

Sources – Internal (any channel), external, or VXI TTL and ECL trigger bus.

Types – Main; Edge or Pulse (time qualified); Delayed; Delay by Time – 16 ns to 250 secs; Delay by Events – 1 to 10,000,000 events with a maximum rate of 250 MHz.

Modes – Normal, Single, or Auto.

Range Internal – ±100% of Full Scale Input Range settable in steps of 0.1%.

See Tektronix on the World Wide Web: http://www.tek.com

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

VXI Waveform Analyzers

TVS621 • TVS625 • TVS641 • TVS645

Range External – ±1 V settable in steps of 6 mV.

Sinewave Sensitivity Internal – 3.5% Full Scale DC to 50 MHz increasing to 10% Full Scale at 1 GHz.

Sinewave Sensitivity External – 0.25 V DC to 50 MHz increasing to 1 V at 1 GHz.

Trigger Coupling –
Internal: DC, AC, LF Reject, HF Reject, and Noise Reject. External: DC – 50 Ω.

Trigger Slope – positive or negative.

Pulse Triggering –
Width: Trigger event time either in or out (user selected) of user specified time window. Glitch: Trigger event either greater than or less than (user selected) of user specified time window. Minimum Trigger Event Width: 1 ns. Rearm Latency: 2 ns + 5% of setting. Range: 1 ns to 1 sec.

Arm Input – Internal, External, or from the VXI TTL or ECL trigger bus. External (front panel connector) is TTL compatible and arms on switch closure to ground or 0 V level. 1 K pull-up to +5 V provided.

OTHER FRONT PANEL CONNECTORS

Probe Compensation – Allows adjusting passive probes for use with 1 MΩ input impedance.

Reference Output – Allows verifying accuracy of internal amplitude and time sources.

Serial Interface – RS-232C DTE Interface provides an alternative computer interface for instrument control and waveform data transfer.

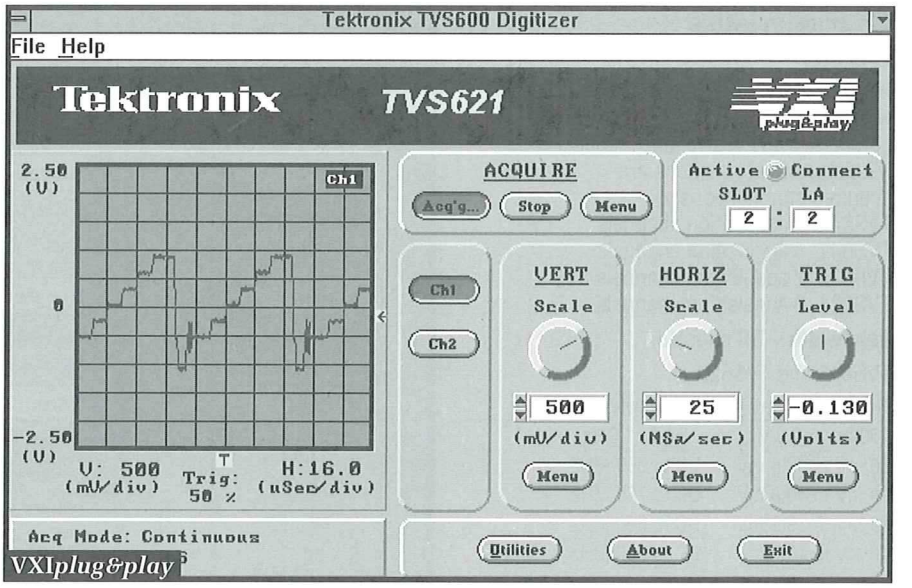
Performance Assurance –

Auto-Cal with user verifiable references.

Tested to IEEE-1057 Standard for Digitizing Waveform Recorders.

3 year product warranty.

Environmentally rugged.



ENVIRONMENTAL, PHYSICAL AND SAFETY

VXI – "C" size, 2 slots wide.

Temperature – Operating: 0°C to +50°C.

Humidity – Operating: 95% relative (non-condensing) ≤ 30°C. 45% relative to +50°C.

Vibration – Operating: Mil-T-28800E Type III Class 3.

Shock – Nonoperating – 60 g, 11 ms, half-sine, 3 shocks per side.

Altitude – Operating: to 4.6 km (15,000 ft.).

Airflow – 6.6 l/s at 0.078 mm H_2O for 10°C rise.

Current Requirements –

	TVS600
+12 V	1.1 A
+5 V	9.6 A
–2 V	0 A
–5.2 V	4.1 A
–12 V	0.9 A

Maximum Power – 98 Watts.

EMC

EMC performance in VXI mainframe dependent with testing for the TVS600 Series tested in a Tektronix VX1410 mainframe.

Emissions (complies with) – Enclosure: EN55022 Class B for radiated emissions; AC Mains: EN60555-2 for power line harmonics EN55022 Class B for conducted emissions.

Immunity – Complies with EN50082-1 (IEC 801-2).

Immunity ESD – Complies with EN50082-1 (IEC 801-2).

Immunity Fast Transient – Complies with EN50082-1 (IEC 801-4).

Compliance – Complies with VFG243, FCC CFR 47, Part 15 Subpart B, Class A, MIL-STD-461.

Safety – Complies with UL 1244, CSA 22.2 no. 231, and IEC 1010-1.

COMMAND SET

Message Based – SCPI (Standard Commands for Programmable Instruments).

Throughput Enhancements:

Fast Data Channel for waveform and measurement transfers.

10 complete instrument settings stored in the instrument (battery backed-up).

Low level (binary) settings query and return.

Fast instrument settings changes.

Acquisition and Waveform Data Transfer Looping.

Auto Advance with Time Stamping.

Waveform Measurements, Math, and Transforms executed in hardware DSP.

Answers not just waveform data for further processing in the system computer.

Instrument status signaling (e.g., operation complete, triggered, waveform data available) using the VXI TTL and ECL trigger bus.

Waveform Math – Between waveforms, or a waveform and a scalar.
Operators: Add, Subtract, Multiply, and Divide.

See Tektronix on the World Wide Web: http://www.tek.com

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

VXI Waveform Analyzers

TVS621 • TVS625 • TVS641 • TVS645

Waveform Transforms –

Integrate.

Differentiate.

Smooth with user selected number of points.

FFT with user selection of 6 Window functions and scaling (e.g., linear, logarithmic).

Waveform Measurements –

Period	Frequency
High	Low
+ Width	– Width
Maximum	Minimum
Rise Time	Fall Time
Peak to Peak	Amplitude
+ Duty Cycle	– Duty Cycle
Mean	Cycle Mean
RMS	Cycle RMS
Area	Cycle Area
Mid	Standard Deviation

Measurement flexibility is provided through independent user selection of functions such as Base-Top method, and crossing levels for making rise time measurements.

Digital Filtering –

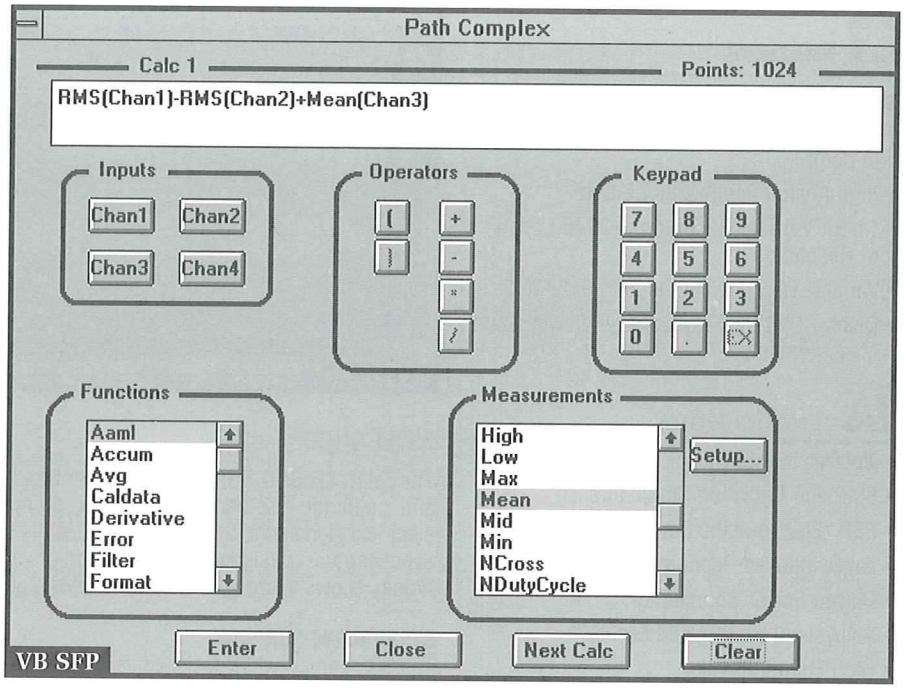
Lowpass

Highpass

Bandpass

Notch

User selection of start, stop, center frequency, span, stopband rejection, and transition width.



Processing Power – Waveform math, transforms, measurements, and digital filtering can be intermixed in an algebraic expression to act on acquired waveform data.

For example:

Rise time (Smooth (CH 1* CH 2)).

VXI*plug&play* – The TVS600 Series is VXI*plug&play* WIN Framework compatible.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TVS645
4 channel, 1 GHz, 5 GS/s, 15 K Waveform Analyzer.

TVS641
4 channel, 1 GHz, 1 GS/s, 15 K Waveform Analyzer.

TVS625
2 channel, 1 GHz, 5 GS/s, 15 K Waveform Analyzer.

TVS621
2 channel, 1 GHz, 1 GS/s, 15 K Waveform Analyzer.

Each includes: User Manual, Quick Reference Guide, and plug&play WIN Framework software.

RECOMMENDED ACCESSORIES – Also see page 434.

PROBES

Active Probes –
750 MHz. 2pF/1M, 10X, 1.5 m. Order P6205.
1 GHz. 10X, 1.5 m. Order P6243.
1.5 GHz, 1pF/1M, 10X, 1.5 m. Order P6245.

Passive Probes –
500 MHz, 8pF/10M, 10X, 1.3 m. Order P6139A.
500 MHz, 5pF/9.5M, 20X, 1.5 m. For Fine Pitch/Surface Mount Devices. Order P6563AS.

Differential Probes –
100 MHz, 10,000:1 CMRR, 1X/10X, 2 m. Order P6046.
100 MHz, –50 db CMRR, 50X/100X. Order P5205
1 MHz, 100,000:1 CMRR, 1X/10X/100X, Differential Amplifier. Order ADA400A.

High Voltage Probes –
2.5 kV, 250 MHz, 2.75 pF/10M. 100X. Order P5100.
20 kV, 75 MHz, 3pF/100M. 1000X, 3.1 m. Order P6015A.

Word Recognizer Probes – 20 MHz, 17-Bit TTL, 40 ns word. Order P6408.

Current Probes, AC Only –
120 Hz to 60 MHz, 7.5 A peak. Order P6021.
965 kHz to 120 MHz, 3 A peak. Order P6022.

Current Probes, AC and DC –
DC to 50 MHz, 20 A DC/50 A Peak. Order AM503S.

See Tektronix on the World Wide Web: http://www.tek.com

Transient Event Digitizers

SCD 5000

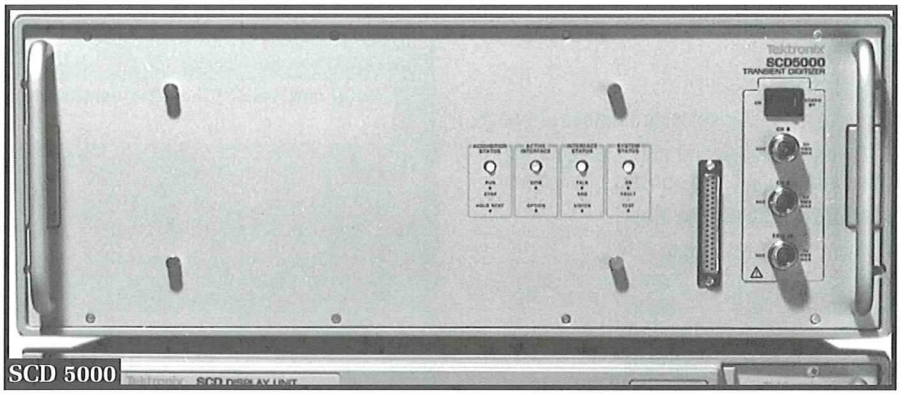
Features

SCD 5000

- High Single-shot Sample Rate to 200 GS/s (5 ps/pt)
- High Analog Bandwidth 4.5 GHz
- 11-Bit Vertical Resolution (2048 Levels of Resolution)
- Variable Record Lengths 256, 512, 1024
- Display Unit for Easy Control, Viewing, and Measurements

Applications

- Nuclear Events
- EMP and Radiation Simulators
- ESD (Electro-static Discharge)
- Laser Induced Phenomena
- Pulsed Power Sources
- Analysis of Fast Pulsed Events
- High Energy Physics
- Fluorescence Decay
- Radar and Lidar
- High Frequency Ultrasonics



SCD 5000

SCD 5000

The Tektronix SCD Transient Waveform Digitizers provide the unique capability of high time and amplitude resolution single-shot capture of low nanosecond and picosecond events. For electrical signals the SCD 5000 provides the highest bandwidth and sample rates for transient event capture. Designed for the capture of very fast transition single-shot events, this technology allows a large number of waveform data points, even on the fastest events.

STANDALONE SUPPORT

The SCD Family, while designed as a system product, has a feature set and capabilities to meet application requirements as a standalone instrument. These include a display unit for waveform viewing that also provides for full instrument control. The display provides viewing of up to four waveforms with horizontal and vertical expansion for finer detail visual examination. Cursors that can be placed on the same waveform or different waveforms allow for absolute and delta time and amplitude values on any part of the waveform(s).

Further supporting this capability is a set of on-board time and amplitude measurements. These measurements' routines also provide a high degree of flexibility for how measurements are made and over what part of the waveform the measurements are made. Up to eight of the 21 measurements that are made can be displayed on the Display Unit (all 21 measurements, plus additional information, are available over the GPIB).

For benchtop use the SCD Family Display Unit provides waveform viewing and full instrument control. There is hardcopy capability using either a video copier or to a plotter using the GPIB. Hardcopies can be initiated from either the display unit or over the GPIB.

SYSTEM SUPPORT

The SCD Family is designed as a system product. Besides the hardware and firmware capabilities described above, the SCD Family has additional features addressing system applications. These include:

- External Arming
- External Triggering
- Gate Out Signal effectively providing a trigger output
- Ten stored (and battery backed-up) instrument settings
- Rackmounting hardware a standard part of the instrument
- As an option, rear signal inputs and signal feed-through
- Display Unit that can be moved from instrument to instrument

These capabilities are further supported with an "Engineering English-like" command set that eases the task of software development. The optional Display Unit also has a Debug mode that allows viewing of the GPIB traffic to the instrument with error and event condition reporting.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*

Transient Event Digitizers
SCD 5000

Another important system capability is the maintaining of the highest accuracy and signal fidelity. The SCD 5000 provides a Standardize function, instrument diagnostics, and power-on diagnostics (power-on diagnostics can be turned off by the user) to meet these requirements. The Standardize function (executing only upon user request either over the GPIB or from the Display Unit) is used to maintain the highest accuracy. Power-on and instrument diagnostics are used to verify the proper functioning and performance of the instrument.

HIGH FIDELITY WAVEFORM CAPTURE
The SCD 5000 provides high time and amplitude resolution capture of extremely fast transient events, offering an unmatched combination of bandwidth and sample rate performance required for the capture of the fastest transient signals.

Characteristics

HORIZONTAL

Time per Point – 5 ps/pt (5 ns time window with 1024 point record length) to 400 ns/pt (100 µsec time window with 256 point record length).

Time Windows – 5 ns to 100 microseconds in a 1-2-5 sequence.

Record Length – 256, 512, or 1024 waveform data points.

Trigger Delay – 0% to 900% of time window.

Multiple Records (Auto-advance) – 16 waveform locations (first four locations are battery backed-up).

Time Stamping – Time and date are stored with each acquisition.

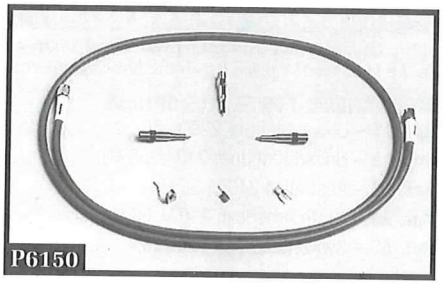
Arming – Internal or External. Triggers are not recognized until the unit is armed. External Arm is a BNC input that arms on a switch closure to ground (internal pull-up provided to 5 V).

Gate Out Signal – A TTL low level (≤0.8 V) output at the BNC for the duration of the sweep.

VERTICAL (CONTINUED)

Input Channel – Each SCD provides a single channel of transient event waveform digitizing.

Parameter	SCD 5000	SCD 5000 Opt. 01
Analog Bandwidth (–3 dB)	≥4.5 GHz	≥3.0 GHz
Rise time (from Calculation) Tr = 0.35/Bandwidth	≤80 ps	≤120 ps
Vertical Resolution Averaging	11-Bits/2048 levels Averaging to 14-Bits	11-Bits/2048 levels Averaging to 14-Bits
Input Range(s) Resolution per Bit	5 V Full Scale 2.44 mV/Bit	10 V Full Scale 4.88 mV/Bit
Offset Range	±4 V	±8 V
Input Impedance and Coupling	DC Coupled: 50 Ω	DC Coupled: 50 Ω
TRIGGERING		
Sources	External	External or Internal
Coupling	AC	AC or DC
Slope	Positive or Negative	Positive or Negative
Range	±0.5 V	±0.5 V External ±1.0 V Internal
Sensitivity (Sinewave) Internal	N/A 3.5 V 500 MHz to 1 GHz	500 mV 20 kHz to 50 MHz 1.5 V 50 MHz to 500 MHz
Sensitivity (Sinewave) External	50 mV 20 kHz to 50 MHz 150 mV 50 MHz to 500 MHz 350 mV 500 MHz to 1 GHz	50 mV 20 kHz to 50 MHz 150 mV 50 MHz to 500 MHz 350 mV 500 MHz to 1 GHz
Sensitivity (Pulse) External	≤150 mV with 500 ps HAD (half duration amplitude) pulse	≤150 mV with 500 ps HAD (half duration amplitude) pulse
Pretrigger View Time	N/A	≥2 ns



Accessory

P6150

Lowest Capacitive Loading Available

- <0.15 pF/500 Ω provides lowest circuit loading for 50 Ω circuitry
- Extremely wide bandwidth (>9 GHz)
- Interchangeable attenuator tips (1X, 10X)
- Useful in high-speed sampling TDR applications
- SMA style connection

For complete information on all Accessory products, see page 455.

Transient Event Digitizers

SCD 5000

COMPUTER INTERFACES

GPIB IEEE 488 – Interface is standard for instrument control and waveform data transfer. Maximum transfer rate ≥500 KB/sec.

A parallel port option is available for waveform data out (2F). The data is available in a 16-Bit word; the data is capable of 2 Mwords (4 MB) data transfer rates. This provides TTL level outputs and has several operating modes to allow use with a wide range of computer interface cards.

Calibrator Output – BNC providing the time and amplitude signals required for the Auto-Cal function. This can also be used to verify the performance of the internal Auto-Cal signals.

DISPLAY AND INSTRUMENT CONTROL

Display – Provides for waveform viewing and instrument control. The waveform data display provides viewing of up to four waveforms at one time, with cursor measurement capability and waveform display expansion in both time and amplitude. The waveform expansion capability enables viewing of the full waveform or zooming in for closer examination of details of interest. User selection of up to eight of the 21 on-board time and amplitude measurements can also be displayed.

Hardcopy – The instrument also supports a video hardcopy capability (EGA compatible) and, with the Display Unit plotter output over the GPIB, is available without the need for a controller/computer. Using either hardcopy method, a representation of the information on the Display Unit is provided. The EGA compatible output can also be used to drive an EGA compatible monitor.

ENVIRONMENTAL (WITHOUT DISPLAY UNIT)

Temperature Range – Operating 0°C to 50°C.

Humidity – 0% to 95% relative humidity (non-condensing).

Altitude – Operating to 4.5 km (15,000 ft.) maximum; nonoperating to 15 km (50,000 ft.) maximum.

POWER REQUIREMENTS

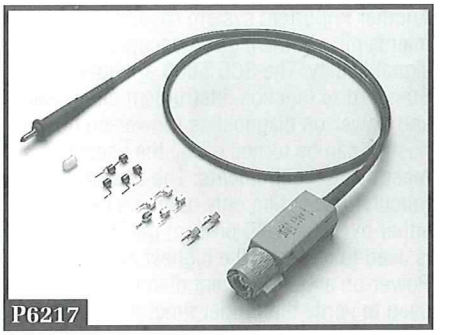
Line Frequency – 48 to 440 Hz.

Voltage Range – Selected by rear panel switch 90 to 132 V RMS or 180 to 250 V RMS.

Power Consumption – SCD 5000 is fully optioned ≤300 W.

Warranty – The SCD 5000 carries a standard Tektronix one-year warranty covering labor and replacement parts for the instrument.

Safety – UL Listed 1244, Certified CSA C22.2 No. 231-M89.



Accessory

P6217 FET PROBE

Maximize Your Signal Acquisition Performance

- Wide Bandwidth (DC to >4 GHz)
- Minimal DUT Loading <0.4 pF capacitive/>100 kΩ resistive
- Requires no additional cables or power supplies
- Smaller size than traditional active FET Probes

For complete selection information on all Accessory products, see page 450.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

SCD 5000

4.5 GHz Bandwidth Transient Event Digitizer.
Includes: Instrument with Type N Connectors and Detachable Display with Power Cord; Fuses; User Manual (070-6960-01); Instrument Interfacing Guide (070-7315-01); Quick Reference Guide (070-7316-01); and Rackmount Kit.

Opt. 1P – Increase waveform capture and transfer rate from one to ten 512 point waveforms per second.

Opt. 2E – Change Type N Input Connectors to SMA.

Opt. 2F – Parallel Waveform Data Output Port with Battery Back-up of Linear Array Data.

Opt. 2O – Delete Display Unit.

Opt. 01 – Add Delay Line with Internal Trigger Pick-off.

Opt. 9E – Change position of the Input Connectors to rear of the instrument (Type N connectors only) with signal feed-through and external termination (mutually exclusive with Opt. 01 and 2E).

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – United Kingdom 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.

RECOMMENDED ACCESSORIES

Also see page 434.

PROBES

Active – 4 GHz, 0.4 pF/100 kΩ, 1 m. (Requires Opt. 1E or 1103 Power Supply). Order P6217.

50 Ω Divider (Zo) – 3.5 GHz, 1 pF/500 Ω; 10X, 3 GHz, 1.1 pF/5000 Ω, 100X, 1.5 m. Order P6156 with Opt. 25.

9 GHz, 0.15 pF/500 Ω; SMA Compatible. Order P6150.

CAMERAS/PLOTTERS/PRINTERS

Plotter – Four Color. Order HC100 with Opt. 01.

Cart – Order K475.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*

Transient Waveform Digitizer

RTD 720A

Features

RTD 720A

- 2 GS/s Single-channel Mode
- 1 GS/s Dual-channel Mode
- 500 MS/s Four Channel Mode
- Long Waveform Memory – 128 K Standard
  - 512 K Battery Backed-up Memory Option
  - 4 MB Memory Option
- Intelligent Memory Usage
  - User Selection of Memory Size
  - Extremely Fast Multiple Event Capture
- 500 MHz Analog Bandwidth
- 8-Bit Vertical Resolution
- Optional Removable Display with Remote Operation Capability

Applications

IMPULSE PHENOMENA

- Nuclear Events
- EMP and Radiation Simulators
- Laser Induced Phenomena
- Pulsed Power Sources
- Analysis of Multiple Fast Pulsed Events
- High Energy Physics

PULSE ECHO EVENTS

- Radar and Lidar
- High Frequency Ultrasonics

LONG RECORD LENGTH APPLICATIONS

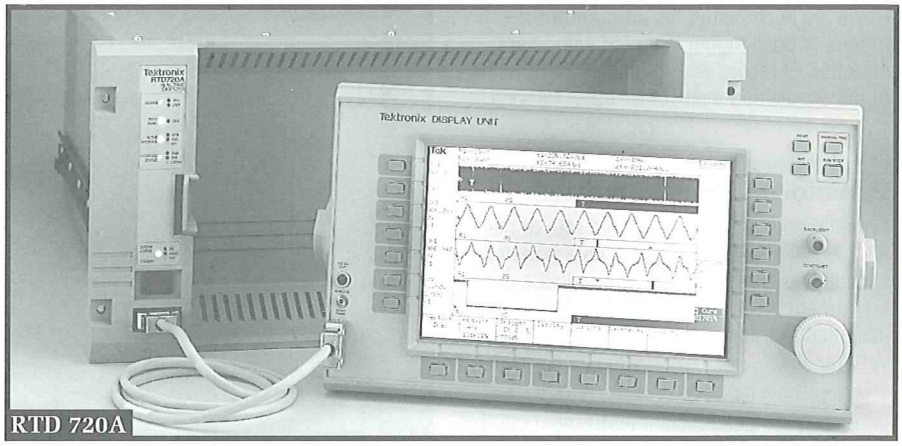
- Intelligence/Electronic Warfare
- Spectroscopy (Time-of-Flight)
- Computer Mass Storage Device and Media Characterization

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1, and with Tektronix Standard Codes and Formats.*

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Signal Fidelity

The Tektronix RTD 720A Transient Waveform Digitizer provides high fidelity capture of transient events. Signal fidelity is another name for high resolution capture of signals. Base resolution is of little value if the characteristics of the signal are lost. The RTD 720A provides input signal conditioning and Analog to Digital conversion that maintains the characteristics of the signal of interest. Factors affecting signal quality include bandwidth, transient response, accuracy, input range and offset, overdrive recovery, and a measure of the complete digitizing process (i.e., IEEE-1057) Effective Bits measurement. The RTD 720A maintains the high fidelity required without the need for post-acquisition correction, enhancement, filtering, or averaging of the acquired waveform data. This quality of the acquired signal translates directly to the effective resolution that the acquisition system provides.

The digitizing process and the quality of the waveform data provided are the starting point for high resolution and fidelity capture of transient events. Sample rate is another key parameter, since it determines the maximum signal frequency that can be accurately captured. The RTD 720A provides sample rates from 2 GS/s (500 picoseconds/point) to 5 MS/s (200 microseconds/point) for fine time resolution and accurate capture of the signals of interest. With up to four channels of acquisition (requires Opt. 06) the RTD 720A provides high amplitude and time resolution and fidelity signal capture of multiple events. The long record length capability of the RTD 720A provides the needed final characteristic for high resolution and fidelity capture of transient events.

Long Acquisition Memory with Intelligent Utilization of the Memory

The waveform memory of the RTD 720A allows capture of even long duration events at the sample rate needed to accurately represent the signal to be captured. The RTD 720A's standard acquisition memory is 128 K waveform data points (131,072 sample or >65 µsec time window at 2 GS/s). Optional acquisition memory is available for the RTD 720A of 512 K of battery backed-up memory, and 4 MB of memory. Memory can be assigned entirely to one channel or shared equally among the active channels (1, 2, or 4), with simultaneous acquisition on all channels.

Not only does the RTD 720A provide long memory for contiguous acquisition of waveforms, it also provides flexibility in memory usage. Memory can be configured for shorter acquisitions to match the total time of the event of interest. Furthermore, with shorter record length acquisitions, memory can be partitioned to capture multiple independent events.

Using the internal acquisition memory partitioned for the capture of many independent events provides a rapid signal capture capability. Auto-advance mode captures a sequence of up to 1024 events on each channel. Time-of-Arrival of each event is also captured with time resolution as fine as 500 ps.

Further extending the usefulness of the memory is pre-trigger and post-trigger acquisition. With pre-trigger to approximately 100% of the record, it is possible to capture events prior to the triggering event. Post-triggering, to 99,999,999 sample intervals, allows capturing events occurring significantly after the trigger event.

Continued on next page.

Transient Waveform Digitizer

RTD 720A

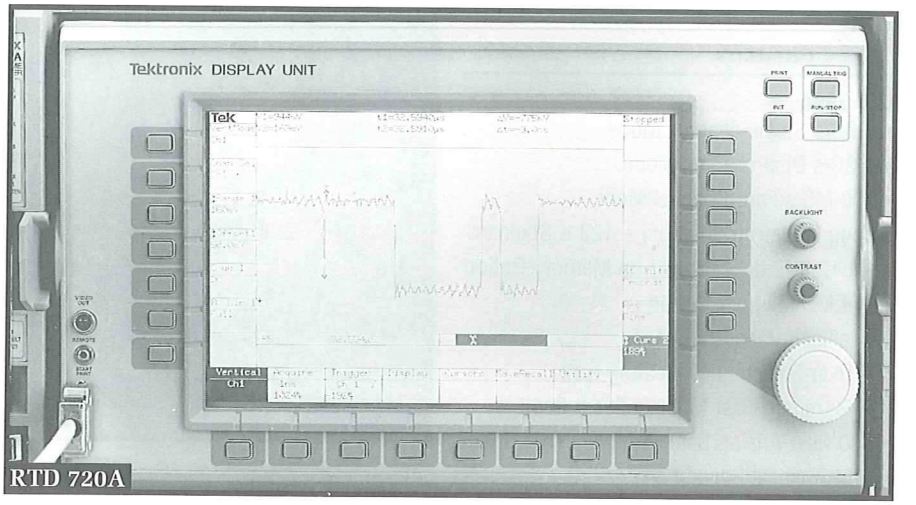
Flexibility in choosing the amount of pre-trigger or post-trigger, coupled with user selection of record length, allows positioning of the acquisition over the event of interest.

High-speed Waveform Data Transfers

Complimenting the high capture rate of the RTD 720A, a fast and efficient data transfer capability is provided by both hardware and instrument firmware. The RTD 720A is designed to transfer data to a computer very rapidly.

The digitizer's GPIB (IEEE 488) computer interface provides efficient instrument control and waveform data transfer. In burst mode (such as when transferring waveform data) the maximum transfer rate is ≥500 KB per second (dependent on the transfer speed capability of the computer). For even faster transfer of waveform data a 16-Bit parallel port is provided that is capable of transferring 4 MB per second (two Mwords per second). The parallel port operates with TTL levels supporting both a handshaked and clocked mode of operation.

To take advantage of the hardware speed the RTD 720A's command set is also designed to provide high-speed transfers to a computer. These commands allow defining: which acquired channels are to transfer data; whether the full set of waveform data or part of a record is to be transferred; and how many records to transfer if in Auto-advance mode. This capability allows all acquired data to be transferred with a single command, which significantly lessens the time addressing and unaddressing the instrument. For applications requiring repeated transfers (i.e., acquire, transfer, acquire, transfer,...) the RTD 720A provides a command that allows waveform data transfer without the need to issue commands to the instrument for each transfer. Again, this lessens the time required to issue commands and for the instrument to decode the commands, which speeds the data transfer process. These capabilities are available for both the GPIB and parallel ports.



System Support

The RTD 720A is designed as a system product. Besides the hardware and firmware capabilities described above, the RTD 720A has additional features addressing system applications. These include:

- Fiducial Input
- External Arming
- External Clocking
- External Triggering
- Trigger Out Signal
- Optional Display Unit that can be moved from instrument to instrument and can be used for controlling the instrument and waveform viewing

These capabilities are further supported with an "Engineering English-like" command set that eases the task of software development. The optional Display Unit also has a Debug mode that allows viewing of the GPIB traffic to the instrument with error and event condition reporting.

Another important system capability is maintaining highest accuracy and signal fidelity. The RTD 720A provides a Standardize function, instrument diagnostics, and power-on diagnostics (power-on diagnostics can be turned off by the user) to meet these requirements. The Standardize function (executing only upon user request either over the GPIB or from the Display Unit) is used to maintain the highest accuracy. Power-on and instrument diagnostics are used to verify the proper functioning and performance of the instrument.

For benchtop use the RTD 720A Display Unit provides waveform viewing and full instrument control. There is hardcopy capability using either a video copier attached to the Display Unit or to a plotter using the GPIB (Talk Only mode) initiated from the Display Unit. The RTD 720A also supports Tektronix TEKPROBE® I/F, allowing the use of active (FET) and optical probes, as well as passive probes.

High Fidelity Waveform Capture

The RTD 720A provides high fidelity capture of transient events, offering an unmatched combination of signal quality, sample rates, and record lengths, providing the performance needed for the capture of fast transient signals.

Characteristics

VERTICAL

Input Channels – Two (optionally four) single-ended BNC's with Tektronix TEKPROBE® Interface. Simultaneous digitizing on all channels, in Dual and Quad modes of operation. Four input channels (Quad Mode) require Option 06.

Input Ranges, Offsets – 50 mV full scale to 12.5 V full scale in 25 ranges with each range 1.25 times the previous range. Each range provides an independent ±100% offset capability with fast overdrive recovery (≤20 ns from a two times overdrive signal).

Bandwidth (–3 dB) – DC coupling: DC to ≥500 MHz; AC coupling: ≤1.5 kHz to ≥500 MHz.

Input Accuracy (after Standardization) – Mean Value: –Δ DC Volts: ±(1% of Signal +1% of Full Scale Input Range); Offset: ±(1% of Full Scale Input Range + 0.5% of Offset Range +1% of Offset Value).

Transient Waveform Digitizer

RTD 720A

Maximum Input Voltage and Input Protection – DC coupled 5 V RMS (0.5 W into 50 Ω) or 0.25 Watt-second pulses not to exceed 25 V peak. AC coupled same as DC with ±100 V DC + peak AC.

Fiducial Input – BNC signal input in parallel with CH 1 for providing a time marker allowing cross timing references between multiple units.

Vertical Resolution – 8-Bits providing 256 discrete levels (≈ 50 dB dynamic range).

Sample Rates – 2 GS/s (500 ps/point) to 5 MS/s (200 ms/point).

ACQUISITION MEMORY

Standard instrument 128 K waveform data points.

Opt. 10: 512 K waveform data point with battery backed-up.

Opt. 15: 4 MB waveform data points.

All memory is shared equally among active channels (1, 2, or 4) with user selection of active channels. User also has control of record size selection from 512 waveform data points to the full memory available, in a binary sequence (i.e., 512, 1024, 2048,...).

Multiple Records (Auto-advance) – Memory can be further segmented in up to 1024 records per channel. Maximum number of records equals: Total Acquisition Memory ÷ (# of Active Channels x Record length). Re-arm time between records in Auto-advance Mode is 6.5 to 25 µsec plus pre-trigger fill time.

TRIGGERING

Sources – Internal from any channel (active or inactive) or External.

Trigger Coupling and Impedance – DC and AC. Impedance for Internal is the same as input channel coupling (50 Ω); for External 50 Ω ±5%.

Trigger Slope – Positive or Negative.

Trigger Modes – Normal (unit will wait indefinitely until a valid trigger occurs) and Auto (a trigger will be generated after approximately 60 Ms if a valid trigger does not occur).

Trigger Time Accuracy (including jitter) – CH 1: 1 sample interval RMS; Dual Channel: 0.5 sample interval RMS; Quad Channel: 0.25 sample interval RMS.

Pre-Trigger Capture (Waveform data captured prior to the Trigger event) – From ≈100% of the Record Length to 0% in increments of 64 sample intervals.

Post-Trigger Capture (Waveform data captured after the Trigger event) – From 0% of the Record Length to 99,999,999 sample intervals after the trigger. For post-trigger mode, acquisition begins after the post-trigger delay set and captures the full defined record length.

Arming – Internal or External. Triggers are not recognized until the unit is armed. External Arm is a BNC input that arms on a switch closure to ground (internal pull-up provided to 5 V).

Trigger Out Signal – A TTL low level (≤0.8 V) output at the BNC after trigger and remains low during the acquisition cycle.

COMPUTER INTERFACES

GPIB – IEEE 488-1 interface is standard for instrument control and waveform data transfer. Maximum transfer rate ≥500 KB/sec.

Parallel Port – A waveform data output only 16-Bit wide TTL level parallel port is provided capable of two Mwords (4 MB) data transfer rates.

DISPLAY AND INSTRUMENT CONTROL

Optional Display – Provides for waveform viewing and instrument control. Display can be remotely mounted and moved from instrument to instrument by simply moving the connecting cable.

Hardcopy – The display also supports a video hardcopy capability (EGA compatible) and with the Display Unit plotter output over the GPIB is available without the need for a controller/ computer.

ENVIRONMENTAL (STANDARD INSTRUMENT)

Temperature Range – Operating: –10°C to +55°C; Nonoperating: –51°C to +71°C.

Humidity – 0% to 95% relative humidity (non-condensing).

Altitude – Operating to 4.5 km (15,000 ft.) max; Nonoperating to 15 km (50,000 ft.) max.

POWER REQUIREMENTS

Line Frequency – 48 to 440 Hz.

Voltage Range – Selected by rear panel switch 90 to 132 V RMS or 180 to 250 V RMS.

Power Consumption – ≤500 W fully optioned (typical ≤350 W).

Warranty – The RTD 720A carries a standard Tektronix one-year warranty covering labor and replacement parts for the instrument.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	482.6	19
Height	225.25	8.75
Depth	635	25
Weight ≈	**kg**	**lb.**
Net	19	49

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

RTD 720A
Transient Event Digitizer.
Includes: Two Input Channels and 128 K Acquisition Memory; Power Cord; Fuses; User's Manual (070-8516-00); Programmer's Manual (070-8518-00); Quick Reference Guide (070-8517-00); and Rackmount Kit.

Opt. 06 – Four (4) Acquisition Channels (adds two additional full function channels).

Opt. 10 – 512 K Battery Backed-up Acquisition Memory.

Opt. 15 – 4 MB Acquisition Memory.

Opt. 19 – Optional remote mountable display for waveform viewing and instrument control.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 – See General Customer Information.

RECOMMENDED ACCESSORIES – Also see page 434.

PROBES

Active – 1 GHz, 1.9 pF/10 MΩ, 1.5 m. Order P6204.10X, 1.5 GHz, 1 pF/1 MΩ, 1.3. Order P6245. 750 MHz, 2 pF/1 MΩ, 1.5 m. Order P6205. 4 GHz, 0.4 pF/100 kΩ. Order P6217.

Differential – 100 MHz, Active Differential. Order P6046.

50 Ω Divider (Zo) – 53.5 GHz, 1 pF/500 Ω, 10X; 3 GHz, 1 pF/5000 Ω, 100X, 1.5 m. Order P6156 with Opt. 25.

Current – DC – 50 MHz System. Includes AM503A, A6302, TM502A. Order AM503S.

CAMERAS/PLOTTERS/PRINTERS/CART

Plotter – Order HC100 with Opt. 01.

Cart – Order K475.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

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Logic Scope
TLS 216

Features

TLS 216

- 2.5 pF, 1 MΩ Podlet Style FET Probes
- Display Modes: Analog, Timing Diagram and BusForm™
- <±100 ps Timing Resolution
- 16 Input Channels
- 2 GS/s Simultaneous Sampling on All Channels
- 500 MHz Real-time Bandwidth
- Logic Family Presets for TTL, ECL and CMOS
- Sophisticated Time Qualified Triggering with Four Word Recognizers
- 3-Year Warranty

BENEFITS

- Facilitates Hands-free Connection to SMT Devices
- Low Capacitance Probe for Non-intrusive Probing
- Powerful Triggering Reduces Time to Identify Problems
- Flexible Display Modes Simplify Recognition of Timing Faults
- High-speed Acquisitions on All Channels Facilitate Analysis of Complex System Interactions

Applications

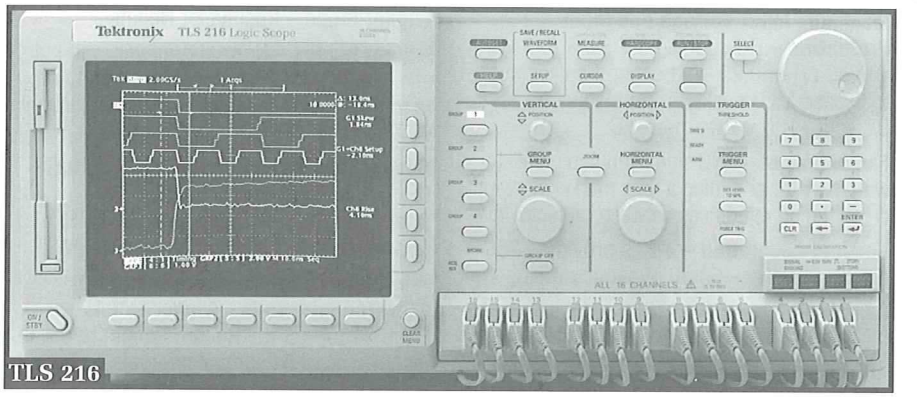
- Hardware Performance Verification
- Multi-channel Data Acquisition
- Mixed Signal Analysis
- A/D and D/A Analysis
- Hardware Timing Analysis

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

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TLS 216 Logic Scope

The TLS 216 Logic Scope is a new class of instrument designed to simplify the task of debugging digital hardware. The Logic Scope seamlessly combines in a single instrument the analog acquisition system of a high-speed digital storage oscilloscope (DSO) with the triggering and display systems of a logic analyzer. The 500 MHz bandwidth Logic Scope samples all channels simultaneously at 2 GS/s and has sophisticated time-qualified triggering, a high resolution color display, and an integrated MS-DOS compatible 3.5 inch floppy disk drive.

SOPHISTICATED TRIGGERING TO IDENTIFY COMPLEX DIGITAL PROBLEMS

In addition to edge trigger, most digital signals can be easily captured using pulse, glitch and pattern triggers. The Logic Scope provides two new trigger resources that allow the instrument to directly trigger on common digital circuit behavior. The industry's first time-interval or sequence trigger type monitors the time between two events, allowing the instrument to easily trigger on setup time violations, hold-time violations, or unexpected propagation delay. The powerful "Time-out" trigger type can be used to capture incomplete handshake sequences or to trigger the instrument when the DUT "hangs."

All of these trigger types let developers identify channel-to-channel relationships, including 16-Bit patterns and time-related/time-qualified system faults. The Logic Scope's external trigger-input can be used as a "Trigger Arm" to enhance cross-triggering between two instruments, simplifying the task of using a Logic Scope with other test equipment.

2.5 pF, LOW-MASS FET PROBES ENSURE NON-INTRUSIVE CONNECTION

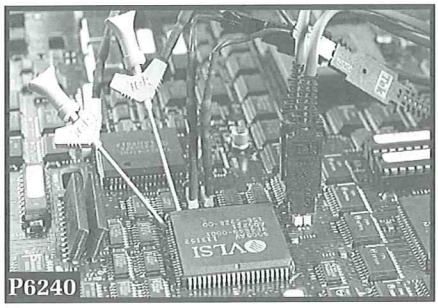
The Logic Scope includes a set of 16 specially designed probes that have extremely low probe-tip mass (1.5 grams) and input capacitance (2.5 pF). The low probe-tip mass ensures that connections made to surface mount and fine pitch ICs will be reliable. The low input capacitance, combined with the 1 MΩ input resistance, decreases the effect of the probe on the DUT's operation, allowing very accurate measurements to be made with confidence.

These characteristics are made possible by using a "podlet-style" probe-tip design instead of the "pencil-style" design of traditional oscilloscope probes. Employing the de facto industry standard of 0.1 inch spacing between the signal and ground inputs, each 0.1 inch thick podlet can directly attach to the hundreds of readily available IC adapters and clips.

TEST & MEASUREMENT WORLD BEST IN TEST 1994 AWARD WINNER

Logic Scope
TLS 216

Accessories



Characteristics

SIGNAL ACQUISITION SYSTEM

Sample Rate	2 GS/s
Bandwidth	500 MHz
Channels	16
Samplers	16
Sensitivity	50 mV to 10 V/div*[1]
Position Range	±5 Div
Offset	±1 V from 1 to 99.5 mV/div

*[1] *Magnification used above 2 V/div range.*

VERTICAL SYSTEM

DC Gain Accuracy – ±1.5% after probe calibration.

Vertical Resolution – 8-Bits (256 levels over 10.24 vertical divisions), 11-Bits with averaging.

Analog Bandwidth Selection – 20 MHz and full.

Input Coupling – DC.

Input Impedance – 50 Ω with coax adapter, 1 MΩ with probe.

Maximum Input Voltage – Max non-destructive input ±25 V (DC + Peak AC).

Dynamic Range – +15 V to –12 V with probe.

TIME BASE SYSTEM

Time Bases	Main, Delayed
Time/Division Range	500 ps to 5 s/div
Time Base Accuracy	0.01% over any interval ≥1 ms
Record Length	500 to 2,000 pts
Pre-trigger Position	20% to 80% of record

ACQUISITION MODES

Sample – Sample data only.

Envelope – Max/min values acquired over one or more acquisitions.

Average – Waveform averages selectable from 2 to 10,000.

DISPLAY

Mixed-mode Data Display – Logic Scope offers Analog, Timing, and BusForm™ display formats that simplify recognition of digital timing faults and signal anomalies. BusForm™ display compresses many input signals into the least amount of display area. The acquired data can be displayed in any of the three display modes without re-acquiring.

Waveform Style – Dots, vectors, variable persistence selectable from 250 ms to 10 s, infinite persistence, and intensified samples.

Color – Standard palettes and user definable colors for waveforms, text, graticules, and cursors. Measurement text and cursor colors matched to waveform. Waveform collision areas highlighted with different color. Statistical waveform distribution shown with color grading through variable persistence.

Color Grading – With variable persistence selected, historical timing information is represented by temperature or spectral color scheme providing "z-axis" information about rapidly changing waveforms.

Graticules – Full, grid, cross hair, frame.

Format – YT.

Fit to Screen – Entire acquisition memory displayed on screen.

TRIGGERING SYSTEM

Triggers – Main, Delayed.

Main Trigger Modes – Auto, Normal, Single.

Delayed Trigger – Delayed by time and/or events.

Time Delay Range – 16 ns to 250 s (time/div ≤10 µs); 15.1 ns to 250 s (time/div ≤25 µs).

Events Delay Range – 1 to 9,999,999 events.

AUX Trigger Input – TTL compatible; Max input voltage is –1 V to +6 V.

MEASUREMENT SYSTEM

The Logic Scope provides a comprehensive suite of automatic measurements specifically designed to improve efficiency when troubleshooting digital hardware. Twenty-eight onboard measurements, including setup time, hold time, and skew, speed identification of common digital problems. Whereas traditional DSOs confine waveform measurements to establishing the relationship of a single channel to a clock, the Logic Scope simultaneously samples on all channels, so you can see the relationships between multiple channels.

Automatic Waveform Measurements –

Period	Frequency
High	Low
+ Width	– Width
Maximum	Minimum
Rise	Fall
Peak to Peak	Amplitude
+ Duty Cycle	– Duty Cycle
+ Overshoot	– Overshoot
Propagation Delay	Burst Width
Mean	Cycle Mean
RMS	Cycle RMS
Area	Cycle Area
Phase	Setup Time
Hold Time	Skew

Continuous update of up to four measurements on any combination of waveforms.

Gated – Any region of the record may be isolated for measurement using vertical bars.

Snapshot – Performs all measurements on any one waveform, showing results from one instant in time.

Cursor Measurements – Absolute, Delta; Volts, Time, Frequency, Binary Readout.

Cursor Types – Horizontal bars (volts); Vertical bars (time); operated independently or in tracking mode.

COMPUTER INTERFACE

GPIB (IEEE 488.2) Programmability – Full talk/listen modes. Control of all modes, settings, and measurements.

HARD COPY/DESKTOP PUBLISHING

Printer – HP ThinkJet, Epson, PostScript, DeskJet, LaserJet, DPU 411/412.

Export File Formats – EPS (Encapsulated PostScript), Interleaf, TIFF, PCX, BMP, RLE.

Plotter Support – HPGL.

I/O Ports – GPIB, Centronics, RS-232 (Talk only).

Floppy Disk Drive – 3.5 in., 1.44 MB DOS format.

VGA Output – 15-Pin analog output (Color).

STORAGE

Waveforms – 16 full 2,000 pt waveforms. 119,008 500 pt waveforms on 1.44 MB floppy disk.

Setups – 10 front-panel setups. 78,947 setups on 1.44 MB floppy disk.

Logic Scope
TLS 216

TRIGGER TYPES (MAIN AND DELAYED)

Edge	Trigger when either a rising or falling edge (positive or negative slope) is detected.
Pulse	The pulse may be positive or negative and defined by a duration.
Width (<Time, >Time)	Trigger when the duration of either a positive or negative pulse is less than or greater than the user-defined input.
Range (In Range, Out of Range)	Trigger when the duration of either a positive or negative pulse is either between the upper and lower limits or outside the limits.
Time-out	Trigger at the end of a user-defined time period if the trailing edge of either a positive or negative pulse is not detected.
Pattern	Each input may be defined as a low (logic 0), high (logic 1), or don't care (X). Inputs can be ANDed or ORed. The pattern may be positive true or positive false.
Width (<Time, >Time)	Trigger when the duration of a user-defined logical pattern is less than or greater than the user-defined input.
Range (In Range, Out of Range)	Trigger when the duration of a user-defined logical pattern is either between the upper and lower limits or outside the limits.
Time-out	Trigger at the end of a user-defined time period if the user-defined logical pattern of a specified duration does not occur.
Sequence	The sequence is defined by a set of start and end events. The start or end event can be either a pattern or an edge (positive or negative slope).
Width (<Time, >Time)	Trigger when the duration between the user-defined start and end events is less than or greater than the user-defined input.
Range (In Range, Out of Range)	Trigger when the duration between the user-defined start and end events is either between the upper and lower limits or outside the limits.
Time-out	Trigger at the end of a user-defined time period if the user-defined end event does not occur within the specified time after the start event.
State	Trigger when a user-specified logical pattern is detected and the input defined as the clock goes true or goes false. Each input may be specified as a low (logic 0), high (logic 1), or don't care (X). Inputs can be ANDed or ORed.

POWER REQUIREMENTS

Line Voltage Range – 90 to 250 V RMS.

Line Frequency – 47 to 63 Hz.

Power Consumption – 300 W max.

ENVIRONMENTAL AND SAFETY

Temperature – Operating: +4°C to +50°C. Nonoperating: –22°C to +60°C.

Humidity – Operating and Nonoperating: Operating to 80% at or below 29°C, to 20% from +30°C to +50°C. Nonoperating to 90% at or below 41°C to 5% from +41°C to 50°C.

Altitude – Operating: 15,000 ft., Nonoperating: 40,000 ft.

Electromagnetic Compatibility – Meets MIL-STD-461C, CE-03, Part 4, Curve # 1; meets VDE 0871, Category B, FCC rules and regulations, Part 15, Subpart B, Class A.

Safety – Listed UL 1244, certified CSA C 22.2 No. 231-M89.

PROBES

Active Probes – 2.5 pF, 1 MΩ FET.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height with feet	236	9.3
without feet	193	7.6
Width with handle	445	17.5
Depth with front cover installed	432	17.0
Weight	**kg**	**lb.**
Net ≈	12.3	27
Shipping ≈	20.0	44

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TLS 216
Logic Scope.
Includes: 16 each P6240 2.5 pF, FET Probes, 2 each Handheld Adapters (013-0281-00), 2 each 7 in. Ground Leads (196-3302-00), 2 Packages of 10 each Y-leadsets (020-2008-00), 3 Packages of 12 each KlipChip™ (020-1386-01), 2 each 2-to-1 Podlet Adapters (013-0280-00), 1 Package of 6 Probe Cable Looms (352-0139-00), 3 Cards of Channel ID Labels (334-8632-00), Instrument Front Cover (200-3696-00), U.S. Power Cord (161-0230-01), Quick Reference Guide (070-8833-00), User Manual (070-8834-00), Programmer Manual (070-8835-00).

Opt. 1B – Package of 16 50 Ω Coax Adapters.
Opt. 1K – K420 Instrument Cart Without Power Strip.
Opt. 1R – Rackmount Kit.
Opt. 1S – Substitute 16 Coax Adapters for Standard Probes.
Opt. 24 – Four Extra P6240 Probes.
Opt. 3I – Phaser® 140 360 dpi Color Ink-jet Printer (220 V).
Opt. 3P – Phaser® 140 360 dpi Color Ink-jet Printer (110 V).
Opt. 95 – Calibration Data Report.
Opt. 96 – Calibration Certificate.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.
Opt. A2 – United Kingdom 240 V, 50 Hz.
Opt. A3 – Australian 240 V, 50 Hz.
Opt. A4 – North American 240 V, 60 Hz.
Opt. A5 – Switzerland 220 V, 50 Hz.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

PROBES

FET Probes Only – 2.5 pF, 1 MΩ, 800 MHz, 20X, 1.5m. Order P6240.

CARTS

Instrument Cart – Order K420.

ADDITIONAL ACCESSORIES

Also see page 434.

Service Manual – Order 070-8836-00.
Soft Carrying Case – Order 016-0909-00.
Hard Transit Case – Order 016-1157-00.
U.S. Power Strip – Four Outlet, 6 ft., Noise/Surge Suppression. Order 131-5342-01.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*

Logic Analyzers
and Digital Analysis Systems

Digital Systems Development Strategy

Tektronix is a leading supplier of instruments for digital systems development, with a range of products designed to help engineers meet the productivity and time-to-time market challenges in today's global markets.

TLA 510 and TLA 520 Logic Analyzers

The TLA 500 Series offers mid-priced logic analysis at performance levels previously available only in high end system analysis tools. The TLA supports the most advanced high-speed RISC/CISC microprocessors and multiple microcontroller embedded systems. The Tektronix Power*Flex*™ capability allows the TLAs to grow in capability as the testing demands increase.

The TLA Series provides acquisitions at depths from 8 K to 8 MB sequences. The TLA 510 has 100 channels of acquisition with an optional pattern generator. The TLA 520 has 150 or 200 acquisition channels. The X-window style interface is available on a standard 14-inch or optional 17-inch terminal.

New this year is off-line analysis of acquired data (LA-OffLine™) and the latest advancement in logic analysis – source code tracing with LA-Browser™.

The Enterprise Digital Analysis System – DAS® NT

The global effort toward "Enterprise Computing" centers on efficient exchange and reuse of data across multiple tool sets. To this environment Tektronix brings the DAS® NT Digital Analysis System as enterprise instrumentation. A fully networked real-time analysis system that supports both software and hardware design and optimization. The workstation-based interactive interface provides control, data presentation and automated data exchange with other design tools such as logic simulators and compilers.

The DAS NT Digital Analysis System is the unrivaled performance leader in the analysis of complex digital systems. The DAS® NT has super deep memory of up to 8 M per channel, up to 1536 channels of 100 MHz synchronous acquisition, pattern generation, high-speed timing, support for multiple microprocessors, the most intelligent disassembly available, links to high level debug tools and languages, and is networked to your X-Window based workstation for easier and faster operation.

New this year is off-line analysis of acquired data (LA-OffLine) and the latest advancement in logic analysis – source code tracing with LA-Browser.

DAS® XP Digital Analysis System

The DAS® XP Digital Analysis System provides much of the capability of the DAS® NT system in a standalone environment. A Tektronix X terminal provides the same X-Window interface as the DAS® NT and can be independent of any network.

3000 Series GPX™ Logic Analyzer

The 3000 Series is Tektronix' mid-range logic analyzer targeted at medium sized designs. The cornerstone of the 3000 Series is the GPX Logic Analyzer. The GPX, with eight tools in one module, offers an outstanding value in a general purpose logic analyzer. In addition, the GPX supports today's leading microprocessors, and is available in three different mainframe configurations. Other modules add a digital oscilloscope, high-speed timing analyzer, and low cost microprocessor support capabilities. GPX is also available in a deep memory version.

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Logic Analyzers
and Digital Analysis Systems

Features

ENTERPRISE DIGITAL ANALYSIS SYSTEMS
- The Unrivaled Performance Leader in Systems Analysis of Complex Designs
- The First Networked Analysis System
- Automated Data Exchange with Other Design Tools

TLA 500 SERIES
- Optimized for Embedded Software Debug
- Scalable Architecture to Address Your Present and Future Needs
- Enterprise Instrumentation Technology

3000 SERIES LOGIC ANALYZERS
- Best Value
- Powerful Timing Analyzer
- Comprehensive Microprocessor Support
- Portable and Benchtop Configurations

At the Leading Edge of Technology

Tektronix is a performance leader in digital analysis tools. Our products are different from others on the market in fundamental and important ways. Our logic analyzer products embody our beliefs about how to design, manufacture, and market logic analyzers to achieve long term customer satisfaction.

Banner specs are necessary, but not always sufficient to ensure getting your job done. We want you to know as much as possible about our market emphasis and products before choosing us as your logic analyzer vendor.

Times Change... and So Do Your Needs

A few short years ago acquiring data from a microprocessor was not much different than acquiring data from digital sources in general. As digital systems become faster and incorporate more powerful microprocessors, the task of integrating hardware and software becomes much more difficult. Today's embedded systems use all types of processors, from simple microcontrollers to high-speed, 32-Bit, RISC/CISC microprocessors and DSPs with many megabytes of memory. In addition to the increased complexity of hardware, today's embedded software is almost entirely written in high level languages such as C, C++, Pascal, or Ada, adding another level of abstraction to the debug process.

As memory and microprocessor costs decrease, it makes economical sense to add more functionality to designs through software. The downside to this trend is that software becomes very complex and much more difficult to manage. When applications get very large, it becomes difficult to see the "big picture" of what your software is doing. Also, as more features get added, the design can get "bogged down" in its own functionality and the software becomes sluggish.

The software development process used by most teams concentrates on getting the logic of the program working first and worries about performance later. Often, the time in a schedule set aside to work on performance issues gets used up in debugging the logic of the program.

We have kept these concepts in mind so that your problems become our problems and our products can deliver the solutions that you need readily and conveniently. Our products deliver the performance that has made us one of the premium suppliers of logic analysis tools in the market for a number of years.

Solutions for Your Ever-changing Needs...

The Tektronix family of logic analyzers – the 3000 Series, TLA 500, and the DAS® – offers a variety of solutions to help you get your product to the market faster. Our broad offering can address basic timing problems to the most complex hardware-software integration applications. Or, if you prefer a monolithic, portable, or a card modular system that is capable of being networked and operated from a remote location, we have the form factor compatible to fit with your working environment.

DETERMINING A LOGIC ANALYSIS SOLUTION

# micros under test	0-1	1-2	up to 10
Micro Bus Size	8/16	16/32	16/32
Team Size	small	medium	large
Application	timing/integration	HW/SW integration	HW/SW integration
Environment	standalone	standalone/networked	networked/standalone
Recommended Solution	**3000 Series** (page 143)	**TLA 500** (page 130)	**DAS®** (page 134)
Synchronous Speed	80 MHz	100 MHz	100 MHz
Asynchronous Speed	200 Ms/IGs	400 Ms	400 Ms
# Channels	20-320	100-200	100-1600
Memory Depth	8 K-32 K	8 K-8 M	8 K-8 M
Performance Analysis	√	√	√

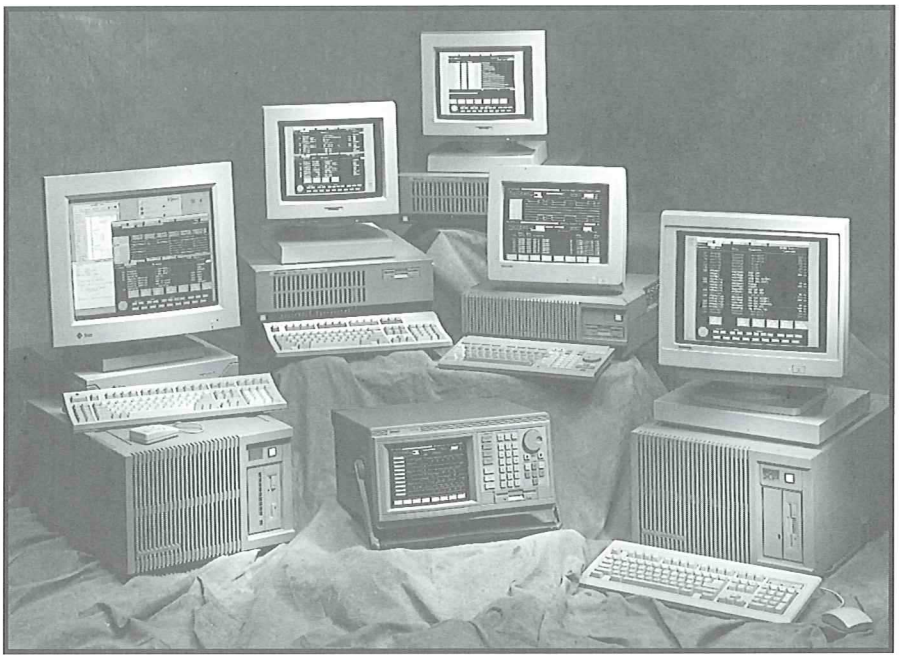
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See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

Logic Analyzers
and Digital Analysis Systems



It All Starts at the Probe Tip...

With today's smaller and denser IC package, it becomes increasingly difficult to get to the signal source without compromising fidelity. Our NiCR Coax 7 component passive hybrids embedded in each podlet probing standard ensure the purest of signals delivered to the logic analyzer interface.

The fact that we offer the unique capability of delivering state as well as timing information using the same probe ensures that your task is performed quickly and accurately with as little stress as possible to the system under test.

Disassembly... Much More Than Inverse Assembly

In years past, if one acquired state data from a microprocessor bus it was possible to simply look up instruction mnemonics in a table ("inverse assembly") with good results. Today's microprocessors include deep pipelines, prefetch queues, caches, and other architectural structures that have created a "many-to-one" relationship between bus activity and object code. A look-up table approach is now totally inadequate.

As part of our logic analysis solution, we offer disassemblers that intelligently predict branches, queue flushing, and other microprocessor specific operational idiosyncrasies. Our disassemblers also support modes of data display configurable for individual needs with varying levels of data abstraction.

Triggering is Key

The most fundamental distinction between having good banner specs and being able to solve real problems is in the area of triggering. Logic analysis triggering is a classic example of what at the surface can appear to be an inevitable trade off between power and ease of use. Tektronix has developed a fresh approach to this area.

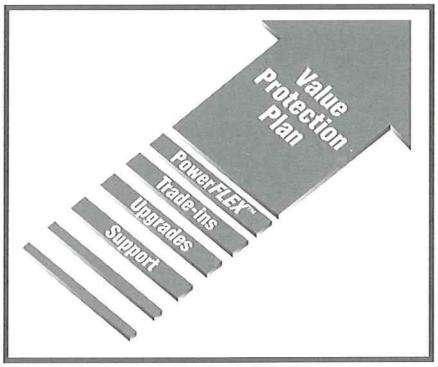
We use a patented triggering state machine architecture that provides a rich triggering tool set. We combine the versatility of the true state machine triggering with extensive on-line libraries which can be modified for your individual situation.

"Level oriented" trigger paradigms are confining, difficult to drive, and often lack the horsepower to describe the unique symptoms you may wish to trigger on. As a general rule, one state equates to several levels in raw triggering power and is generally easier to use.

The Value Protection Plan – A Commitment for Preserving Your Investment over Time

The need to invest in logic analysis tools is typically driven by your current needs. However, as your needs grow in the future, your tools become obsolete.

The Value Protection Plan is a long term policy that provides you with an upgrade path to the latest logic analysis tools from Tektronix. This unique policy will protect your existing investment by enabling you to upgrade or replace your current system to one of increased performance when you need it.



PowerFlex™ Industry's First Scalable Architecture

In most situations logic analyzers are set up to trigger on a visible symptom of a problem. With microprocessor based designs, the cause of the problem is often separated from the symptom by long periods of time.

We believe a most important, but often least considered, specification for a logic analyzer is the acquisition memory depth. It is often the factor between capturing the problem in the first acquisition or having to make multiple acquisitions. This is one reason we introduced Power*Flex*™ in the TLA and DAS® products – a scalable architecture that allows you to conveniently increase the depth in acquisition memory.

Each of our products is backed by our commitment to quality, support and convenience. Our logic analyzers are supported by a staff of specialists and application engineers as well as a toll-free telephone hotline support. We are equipped to serve you at a personal level to ensure that our products are well made and address your needs today and in the future.

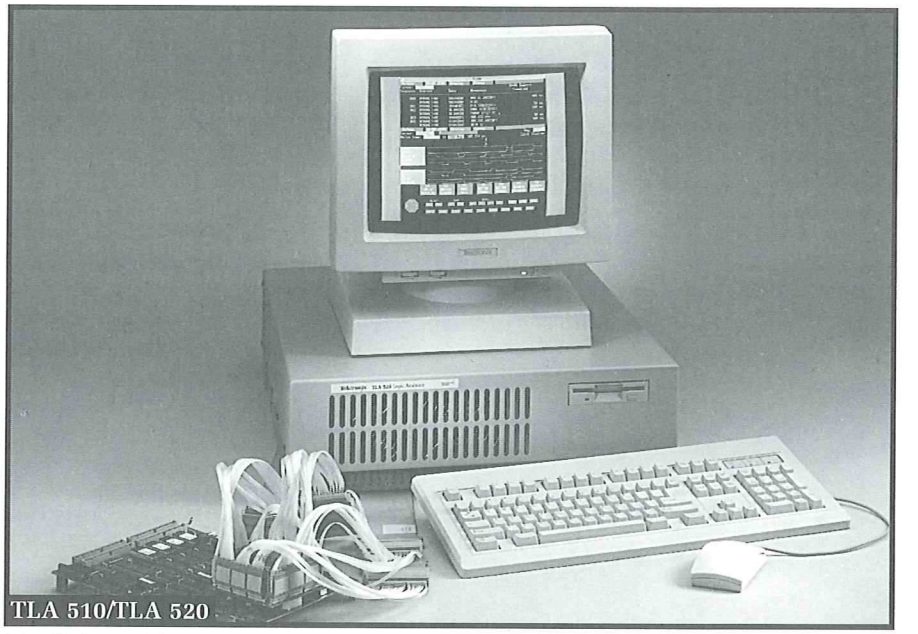
TLA Logic Analyzers

TLA 510 • TLA 520

Features

TLA 510/TLA 520

- 100 MHz State Analysis
- 400 Ms Timing Analysis
- 8 K to 8 M Acquisition Memory Depths
- 100, 150 and 200 Channel Widths Models
- High Performance RISC/CISC Microprocessor Support
- Advanced Performance Analysis
- Links to High Level Languages for Software Debug
- Compliant with CISPR IIA Radiated and Conducted Emissions Requirements
- 18-CH, 50 MHz Algorithmic Pattern Generator



The TLA 500 Series user interface is displayed and controlled from a 14 in. X11 terminal. A 17 in. terminal is optionally available.

Excellent Price/Performance

The TLA Series has the performance necessary to solve the tough software/hardware integration and software debug problems previously available only in high-performance analysis systems.

SIZED TO THE TASK

The TLA 510 includes 100 channels (96 data and four clock) of 100 MHz acquisition. This is ideal for most single processor applications. The TLA 520 includes 200 channels of 100 MHz acquisition that can be divided to support two processors time correlated, or combined to support one advanced processor. The TLA 520 can optionally be configured as one 100 channel and one 50 channel acquisition. This is convenient when the integration task requires single processor support with separate, but time correlated, state or timing channels.

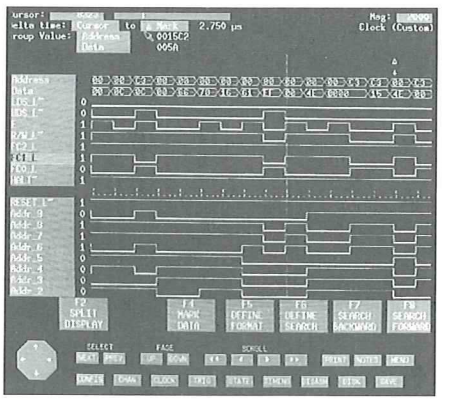
ROBUST COMMUNICATION CAPABILITY

LAN Ethernet and RS-232 communication comes standard with each TLA. Optional and accessory application software offers full remote control capability across the LAN network.

POWER*FLEX*™, THE FIRST SCALABLE ARCHITECTURE

The Power*Flex*™ technology allows the TLA to grow in memory depth and channels without throwing away major portions of your investment. The capability of the instrument can quickly and economically grow as the debug complexity of the target system increases.

All TLA acquisition modules come standard with 8 K of memory. Synchronous acquisition memory depths of 32 K, 128 K, 512K and 2 M are optionally available. Both channel count and memory depth can be easily upgraded in the future using the Power*Flex*™ capability.



General purpose timing and state data displays are available either as independent displays, or time correlated with the microprocessor acquisition.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

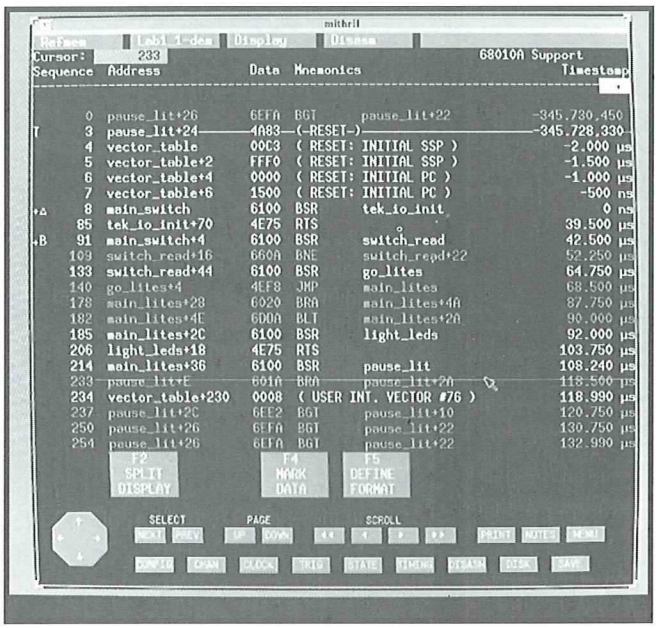
See Tektronix on the World Wide Web: http://www.tek.com

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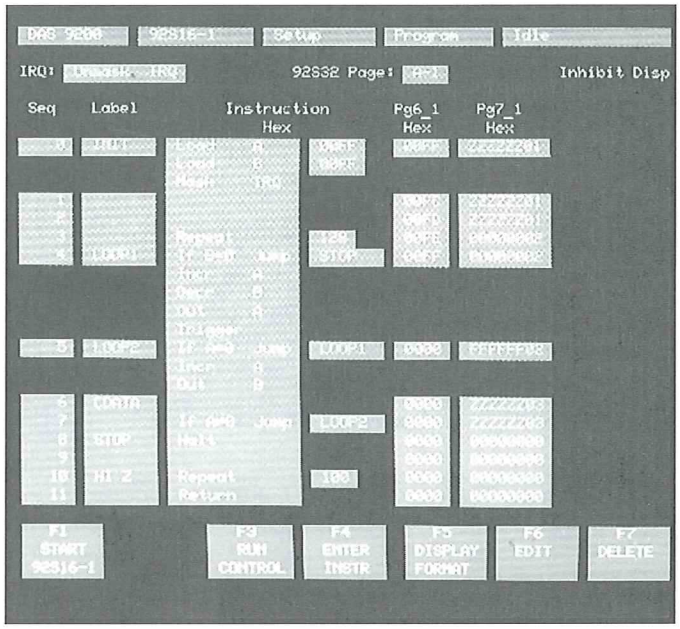
Tektronix Measurement products are manufactured in ISO registered facilities.

TLA Logic Analyzers

TLA 510 • TLA 520



The point-and-click X-windows user interface provides efficient setup and rapid display selections. Various modes of displays can be displayed simultaneously, e.g., Disassembly and Timing.



The 50 MHz pattern generation capability offers efficient, real-time hardware simulation, external event simulation or fault injection.

MULTIPLE DATA DISPLAYS

Beyond the basic state and timing data displays there are four levels of disassembly display available with high level language symbols for software debug.

The Graph display plots acquired data value versus sequence. This is useful to spot errant software execution and for A/D display applications.

ADVANCED PRINT SUPPORT

Both screen images and data files are efficiently printed. PostScript, LaserJet, PCX and BMP are all supported formats. The images can be output to either a local printer or a printer on the LAN network. Alternatively the images are stored in either a local file or transferred across the network to a remote file.

PATTERN GENERATION FOR SIMULATION AND FAULT INJECTION

The TLA 510 offers optional 50 MHz algorithmic pattern generation support TTL signals with Tristate. The 18 channels of TTL signals, with Tristate, can be programmed with specific data values or driven from internal registers that can be loaded, incremented and decremented. Robust branching and looping capability allows full programming of up to 1,000 sequences.

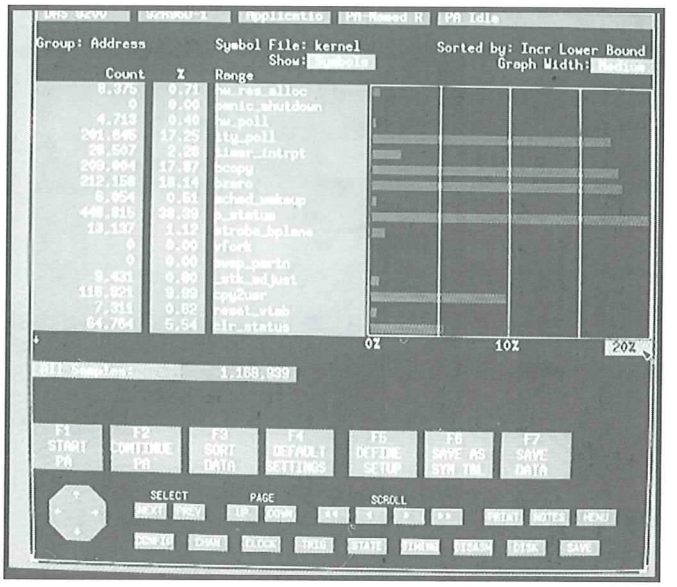
Optional accessory probes are available to control the program sequencing from external events and/or add fully programmable pulse timing capability. ECL probe capability is also available.

The pattern generator can be used to simulate hardware that is not available or real-time events on an external bus. It can also inject real-time faults into a target for system analysis.

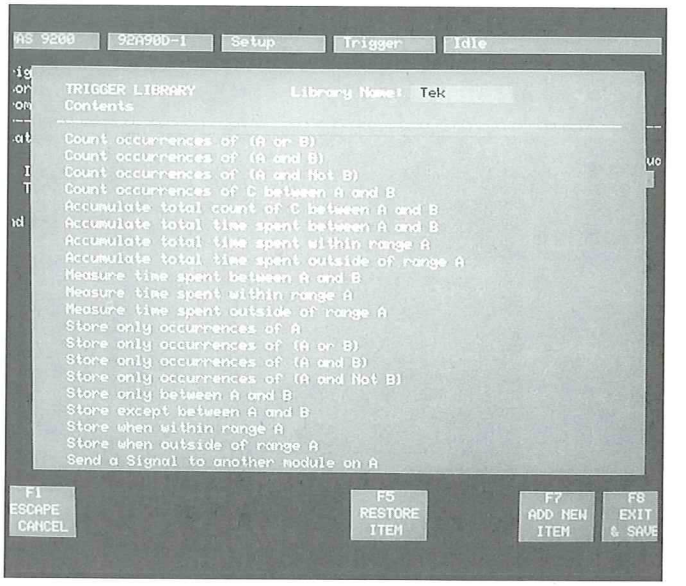
The TLA510 is compatible with our other B pattern generator cards (page 130).

TLA Logic Analyzers

TLA 510 • TLA 520



The performance analysis software includes address binning and event timing modes to quickly determine where performance improvements are needed. Support for 5000 ranges, symbolic representation and data output coupled with deep memory make this a powerful analysis tool.



Rapid selection of common trigger setups, either Tektronix or user defined, access the power of the state-based trigger machine without requiring detailed programming.

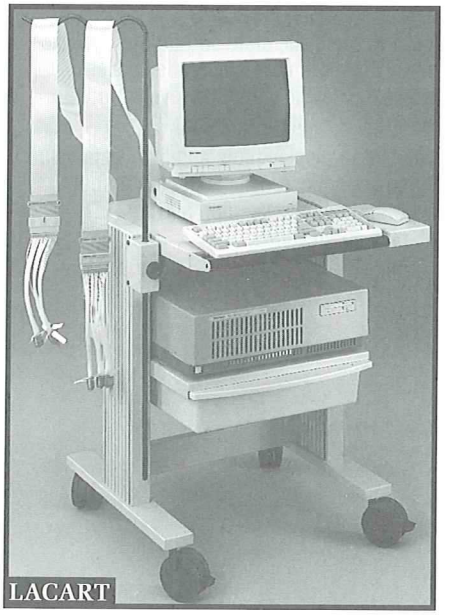
SYMBOLIC PERFORMANCE ANALYSIS

It has become vitally important to know how well your embedded system is performing. The optional performance analysis software charts a histogram of the percentage of execution time spent in each range of software. The screen updates rapidly and the ranges can be sorted while running. The display quickly shows where the bulk of the execution time is being spent. An alternate analysis mode displays a histogram of the range of time required for a particular event, e.g., interrupt latency.

Data can be sorted into 5,000 ranges allowing concise range placement. Data for the ranges can be imported directly from your computer, easing the definition of ranges. The output can be saved as an ASCII file for further analysis.

SIMPLIFIED TRIGGER SETUP

A robust set of pre-programmed triggers addresses the common types of desired trigger definitions. Just select the trigger type and enter the specific data, e.g., address value. Users can also define libraries of trigger definitions commonly used in their environment.



The LACART provides efficient operation of your logic analyzer and quick movement between lab stations.

TLA Logic Analyzers

TLA 510 • TLA 520

ENTERPRISE INSTRUMENTATION CAPABILITIES

It is becoming increasingly important to connect the logic analyzer into the engineering network to maximize the efficiency of the debug and integration cycle. The TLA series offers two levels of enterprise capability. An optional 17-inch X terminal display can replace the standard 14-inch model. The larger display provides a larger TLA user interface or additional display room for other X applications across the network. The standard Telnet software provides remote log in to other workstations.

The second level of enterprise integration replaces the local X terminal display with a full interactive X display on the user's workstation. The TLA can be accessed, single user, from any X11 compatible workstation on the network.

LONG TERM PRODUCT SUPPORT

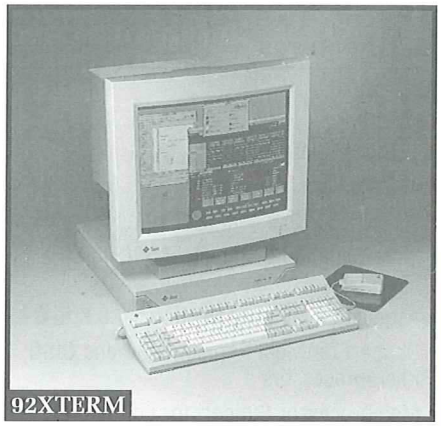
Every TLA 500 is delivered to you with a full one year on-site Service Assurance. (This support may not be available in all geographic areas. Check with your local Tektronix sales engineer.) Service Assurance service options may be purchased to extend coverage to two, three, or four years at the time you purchase your system.

ROBUST APPLICATION SUPPORT

The TLA 500 is compatible with a wide range of advanced application software. (See pages 138-140.)

ADVANCED INSTRUMENTATION

The TLA 510 can be expanded by adding a module from the wide selection of DAS Centurion Acquisition modules and pattern generation modules.



The TLA 500 user interface can optionally be displayed and controlled from any X11 Windows compatible workstation or terminal.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TLA 510
100-CH, 8 K Memory, 100 MHz Acquisition.
Includes: LAN Ethernet and RS-232 Standard, 270 MB Hard Disk, 1.4 MB 3.5 in. Floppy Drive.
Opt. 01 – 32 K Memory.
Opt. 02 – 128 K Memory.
Opt. 03 – 512 K Memory.
Opt. 06 – 2M Memory.
Opt. 04 – Performance Analysis Software.
Opt. 30 – 18-CH, 50 MHz Pattern Generator.
Opt. 1P – Add Additional Probe Accessories.
Opt. 1X – Sub. 92XTERM Networked System Software.
Opt. 8S – Sub. ECL Coax Cable.
Opt. Q0 – On-site Installation.
Opt. 4X – Sub. 17" X terminal.

TLA 520
200-CH, 8 K Memory, 100 MHz Acquisition.
Includes: LAN Ethernet and RS-232 Standard, 270 MB Hard Disk, 1.4 MB 3.5 in. Floppy Drive.
Opt. 01 – 32 K Memory.
Opt. 02 – 128 K Memory.
Opt. 03 – 512 K Memory.
Opt. 06 – 2M Memory.
Opt. 04 – Performance Analysis Software.
Opt. 1D – Delete 50-CH of Acquisition.
Opt. Q0 – On-site installation.
Opt. 1P – Add Additional Probe Accessories.
Opt. 1X – Sub. 92XTERM Networked System Software.
Opt. 8S – Sub. ECL Coax Cable.
Opt. 4X – Sub. 17" X terminal.

SERVICE ASSURANCE OPTIONS

TLA 510
Opt. K1 – Adds one year of post-warranty Customer-Site Repair Protection and Software Subscription Services, as appropriate.
Opt. K2 – Adds two years of post-warranty Customer-Site Repair Protection and Software Subscription Services, as appropriate.
Opt. K3 – Adds three years of post-warranty Customer-Site Repair Protection and Software Subscription Services, as appropriate.

TLA 520
Opt. K1 – Adds one year of post-warranty Customer-Site Repair Protection and Software Subscription Services, as appropriate.
Opt. K2 – Adds two years of post-warranty Customer-Site Repair Protection and Software Subscription Services, as appropriate.
Opt. K3 – Adds three years of post-warranty Customer-Site Repair Protection and Software Subscription Services, as appropriate.

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz.
Opt. A2 – United Kingdom 240 V, 50 Hz.
Opt. A3 – Australian 240 V, 50 Hz.
Opt. A4 – North American 240 V, 60 Hz.
Opt. A5 – Switzerland 220 V, 50 Hz.
See Customer Information Section for additional description.

CART
Workbench Cart – Order K420.
Mouse Pad – Order 436-0317-00.
Skyhook – Order 384-1800-00.

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Digital Analysis System

DAS® NT • DAS® XP

Features

DAS® NT
DAS® XP

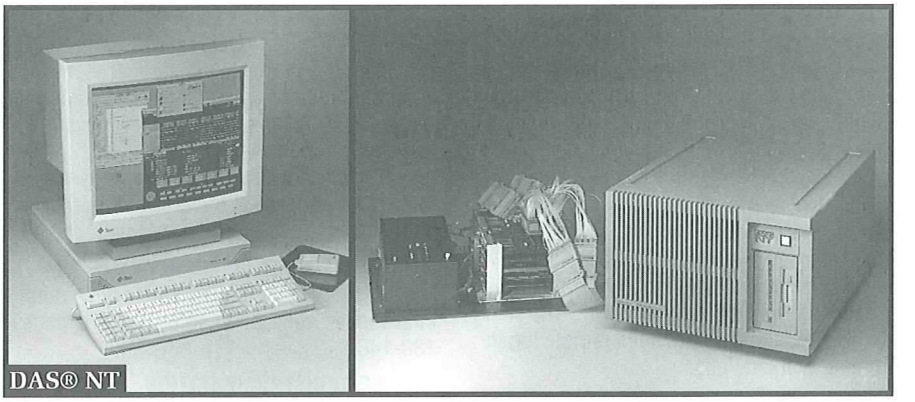
- 100 MHz State Analysis
- 400 Ms, Timing Analysis
- Up to 1536 Channels with 10 ns Resolution
- More than 500 Channels of 50/100 MHz Pattern Generation
- Acquisition Memory Depth from 8 K to 8 M
- Support for Most Popular RISC and CISC Microprocessors
- Multiprocessor Support for up to 10 CPUs at Once
- UL Listed 1244
- Certified to CSA C22.2 No. 231-M89

DAS® NT

- Operates on Any XII/R4 Window Server
- Optional 14 in. and 17 in. Local X Terminal

DAS® XP

- 14 in. X Terminal Standard
- Optional 17 in. X Terminal



The System Challenge

The design and debug of new multiprocessor systems with faster clocks, wider buses, and larger memories is a difficult task to undertake. Complete solutions to these problems are hard to find, and integrating the pieces of a solution are almost impossible.

The DAS NT Digital Analysis System is a complete answer to the needs of design, debug, and test. The advanced architecture of the DAS NT allows you to install all the data acquisition and pattern generation modules you need today without limiting your future demands. You can easily expand or reconfigure as your requirements change.

CONFIGURABLE INSTRUMENT FOR A BROAD RANGE OF APPLICATIONS

Multiple data acquisition and pattern generation cards can be added to a DAS NT system. The cards you select can be grouped into subsystems, allowing you to create virtual instruments within the DAS®. These separate instruments can be controlled independently to observe multiple circuits at once. You can also increase channel widths by grouping like cards into a larger virtual card.

Cards can also interact in real time. For example, two acquisition modules running at different clock speeds can display the acquired data in a time-correlated format, simplifying the debug of multiprocessor designs. Or an acquisition module could wait for a specific event and then start a pattern generator.

THE EFFICIENCY AND PERFORMANCE OF ANALYSIS ON THE WORKSTATION

Many of the tools and most of the data used by designers today are resident on their personal workstations. The DAS NT brings the power of the DAS® to that same interface. All the power of the DAS® is available on an interactive X-window on the workstation. Data from the DAS® can be viewed simultaneously with data from other tools presented in other windows on the workstation. The X-window display is fully compatible with X11/R4 and higher servers.

COMPLEX DESIGNS REQUIRE PROBING OF MANY SIGNALS

As digital designs become more complex, more signals in the SUT (System Under Test) need to be observed to ensure proper operation. To probe those signals, an adequate number of acquisition channels must be available. Having almost enough channels means limiting data acquired, re-probing, or re-acquiring data.

Viewing the whole problem in context is the reason for a digital analysis system. But along with channel count, you require greater measurement performance and the ability to display the data in an intelligible format. The DAS NT display is designed to display large amounts of acquired data with powerful search, format, and symbol capabilities.

Since most logic analyzers can't handle hundreds of timing channels, they don't worry about displaying more than a few channels at a time. With the DAS NT bus waveform display, multiple 32-Bit buses can easily fit on the same timing diagram. Even the buses are cross-correlated to other displays.

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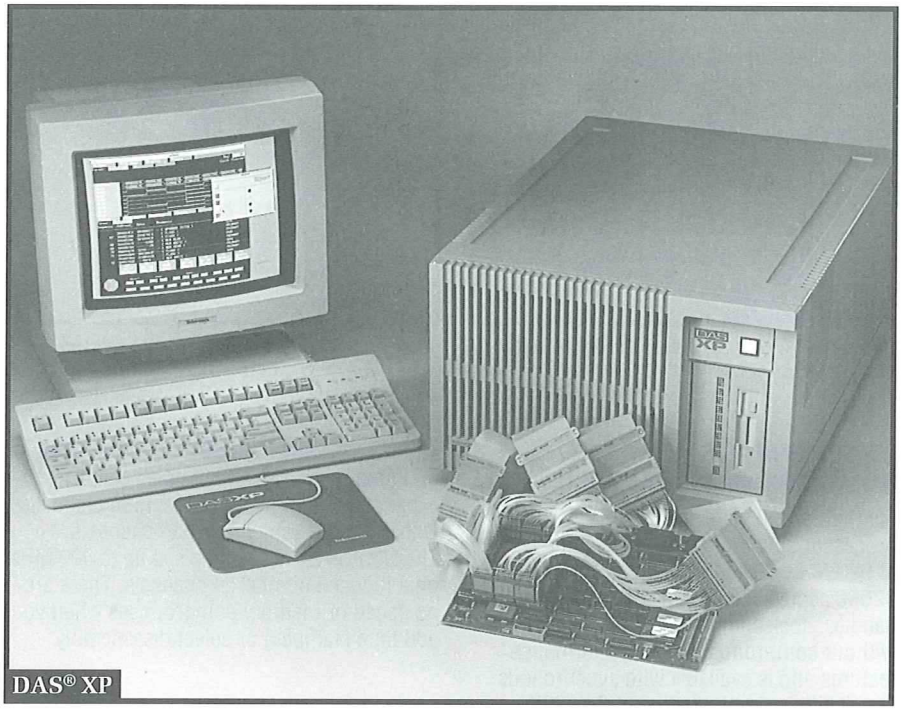
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Digital Analysis System

DAS® NT • DAS® XP



DAS® XP

ADVANCED PRINT SUPPORT

Both screen images and data files are efficiently output. PostScript, LaserJet, PCX and BMP are all supported formats. The images can be output to either a local printer or a printer on the LAN network. Alternatively the images are stored in either a local file or transferred across the network to a remote file.

SIMPLIFIED TRIGGER SETUP

A robust set of pre-programmed triggers address the common types of desired trigger definitions. Just select the trigger type and enter the specific data, e.g., address value. Users can also define libraries of trigger definitions commonly used in their environment.

THE DAS® XP - A MODERN USER INTERFACE FOR THE STANDALONE USER

The DAS® offers powerful analysis capability into applications that do not require the workstation environment. The DAS XP set of configured systems includes a Tektronix X terminal that provides the same powerful user interface as the DAS NT without requiring a network interface. All DAS® control and display functions are present with the DAS XP.

HIGH-PERFORMANCE MAINFRAMES THAT OFFER CHOICES

The high-performance DAS® systems are controlled by a 40 MHz, 32-Bit CPU and contain 16 MB of system RAM, a 270 MB Hard Disk, a PC compatible 1.4 MB Floppy Drive and seven instrument slots. A removable hard disk is also available. The communications ports on the DAS® systems include Ethernet LAN capability, three RS-232 I/O ports and an optional GPIB interface.

The DAS® systems can also be controlled in a lab environment by using PCL, a complete, high level remote control language. PCL can be used to remotely control a DAS® from another computer or controller, over Ethernet LAN, GPIB or RS-232.

Acquired data is easily documented for future reference. Full color printouts of any screen are available on the workstation by using SNAPSHOT or a similar window capture package.

HIGH PERFORMANCE EXPANSION CAPABILITY

The DAS 92E9 expansion chassis is used to expand the number of instrument card slots, available with a DAS® mainframe. The expansion chassis includes an expansion receiver card and cabling, and offers eight additional instrument card slots. A system maximum of 28 card slots are available in a fully expanded system consisting of one mainframe and three DAS 92E9 expansion chassis.

SYMBOLIC PERFORMANCE ANALYSIS

With increasingly complex software, speed and size become harder to manage. When software begins to bog down, you need to know where it's spending its time. With 92PA Performance Analysis, you can chart the ranges where software is running. The screen updates rapidly and data can be sorted while running. A histogram of the execution time of a particular event can be displayed with minimum, maximum and average values continuously updated.

Data can be sorted into 5000 ranges, so everything can be measured in one pass. Data for the ranges can be imported directly from your compiler, easing the definition of ranges. The output of the 92PA can be saved as an ASCII file for later analysis.

PATTERN GENERATION AT UP TO 100 MHZ

For stimulus requirements you can choose between the 92S16/S32 and the 92SX109/SX118. These subsystems generate data rates of up to 50 MHz and 100 MHz respectively. Patterns can be output either sequentially or algorithmically using a command structure that includes subroutine calls. These pattern generators can be combined with any of the acquisition cards to provide powerful stimulus/response systems.

LONG TERM PRODUCT SUPPORT

Every DAS® mainframe and instrument card is delivered to you with a full one year on-site Service Assurance. (This support may not be available in all geographic areas. Check with your local Tektronix sales engineer.) Service Assurance service options may be purchased to extend coverage to two, three, or four years at the time you purchase your system.

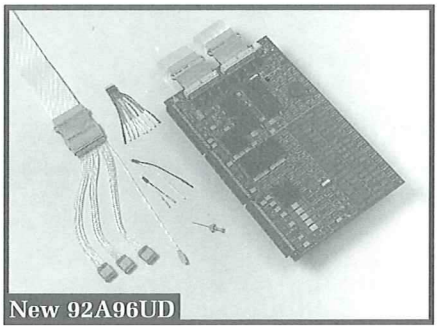
Digital Analysis System

92C96 • 92C96D • 92C96XD • 92C96SD • New 92A96UD

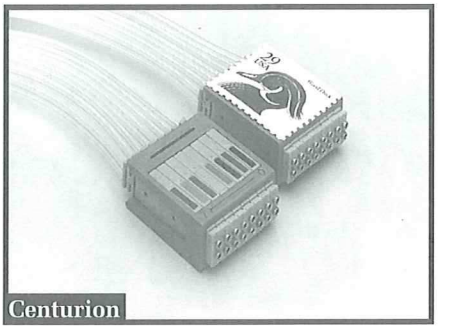
Features

CENTURION ACQUISITION MODULES INCLUDING THE NEW 92A96UD MODULE

- Power*Flex*™
- 96-384 Channels @ 100 MHz Sync or Async
- 400 MHz Async
- 100 MHz Clocking State Machine Tracks Fast, Complex Buses
- 100 MHz, 16 State Triggering State Machine
- 100 MHz Time Stamp
- Available in 8 K to 8 M Memory Depths
- Time-Correlated to Other State/Timing Modules
- Bus-Form Timing Display
- Compact, High Bandwidth Probes
- Provides Timing Analysis Through Same Probes
- Compatible with TLA510 logic analyzers



The 92A96UD offers memory depth of 8 M Bits per channel.



The Centurion family of modules provide accessibility to signals with 8-channel probes as small as a U.S. postage stamp.

State Analysis or Microprocessor Support

For high-speed state analysis or microprocessor support, the solution is the family of 92C96 Centurion acquisition cards. The 92C96 acquisition module of various depths handles clock and bus rates up to 100 MHz without compromising any performance features and is available with synchronous acquisition memory depths of 8 K, 32K, 128 K, 512 K, or 2 M. The 92C96 Centurion is 96 channels wide and can be extended to 384 channels in one mainframe.

TIMING AND HIGH-SPEED STATE ANALYSIS

In timing mode, 92C96 modules can be expanded to a system total of 1536 channels, with 100 MHz sampling on all channels. These cards can also sample at up to 400 MHz on a reduced number of channels. There are no speed or memory compromises when you add time stamping or select disassembly.

Instrument Module Selection Guide

The following instrument cards include probes. A maximum of seven instrument cards may be installed in a DAS® mainframe, depending on the cards. A maximum of eight instrument cards may be installed in a DAS 92E9 expansion mainframe, depending on the cards. Each mainframe includes sufficient power for all card slots. Additional options are available.

MODULE TYPE

Acquisition	Description	Fastest Internal Clock	Fastest External Clock	Maximum per Card	Channels per System	Memory Depth (per CH)
92C96	Master or Expander	2.5 ns	10 ns	96	1,536	8 K
92C96D	Master or Expander	2.5 ns	10 ns	96	1,536	32 K
92C96XD	Master or Expander	2.5 ns	10 ns	96	1,536	128 K
92C96SD	Master or Expander	2.5 ns	10 ns	96	1,536	512 K
NEW 92A96UD	Master or Expander	2.5 ns	10 ns	96	1,536	2 M
Pattern Generator						
92S16	Algorithmic	20 ns	20 ns	18	936	1 K
92S32	Sequential or Expander	20 ns	20 ns	36	1008	8 K
92SX109	Algorithmic	10 ns	10 ns	9	468	2 K
92SX118	Sequential or Expander	10 ns	10 ns	18	504	16 K

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Digital Analysis System
DAS® 9200 • DAS® NT • DAS® XP

WHY HIGH BANDWIDTH PROBES?
Probes are the highest volume component in a logic analyzer and represent a large fraction of the total cost. Probes for the 92C96 use precision NiCR coax and hybrids embedded in the podlets. The specifications are at the probe tip, not at the connector on the acquisition card. Tektronix probes will not add to the uncertainty in your system under test.

The 92C96 has analog bandwidth greater than 150 MHz and can easily handle 100 MHz synchronous acquisition with a setup and hold window of 5 ns.

CONNECT PROBES ONCE!
Probes for logic analyzers are usually optimized for large channel counts at the expense of performance, which makes it difficult to perform timing analysis on the large number of channels necessary for state analysis. The compact 8-CH probes of the 92C96 allow convenient connection to wide buses without compromising timing performance. You can connect to a microprocessor bus for state analysis with disassembly and change to fast asynchronous bus timing without switching probes!

WHY DEEP MEMORY?
In most situations, triggering starts on a visible symptom of a problem. With microprocessor-based designs, the cause of a problem is often separated from the symptom by a long period of time and a lot of bus activity. To trace the cause of the symptom, you need to go backward in acquisition memory to the time of the cause. Only a deep trace buffer with full trigger positioning can prepare you for this kind of problem.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

PowerFlex™ UPGRADES

92FXNET
Upgrades DAS 9219/9220 Mainframe to Workstation Compatible (DAS NT).
Includes: 92FXSE and DAS NT Software.

92FXSE
Upgrades DAS 9219/9220 Mainframe to (DAS XP).
Includes: CPU card, DAS®/OS, 270 MB HDD, X Terminal, and 3.5 in. Floppy Disk Drive.

9206XT
14 in. X Terminal and DAS XP Software.
Opt. 4X – 17 in. X Terminal and DAS XP Software.

92F11
3.5 in. Floppy Disk Drive.

92LANSE
Ethernet LAN Interface.

92C96 UPGRADES

LAF01 – 8 K to 32 K memory upgrade.
LAF02 – 8 K to 128 K memory upgrade.
LAF03 – 8 K to 512 K memory upgrade.
LAF04 – 32 K to 128 K memory upgrade.
LAF05 – 32 K to 512 K memory upgrade.
LAF06 – 128 K to 512 K memory upgrade.

92C02 COMMUNICATION INTERFACE
GPIB/Mainframe Expansion Interface.

DAS® ACQUISITION CARDS

92C96 – 8 K Deep Card.
92C96D – 32 K Deep Card.
92C96XD – 128 K Deep Card.
92C96SD – 512 K Deep Card.
92A96UD – 2M Deep Card.

92C96 CENTURION OPTIONS

Opt. 1P – Additional general purpose accessories.
Opt. 4S – Substitute coax probe cables.

DAS® MAINFRAMES

DAS® NT
Networked System Analyzer Mainframe.
Includes: 40 MHz CPU, 16 MB RAM, 270 MB Hard Disk, 1.4 MB Floppy Drive and Ethernet LAN Interface.

DAS® XP
Standalone System Analyzer Mainframe.
Includes: 40 MHz CPU, 16 MB RAM, 270 MB Hard Disk, 1.4 MB Floppy Drive and Ethernet LAN Interface.

DAS® 92E9
8 Card Slot Expansion Mainframe.

OPTIONS COMMON TO ALL DAS® MAINFRAMES

Opt. 04 – EMI Shielding.
Opt. 05 – Rackmount Kit.
Opt. 1A – 115 V/15 A Power Cord.
Opt. 1B – 125/208 V 3-Phase Power Supply.
Opt. 18 – Sub. Removable HD for Std. HD.
Opt. 2C – GPIB/Expansion Interface (92C02).
Opt. 4X – Sub. 17 in. X Terminal.

DAS® PATTERN GENERATOR CARDS

92S16
18-CH, 50 MHz Algorithmic Pat. Gen., 1 K Deep..
Includes: Two P64643A Probe and Leads.
Opt. 2S – Sub. Two P6465 Probes for Two P64643A Probes.

92S32
36-CH, 50 MHz Sequential Pat. Gen., 8 K Deep.
Includes: Four P64643A Probes and Leads.
Opt. 1S – Sub. One P6465 Probe for One P64643A Probe.
Opt. 2S – Sub. Four P6465 Probes for Four P64643A Probes.

92SX109
9-CH, 100 MHz Algorithmic Pat. Gen., 2 K Deep.
Includes: One Pat. Gen. Multiplexer, and One P6465 Probe and Leads.
Opt. 09 – Add One P6465 Output Data Probe.
Opt. 11 – Add One P6460 External Control Probe.

92SX118
18-CH, 100 MHz Sequential Pat. Gen., 16 K Deep .
Includes: Two Pat. Gen. Multiplexers, and Two P6465 Probe and Leads.
Opt. 09 – Add Two P6465 Output Data Probe.

SERVICE ASSURANCE OPTIONS

Opt. K1 – Adds one year of post-warranty Customer-Site Repair Protection and Software Subscription Services, as appropriate.
Opt. K2 – Adds two years of post-warranty Customer-Site Repair Protection and Software Subscription Services, as appropriate.
Opt. K3 – Adds three years of post-warranty Customer-Site Repair Protection and Software Subscription Services, as appropriate.

Note: Opt. 88, Factory Installation and Test, is a no charge option available for all DAS® instrument cards ordered with a new mainframe.

Note: On-site installation is also available as an option to your system. When you purchase on-site installation, the service technician will:

- Set up and configure your system.
- Configure and integrate all optional accessories.
- Run diagnostics to completely verify functionality.

ADDITIONAL ACCESSORIES

Cart – K420 Work Bench. See page 521.

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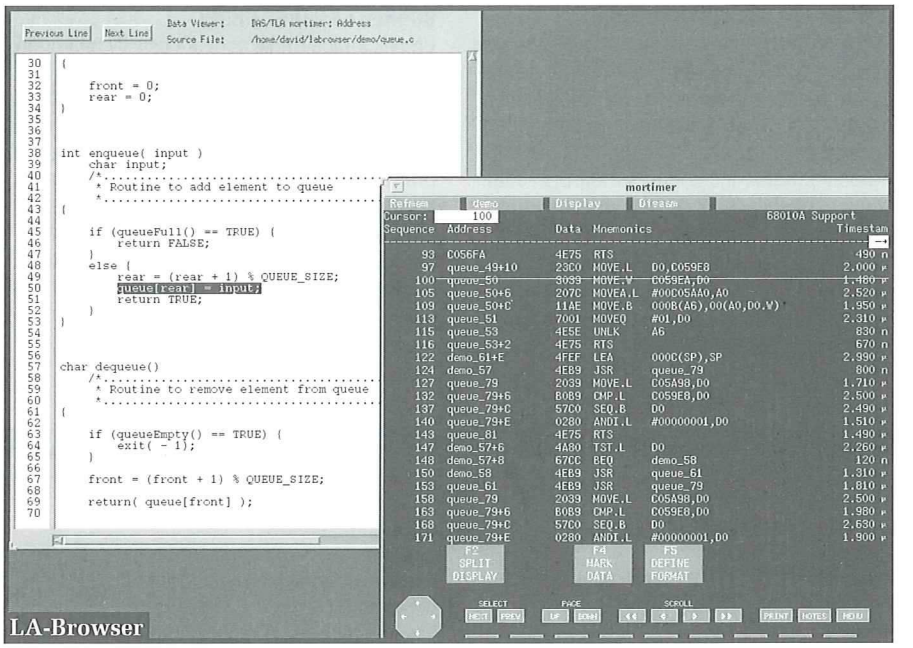
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High Level Language Browser Software

LA-Browser™

Features

- Correlate High Level Language Statements to Disassembly Display
- Supports C, C++, Ada, Pascal, FORTRAN, and Others
- Compatible With All DAS/TLA Supported Microprocessors
- Runs On-line With DAS/TLA Logic Analyzers or Off-line With LA-OffLine™
- Scroll by High Level Statement
- Scroll by Assembly Level Statement
- Trace Real-time Activity by Source Code Statement



LA-Browser displays the high level language statement that generated the assembly code displayed by the logic analyzer. This shows LA-Browser and the DAS/TLA interface being used together.

Source Code Tracing of Logic Analyzer Data

LA-Browser is a host based software product that works with Tektronix Enterprise logic analyzers, the DAS and TLA500 Series and with Tektronix LA-OffLine data analysis software. One window displays the traditional DAS/TLA interface with the disassembly display. LA-Browser opens a second window which displays the original source code. These two windows are synchronized, so that as you scroll through the acquired data in the logic analyzer display, the LA-Browser display highlights the corresponding source code statement.

This revolutionary product will greatly improve the efficiency of your hardware/software integration and software debug task by letting you work at the source code level in which you wrote your program. You no longer need to manually translate assembly language back to the original source code when using your logic analyzer.

MOST MAJOR COMPILERS ARE SUPPORTED

LA-Browser extracts the information it needs from the load file generated by the compiler. When your program is compiled with "debug" turned on, additional information is generated and stored in the load file. When you tell LA-Browser the name of your load file, it extracts the information it needs.

Compilers generate several common formats. LA-Browser supports IEEE695, OMF86, OMF386, and new formats are constantly being added. If your compiler does not generate these formats, LA-Browser has an ASCII format that it can read.

Tektronix is working with major compiler vendors to verify LA-Browser compatibility with their compilers. Check to see if your compiler vendor is a Tektronix partner and if not, have them contact Tektronix to become a marketing partner.

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ORDERING INFORMATION

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LA-Browser™
Source Code Browser for
DAS/TLA Logic Analyzers and LA-OffLine.

Opt. 01 – SUN Based Software, Single License.
Opt. 05 – SUN Based Software, 5 Licenses.
Opt. 08 – SUN Based Software, Site License.
Opt. 41 – 1 Year Software Subscription Service, Single License.
Opt. 45 – 1 Year Software Subscription Service, 5 Licenses.
Opt. 48 – 1 Year Software Subscription Service, Site License.

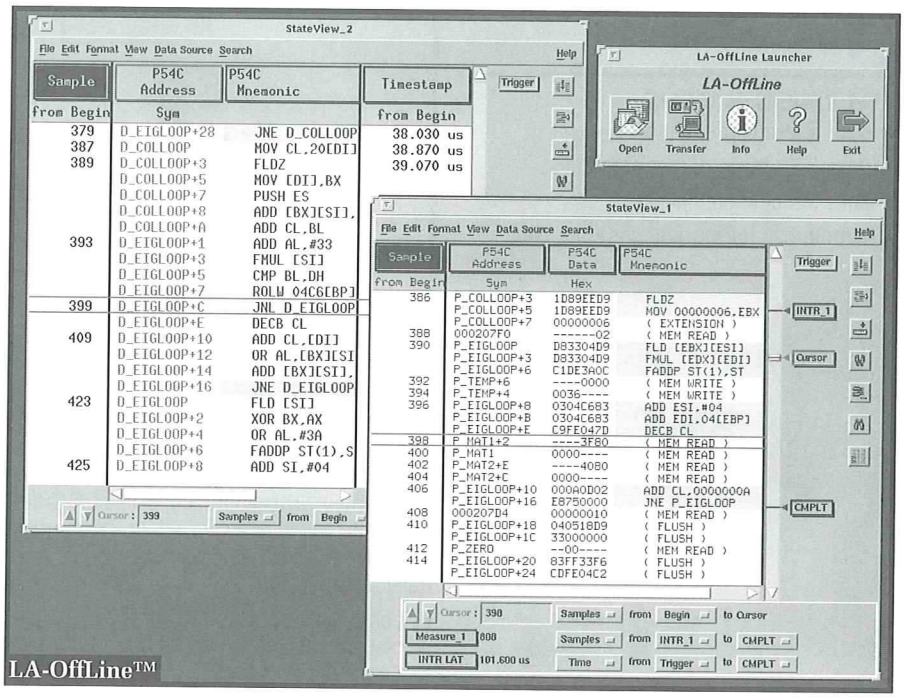
Offline Analysis Software

LA-OffLine™

Features

LA-OffLine™

- Free the Logic Analyzer for Other Users
- Microsoft Windows User Interface on PC
- Full X11/Motif User Interface on Sun
- Takes Advantage of the Workstation Computation Capabilities
- Automated Upload from the Logic Analyzer
- Wide Range of Microprocessor Support Included
- Multi-window and Multiprocessor Support
- Flexible Symbolic Data Search



LA-OffLine™ – Free up the DAS/TLA Logic Analyzer

The LA-OffLine software operates completely independent of the instrumentation. Once the data is acquired it can be automatically uploaded to one or more workstations or PCs for independent analysis.

LA-OffLine is compatible with any SUN SPARCstations and Microsoft Windows based PCs. LA-OffLine supports 92A96 or 92C96 acquisition data from either DAS® or TLA systems.

ROBUST DATA ANALYSIS CAPABILITY

The X-windows and Microsoft Windows environment offers rich data analysis capability. The data may be displayed in multiple windows using different display formats, window sizes and fonts. Correlated acquisitions are displayed in multiple windows with the cursors locked together in time.

LA-Browser™ COMPATIBILITY

When used with LA-Browser, you can analyze your data at both the assembly level and the high level language level (e.g., C, C++, Pascal, Ada).

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All listed application software is compatible with TLA and DAS® instruments.

LA-OffLine™
Offline Disassembly Analysis Software.

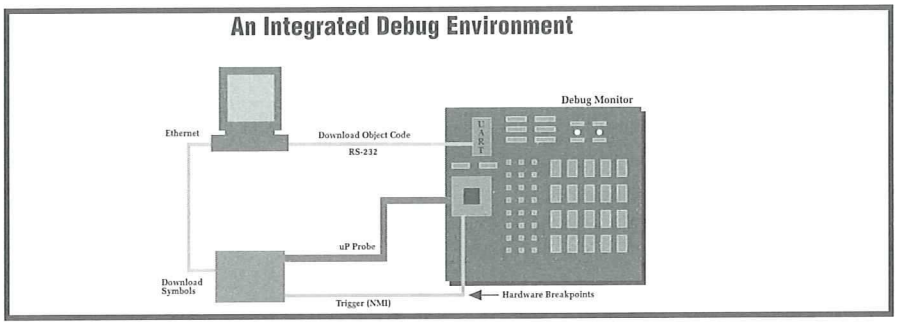
Opt. 01 – Single Sun License.
Opt. 05 – 5 User Sun License.
Opt. 08 – Site Sun License.

Opt. 11 – Single PC License.
Opt. 15 – 5 User PC License.
Opt. 18 – Site PC LIcense.

Applications Software
92PORT • 92LANP • 92QTURN

Features

APPLICATIONS SOFTWARE
- Remote Prototype Control
- Links to Software Debug Packages
- Links to Logic Simulators
- Remote Batch Programming Over LAN



LA-CONNECT combines a logic analyzer, a debug monitor, and a source level debugger to provide a real-time debug environment for today's fastest and most complex microprocessors.

LA-CONNECT™ – An Alternative to In-circuit Emulation

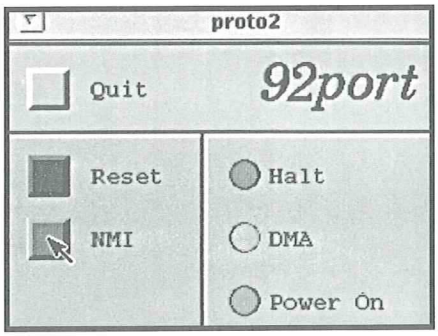
To maximize the functionality of your logic analyzer, Tektronix has teamed up with leading vendors of embedded software development tools to integrate the logic analyzer into their environment. This approach, called LA-CONNECT, combines tools that you may already be using into a cost effective debug environment with functionality that exceeds many emulators. LA-Browser adds high level language debug capability to your logic analyzer enabling you to trace real-time activity in C, C++, Pascal, or Ada.

By combining a debug monitor, a source level debugger and a logic analyzer, a user can sit at a workstation screen and control all of his tools, including the logic analyzer. Tools are available to allow full remote debugging completely over the local area network.

FULL REMOTE CONTROL OVER LAN ETHERNET
The 92LANP applications software provides full remote programming of DAS® and TLA systems with the Tektronix Programmatic Control Language (PCL). Setup, control, status, patterns and results can be exchanged over LAN.

LINKS TO LOGIC SIMULATORS
The CADLINK application software provides a link between logic simulation software data and the DAS stimulus and acquisition instrumentation. The 92SIMLK application software offers translations for specific simulator outputs. The acquired data can be compared to the expected results on the DAS.

LINKS TO ASIC EMULATION
The 92QTURN application software provides full remote programming from the Quickturn Systems Enterprise ASIC emulation system. Through this interface, the channels and clocks for access to internal signals are automatically generated by the Quickturn Systems LAX software package. 92QTURN includes the 92LANP applications software.



CONTROL YOUR TARGET SYSTEM FROM THE WORKSTATION
The 92PORT application software provides control and monitoring of the target system. Eight output bits and eight input bits are displayed in an X-window as soft "buttons" or indicators. With this, static functions of the target system can be controlled or monitored, e.g., RESET or INTERRUPT and READY or FAULT. Each indicator and button can be individually labeled and programmed for the desired logic sense and function.

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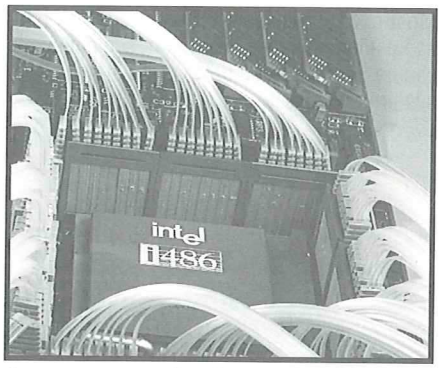
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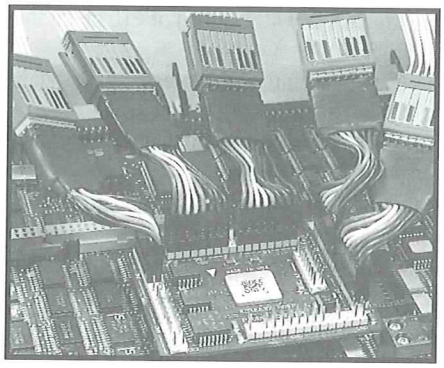
92PORT – DAS® Target Control Software.
CADLINK – Simulation Vector Sampling Software.
92SIMLK – Simulation Translation Software.
92QTURN – Link to Quickturn Systems.
92LANP – LAN Programmatic Control Language (PCL) SW.
92PA – Performance Analysis Software.

Family Microprocessor Support

DAS® • TLA



Over 40 custom probe adapters are available for probing today's dense microprocessor package styles. This shows a PGA probe adapter for the Intel 80486 family.



The LAPIKPV 8-CH leadsets can be used to provide a low-profile connection between your GPX™ probes or DAS 92C96 probes and your System Under Test (SUT).

Timely Support of the Newest Devices

As microprocessors become an increasingly critical factor in system design time and product differentiation, the proliferation of new microprocessor devices is growing explosively. The most important question in the minds of many designers is, "If I use the latest processor, can I find the development tool support I need?"

Tektronix is committed to delivering timely support of key new devices as they appear in the market. This is accomplished through close cooperation with microprocessor vendors, beginning long before the latest devices are fabricated.

Highly integrated hardware and software development techniques and a wide variety of design channels ensure the ability to respond to your unique requirements. The Tektronix factory, OEM suppliers, customer technical support and independent contractors are all sources of microprocessor and bus support products.

CONNECTING TO YOUR DEVICE? – NO PROBLEM WITH TEKTRONIX PROBE ADAPTERS AND ACCESSORIES

There are two methods for connecting to the processor: (1) custom probe adapters, (2) general purpose probing.

Custom Probe Adapters offer a quick and reliable connection to your microprocessor. Tektronix offers a variety of custom probe adapters for a wide assortment of soldered or socketed package styles including DIP, PLCC, LCC, PGA, PQFP (JEDEC) and CQFP (JEDEC).

Each signal on the probe adapter has an adjacent ground pin connected to an internal ground which keeps noise and crosstalk to a minimum. If vertical height is a concern, low profile connections are available (LAPIKPV).

General Purpose Probing allows you to connect to test pins on your prototype or to your own custom test clip when a custom probe adapter is not available.

Tektronix podlets with 100 mil spacing easily interface to a wide variety of test clips and probing accessories. You can use the podlets either individually with a podlet ground lead or in groups of eight with an 8-CH podlet holder.

Memory Depth with No Trade-offs. There are five memory depths available on the 92C96. There is 8 K, 32 K, 128 K, 512 K, or 2 M for state analysis, and 32 K, 128 K, 512 K, 2 M, 8 M for timing analysis behind each channel, fully time-stamped for accurate data correlation. Other logic analyzers force you to lose half of your memory *and* reacquire data when you enable time stamps.

Time-stamping with No Trade-offs. Each acquisition sample includes a time stamp stored with 10 ns resolution. There is no decrease in resolution or overflow for measuring events as long as two days. No memory depth is compromised. Several formats of time stamp display make it easy to measure relative timing of multiple complex events.

Powerful Clocking State Machine. The Tektronix clocking state machine makes the most efficient use of acquisition memory possible by qualifying data and tracking complex bus cycles.

Simultaneous State and Timing Through a Single Probe. If you need to look at individual signals on the microprocessor, you simply change the time base and you can view it at rates of up to 100 MHz. *This is done without moving probes or double probing.*

VIEWING YOUR DATA – TEKTRONIX DOES THE WORK FOR YOU

Tektronix logic analyzers offer the most powerful disassembly in the industry.

Four Modes of Disassembly:

- **Hardware Display** – shows all bus cycles. Automatically disassembles executed instructions and shows unexecuted instructions as FLUSHED.
- **Software Display** – shows only executed instructions. Unexecuted instructions are filtered out.
- **Control Flow Display** – shows instructions that change the flow of your program such as branches, jumps, and returns instructions.
- **Subroutine Display** – shows only subroutine call and return instructions.

Microprocessor support packages come standard with setup software that fully configures the analyzer with individual signal names, channel grouping, comprehensive state clocking and symbol files for bus cycle, simplifying triggering and data display.

EDITABLE AND DOWNLOADABLE SYMBOL TABLES

The DAS® and TLA have a Symbol Editor which can enter or modify symbols, or enter a base offset for relocatable code, or even download symbols from another computer. It supports multiple files with thousands of symbols per file.

TRACE SOFTWARE EXECUTION IN THE HIGH LEVEL LANGUAGE IT WAS WRITTEN IN

See page 138 for a full description of the latest tools for source code trace and off-line analysis.

Digital & TLA Analysis System

DAS® Microprocessor Support

THE MOST USEFUL DATA ACQUISITION IN THE INDUSTRY

Once connected to your microprocessor, you need to consider what impact the logic analyzer has on your systems. The Tektronix probing system is the best in the industry with many advantages over other analyzers.

- Extremely low AC Loading of <10 pF (at the probe tip)
- Ability to acquire both state and timing data through the same probe connections
- Probes are small and lightweight to probe 2 mil square pins.
- Color coded for easy podlet identification

Most microprocessors do not need all of the acquisition channels. These unused channels can be used to probe other parts of your system under test.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

92DM04A – 8086/8 Support (DIP).
Opt. 1D – Delete Probe Adapter.

92DM06A – 80186/8 Support (PGA).
Opt. 1D – Delete Probe Adapter.
Opt. 1S – Sub. PLCC Support.

92DM08A – 80286 Support (PGA).
Opt. 1D – Delete Probe Adapter.
Opt. 1S – Sub. PQFP Support.

92DM09B – 80386DX Support (PGA).
Opt. 1D – Delete Probe Adapter.
Opt. 1S – Sub. QFP Support.

92DM10A – 80386SX Support (QFP).
Opt. 1D – Delete Probe Adapter.

92DM11 – 80386EX Support (QFP).
Opt. 1D – Delete Probe Adapter.

92DM12A – 80486 Support (PGA).
Opt. 1D – Delete Probe Adapter.
Opt. 01 – Add External Power Supply.

92DM13A – P5 Pentium Support (PGA).
Opt. 1D – Delete Probe Adapter.

92DM14 – P54C Pentium Support (PGA).
Opt. 1D – Delete Probe Adapter.
Opt. 01 – Add 192-CH Hi-Density Probe.
Opt 1S – Sub Low Profile Probe.

92DM17 – i960CA/CF 80960 Support (PGA).
Opt. 1D – Delete Probe Adapter.

92DM31B – 68020 Support (PGA).
Opt. 1D – Delete Probe Adapter.
Opt. 1S – Sub. 68EC020 Support (PGA).
Opt. 2S – Sub. QFP Support.

92DM33B – 68030 Support (PGA).
Opt. 1D – Delete Probe Adapter.
Opt. 1S – Sub. QFP Support.

92DM34A – 68040 Support (PGA).
Opt. 1D – Delete Probe Adapter.

92DM35A – 88100 Support (PGA).
Opt. 1D – Delete Probe Adapter.
Opt. 04 – (2) 90-CH Interfaces.

92DM36 – 68060 Support (PGA).
Opt. 1D – Delete Probe Adapter.

92DM55 – SCSI Bus Support.
Opt. 1D – Delete Probe Adapter.

92DM56 – APIC Bus Support.
Opt. 1D – Delete Probe Adapter.

92DM72A – AMD 29000/050 Support (PGA).
Opt. 1D – Delete Probe Adapter.

92DM74 – MIPS R3000/A Support (PGA).
Opt. 1D – Delete Probe Adapter.

92DM75A – R4000 Support (PGA).
Opt. 1D – Delete Probe Adapter.
Opt. 2S – Sub. R4000SC/MC Probe Adapter (PGA).

92DM77A – SPARC CY7C601/L64811/MB86903 Support (PGA).
Opt. 1D – Delete Probe Adapter.

92DM81 – 8096/C196 Support (PGA).
Opt. 1D – Delete Probe Adapter.
Opt. 2S – Sub. PLCC Probe Adapter.

92DM93A – CPU32 Support (QFP).
Opt. 1A – BCC/EVS Support.
Opt. 1D – Delete Probe Adapter.
Opt. 2S – Sub. 68340 Support (PGA).

92DM94 – 68360 Support (PGA).
Opt. 1D – Delete Probe Adapter.

92DM901 – MCS-51 Support (DIP).
Opt. 1D – Delete Probe Adapter.

92DM902 – 8085 Support (DIP).
Opt. 1D – Delete Probe Accessories.

92DM911 – Futurebus+ Support.
Opt. 1D – Delete Probe Adapter.

92DM912 – 68000/10 Support (DIP).
Opt. 1D – Delete Probe Adapter.
Opt. 2S – Sub. PGA Probe Adapter.
Opt. 3S – Sub. PLCC Probe Adapter.

92DM913 – Z80 Support (DIP).
Opt. 1D – Delete Probe Adapter.

92DM914 – 96002 Support (PGA).
Opt. 1D – Delete Probe Accessories.

92DM916 – 80960KA/KB/MC Support (PGA).
Opt. 1D – Delete Probe Accessory.

92DM920 – TMS320C3X Support (PGA).
Opt. 1D – Delete Probe Adapter.
Opt. 2S – Sub. QFP Probe Adapter.

92DM921 – TMS320C40 DSP Support (PGA).
Opt. 1D – Delete Probe Adapter.

92DM923 – 88110 RISC Support (PGA).
Opt. 1D – Delete Probe Adapter.

92DM925 – R3051/52/81 RISC Support (PGA).
Opt. 1D – Delete Probe Adapter.
Opt. 2S – Sub. PLCC Probe Adapter.

92DM926 – DSP3210 DSP Support (PGA).
Opt. 1D – Delete Probe Adapter.

92DM927 – 29205 RISC Support (QFP).
Opt. 1D – Delete Probe Adapter.

92DM930 – 1553A/B Bus Support.
Opt. 1D – Delete Probe Adapter.

LADM932 – PowerPC 60X Support.

LADM933 – 80C166 Support (QFP).
Opt. 1D – Delete Probe Adapter.

LADM934 – MBUS Support.
Opt. 1D – Delete Probe Adapter.

ADDITIONAL ACCESSORIES

Also see page 434.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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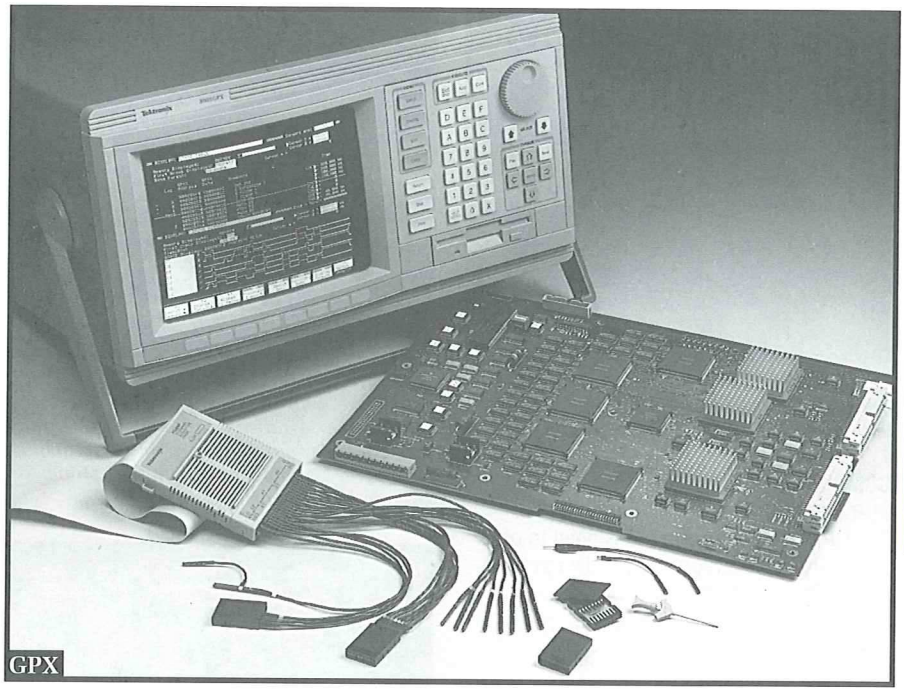
GPX™ Logic Analyzers
3000 Series

Features

GPX LOGIC ANALYZER
- 1 GHz High-speed Timing Analysis
- 200 MHz Timing Analysis
- 80 MHz State Analysis
- 8 K or 32 K Acquisition Memory Depths
- 20 to 360 Channels Available in 20 Channel Increments
- Simultaneous State and Timing – No Double Probing
- Comprehensive Microprocessor Support
- Real-time Performance Analysis
- ROM Emulation
- Links to High Level Languages for Software Debug
- Industry Standard File Outputs

ADDITIONAL MODULES
- 2 GHz High-speed Timing Analysis Module (30HSM)
- 400 MS/s Digitizing Oscilloscope (30DSM)
- Lower Cost Microprocessor Analysis Module (30MPX)

MULTIPLE MAINFRAMES
- 3001 Portable Mainframe
- 3002C Color Modular Mainframe
- 3002P Portable Modular Mainframe



3000 Series Logic Analyzers

The 3000 Series Logic Analyzers are an outstanding value in general purpose logic analysis. The monolithic 3001 is designed for medium size applications or where portability is important. The modular 3002 based systems can house up to four modules in a single system and is suited for larger, more complex applications.

THE GPX ACQUISITION CARD
The 32GPX has 8 K of acquisition memory and the 32GPD has all of the same features of the 32GPX but with 32 K of acquisition memory. Both modules are available in the 3001 or the 3002 based systems.

20, 40, 60, 80 CHANNEL MODULES
The 32GPX and 32GPD modules can be configured in 20 channel increments from 20 to 80 channels per module and up to 320 channels per system.

3000 SERIES APPLICATION MODULE SELECTION GUIDE

Product	Application	Channels/Card	Rate	Clock Type	Memory*3	Triggering
32GPX (page 144)	general purpose microprocessor hardware/software integration	80-160*1 80-160*1 16-32*1	80 MHz 200 MHz 1 GHz	synchronous transitional conventional	4 K/16 K 8 K/32 K 40 K/160 K	4 states/16 levels 4 word/range recognizers 2 counter/timers
30MPX (page 145)	8/16/32-Bit microprocessor hardware/software integration	96 9	16 MHz*2 200 MHz or 90 MHz	synchronous transitional synchronous	8 K 2 K 2 K	7 states 8 word/ range recognizers 8 counter/timers
30HSM (page 146)	high-speed hardware analysis	20 or 4 or 20 or 18	400 MHz 2 GHz 200 MHz 95 MHz	transitional transitional dual threshold synchronous	24 K 120 K 12 K 6 K	15 trigger tests 4 levels 2 counter/timers 4 word recognizers 4 TekLink signals
30DSM (page 147)	analog waveform analysis	1 or 2	400 MS/s 200 MS/s	NA NA	32 K 16 K	edge: rising/falling external trigger

*1 *Channels can be doubled by welding two GPX modules in a 3002 or 3002E mainframe.*
*2 *Supports microprocessor clock rates up to 33 MHz.*
*3 *Two memory depths modules are available, 32GPX and the deep 32GPD.*

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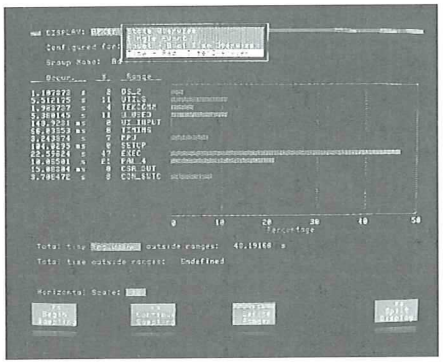
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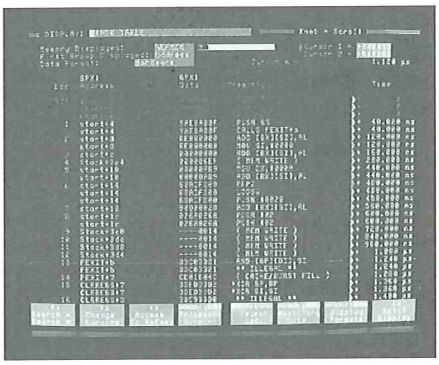
Tektronix Measurement products are manufactured in ISO registered facilities.

GPX™ Logic Analyzers

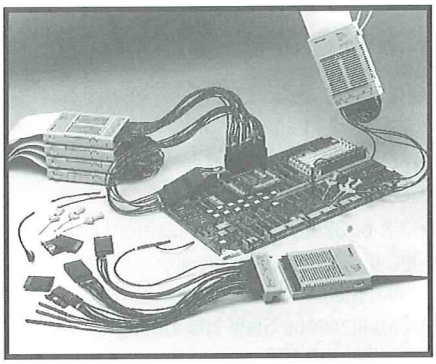
32GPX



Real-time PA provides you the capability to easily determine how to optimize your system for better performance.



GPX offers four modes of disassembly: Hardware, Software, Control Flow, and Subroutine. All disassemblers include automatic fetch prediction, capability to display high level symbols, and automatic time stamps for measuring time.



The GPX probing is comprised of four 20 channel lightweight probes. Eight channels can be grouped together in a podlet holder. Each podlet is 100 mil square and easily interfaces to a wide variety of test clips and probing accessories.

COMPLETE SOLUTION FOR THE WHOLE DESIGN TEAM

The GPX Logic Analyzer is designed to offer capability that everyone on the design team needs. The GPX provides specific features for:

- Hardware Debug
- Software Debug
- HW/SW Integration
- Evaluation
- System Test
- System Optimization

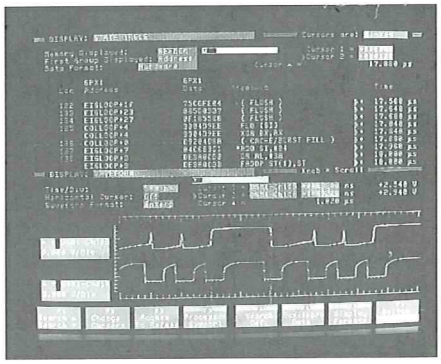
If your budgets are tight and you can afford only one instrument, the GPX is the one to choose.

It All Starts at the Probe Tip

The GPX emphasizes a "single-probe-multi-measurement" connection, so you can make a wide variety of measurements without changing probes or double-probing. The GPX offers a powerful simultaneous state and timing capability with two time bases to acquire a signal both synchronously and asynchronously at the same time, through a single probe.

COMPREHENSIVE MICROPROCESSOR SUPPORT

In addition to being a powerful general purpose logic analyzer, the GPX offers support for today's popular microprocessors including the Pentium, DSPs, microcontrollers and RISC chips. Its low load probing system (5 pF) and custom probe adapters allows you to look at all of the microprocessor's lines both synchronously and asynchronously at the same time. In addition, the 1 GHz timing channels of the GPX are connected to the microprocessor's control lines to allow a detailed analysis of key signals.

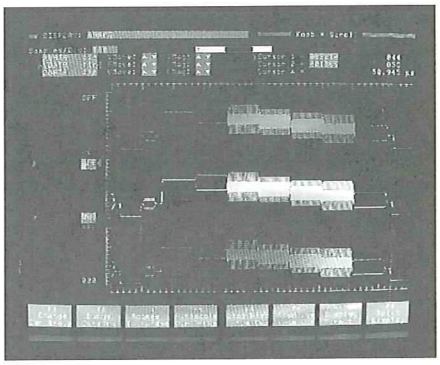


Complimentary modules are available such as a DSO (above) and a high-speed module. Split screen displays allow you to view your data simultaneously, time-correlated.

MULTIPLE DATA DISPLAYS

Acquiring data is just one half of the problem. For quick and accurate analysis you need to look at your data in a mode that makes the problem easy to find. The GPX offers a wide variety of displays:

- 4 Modes of disassembly with high level language symbols for software debug
- Graph Mode plots acquired data value vs. time which is useful for A/D and HDTV applications
- Real-time Performance Analyzer histograms show you where your program is spending its time
- GPX ROM emulator (see page 148) lets you examine and change memory for quick patches to your program



With Graph Display, you can plot the "value" of your acquired data vs. memory location. You can simultaneously view up to three groups as separate, overlaid, or with an offset. Display features include autoscaling, interpolation (linear or sin(x)/x), and data as signed or unsigned.

TRIGGERING MADE EASY

The most difficult aspect of a logic analyzer for a new user is setting up the trigger. The GPX solves this problem by offering 27 pre-programmed trigger setups that can be used in the majority of cases. You can easily customize any of these setups for your specific application.

REAL-TIME PERFORMANCE ANALYSIS

A unique feature to the 3000 Series is real-time PA. The GPX offers 12 ranges (expandable to 48 ranges) that monitor your microprocessor's BUS activity in real time – meaning that no BUS cycle is missed. Traditional statistical Performance Analyzers sample the BUS missing significant amounts of activity. Real-time PA is crucial if you are looking for a random glitch or other single-shot anomaly.

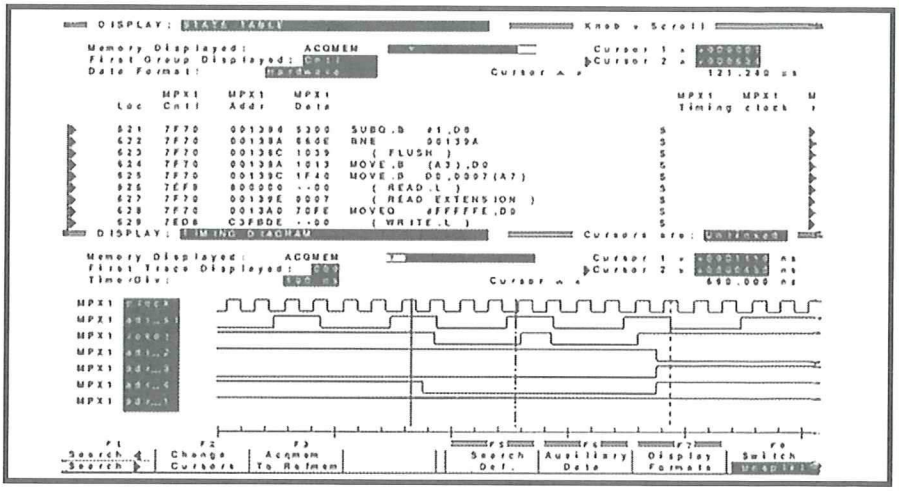
Microprocessor Analysis

30MPX

Features

30MPX

- Combined State and Timing Analysis
- 96 State Channels, 8 K Deep
- Support 8/16/32-Bit Devices up to 33 MHz
- 9 Transitional Timing Channels, 2 K Deep
- 200 MHz Transitional Timing or 90 MHz Synchronous
- Real-time Performance Analysis



The 3000 Series split screen display can display both state and timing at the same time. The "link cursor" option links the two displays together so as one display scrolls, the second display stays in sync.

Microprocessor Analysis Module

The 30MPX module offers the functionality needed for designers of microprocessor based systems on a single, low cost module. Microprocessor analysis, timing analysis, real-time performance analysis and microprocessor control are combined on a single card.

The 30MPX provides 96 channels of state analysis. Each channel has an 8 K memory depth making it ideal for tracing complex program flow and capturing both the cause and the visible effect of software problems.

MULTIPLE DISASSEMBLY FORMATS FOR RAPID ANALYSIS

Four disassembly display formats support rapid analysis of microprocessor activity. You can switch between hardware, software, control flow, or subroutine display without reacquiring data.

SIMULTANEOUS SUPPORT FOR UP TO FOUR MICROPROCESSORS

For analysis of multiple microprocessor based designs, up to four 30MPX modules can be used simultaneously. As data is acquired from each microprocessor, it is time-stamped and stored. You can then split the screen to display data from each processor. This powerful feature enables you to solve complex problems related to the interaction of multiple microprocessors.

200 MHZ TIMING ANALYSIS ON THE SAME MODULE

The 30MPX module provides nine additional channels of 200 MHz transitional or 90 MHz synchronous acquisition with each channel storing 2 K transitions.

High-speed timing analysis complements the state analyzer by giving you detailed visibility of other parts of your circuitry such as control lines, I/O and clocks.

TIME CORRELATION TIES EVERYTHING TOGETHER

All data acquired by the 30MPX's state and timing sections (or from any other 3000 Series module) is automatically time-stamped by the system's high-speed master clock. This time stamp is used to time-correlate all of your data as it is displayed in the split screen display.

The advantage of time-correlation is that you can easily and accurately correlate the activity of the microprocessor to the high-speed activity of your other circuits.

REAL-TIME PERFORMANCE ANALYSIS

The 30MPX offers real-time performance analysis capability similar to the 32GPX/32GPD. Real-time PA gives you the ability to profile the performance of your software. A key aspect of *Real-time PA* over the traditional statistical approach is that *all* activity is captured. No data is lost while the analyzer is processing the acquired data. This is especially vital in optimizing real-time embedded control systems or looking for single-shot events.

With real-time performance analysis you can identify where in your program you should focus your efforts to fine tune your system for its optimum performance.

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See Tektronix on the World Wide Web: http://www.tek.com

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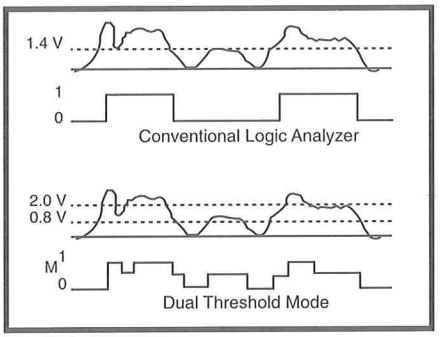
Tektronix Measurement products are manufactured in ISO registered facilities.

High-speed Analysis
30HSM

Features

30HSM

- 2 GHz, 4 Channels
- 400 MHz, 20 Channels
- 95 MHz Synchronous, 18 Channels
- Dual Thresholds
- 24 K Transitionally Stored Memory
- 15 Preset Trigger Tests
- 2.5 ns Glitch Detection



The TTL Signal above rises in the middle of the waveform and exceeds the logic low switching level (0.8 V) forcing unwanted changes in the devices output. It does not, however, exceed the threshold of the logic analyzer and would not be detected by the instrument. The 30HSM assures this condition can be detected and displayed by providing two thresholds which can be set to the logic high and logic low switching levels.

High-speed Hardware Analysis

The 30HSM module is a complete high-speed acquisition system for capturing and analyzing hardware faults in digital circuitry. A range of data acquisition modes, including 2 GHz transitional timing and Dual Threshold Mode, provide the ability to analyze a wide range of potential hardware problems.

The 30HSM's fault triggering lets you quickly locate hardware faults. Trigger selections include tests for set-up and hold time violations, pulse duration violations, and metastability. To save you time, these and other tests are pre-programmed in the 30HSM.

PROBLEMS DETECTED BY THE HSM

The many features of the 30HSM enables the design engineer to detect complex problems such as:

- Bus Contention
- Handshaking Errors
- DMA Problems
- Races and Hazards
- Setup and Hold Violations
- Propagation Delays
- Glitches
- Metastability
- Cross Talk
- Ringing

ACQUISITION MODES

The 30HSM incorporates four acquisition modes which provide you with the resources you need to efficiently solve the most demanding problems or make detailed measurements of your design's operation.

- **400 MHz High Resolution Mode** provides 2.5 ns timing across 20 channels. Each channel can record 24,000 transitions.
- **Unique 200 MHz Dual Threshold Mode.** Not only will you see high and low data, but middle or tri-state data as well. It will help you detect bus contentions, race conditions or metastable states.
- **95 MHz Synchronous Mode** provides 18 channels that can accept an external clock from the system under test.
- **Transitional Storage** enables you to capture long periods of time, (up to 60 minutes) by storing data only when the state of the input signal changes.

400 MHZ HIGH RESOLUTION MODE

The high resolution mode provides 400 MHz timing (2.5 ns) across 20 channels. Each channel can record 24 K transitions. This mode makes it easy to debug problems caused by race conditions, setup/hold time violations, and propagation delays.

DUAL THRESHOLD MODE

The unique dual threshold mode provides 200 MHz timing (5 ns) across 20 channels. Each channel can record 12 K transitions. This mode is uniquely suited to exposing difficult intermittent problems such as those caused by slow rise/fall times, bus contention, low drive or runt pulses, reflections, crosstalk, tri-state conditions, and excessive system noise.

2 GHZ MODE

The 2 GHz mode provides 4 channels of 500 ps resolution for resolving very fine timing relationships. Each channel can record 120 K transitions.

95 MHZ SYNCHRONOUS MODE

The synchronous mode provides 18 channels that can accept an external clock from the system under test up to 95 MHz. Each channel has 6 K of memory for data storage.

TRANSITIONAL STORAGE

In timing mode the 30HSM stores data only when the state of the input signals change. This transitional storage can be contrasted with conventional storage where data is stored at every sample interval. By using transitional storage, the 30HSM enables you to capture long periods of time (up to 60 minutes) while maintaining maximum sampling resolution.

TRIGGERING

The 30HSM makes setting up triggers easy by providing 15 predefined trigger tests for measuring timing related problems. Trigger resources include four 20-Bit word recognizers, two counter/timers, and four intermodule TekLink signals.

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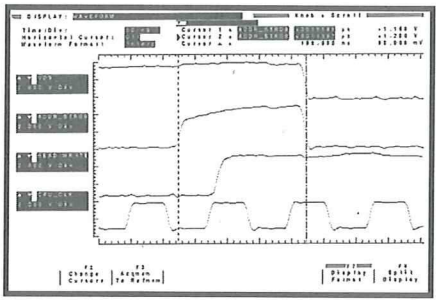
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Waveform Analysis
30DSM

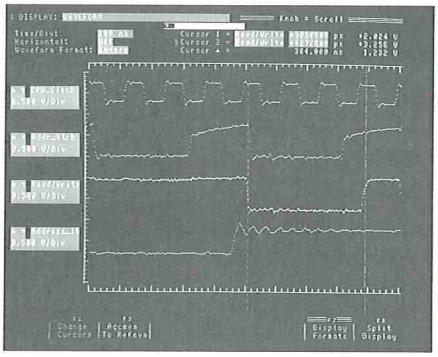
Features

30DSM

- 400 MS/s Digitizing
- 100 MHz Single Shot Bandwidth
- 32 K Bit Record Length
- 8-Bit Vertical Resolution



Data acquired by all PRISM® modules is automatically time-correlated with all other data. Here the PRISM split screen display shows data acquired by the 30HSM correlated to signals acquired by 30DSM.



Multiple waveforms can be freely moved and sized on screen. Not only can you see the time relationship between these waveforms, but the quality of the signals as well.

Analog Problem Solving in a Digital Instrument

A powerful, multichannel digital storage oscilloscope (DSO), the 30DSM has been tightly integrated into the 3000 Series Logic Analyzer. It provides highly accurate analog measurement capability to address the needs of engineers involved in the design and test of sophisticated digital electronic products.

DESIGNED FOR THE DEMANDS OF TODAY'S HIGH-SPEED LOGIC FAMILIES

Each 30DSM contains two high-speed A/D converters and 32 K of acquisition RAM. Measurement accuracy is insured by 8-Bit vertical resolution, 350 MHz bandwidth triggering, user selectable interpolation and bandwidth limit filters, and a high-fidelity probe/attenuator combination. You can easily measure the worst-case propagation delay across a printed circuit board or make repeated measurements to determine the setup and hold margin of a memory system.

FLEXIBLE ACQUISITION MODES PUT YOU IN CONTROL OF YOUR MEASUREMENTS

You can select between the single channel, 400 MS/s acquisition mode with a 32 K record length or the dual channel, 200 MS/s mode with a 16 K record length. In the single channel acquisition mode, the 30DSM can acquire single-shot events up to 100 MHz (50 MHz in the dual channel mode).

Multiple 30DSMs can be integrated into your 3000 Series system to provide up to eight fully attenuated DSO channels. All channels are digitized simultaneously so you can determine exactly both the time and voltage relationships between them. Add a 30DSM to any 3000 Series system to increase the general-purpose utility for troubleshooting both the digital and analog sections of your design.

CURSOR MEASUREMENTS MAKE IT EASY FOR YOU TO SEE WHAT HAPPENED

Every waveform captured can be displayed to nearly the full 14-inch height of the display. You can easily overlap signals by moving them up or down in the display field. Four waveforms can be displayed at one time, selectable from any input probe or saved reference waveforms.

There are two on-screen measurement cursors that can have either a vertical or a horizontal orientation. The voltage and time at the position of each cursor is always displayed on screen. The cursors can be assigned to any of the displayed waveforms. For example, you can assign Cursor 1 to CH 1 and Cursor 2 to CH 2 and then measure the difference in voltage between the waveforms at any instant in time.

TIME CORRELATED DATA TAKES THE PAIN OUT OF MIXED-MODE PROBLEM FINDING

It's nearly impossible to troubleshoot today's complex digital designs using only an oscilloscope. The 3000 Series helps you overcome this limitation by combining the power of the 32GPX, 32GPD, 30MPX or 30HSM with the high-speed digitizing offered by the 30DSM. You can trigger on, acquire, and display microprocessor execution, setup and hold time violations, or control line signal integrity. The system automatically correlates all acquired data, regardless of the acquisition module.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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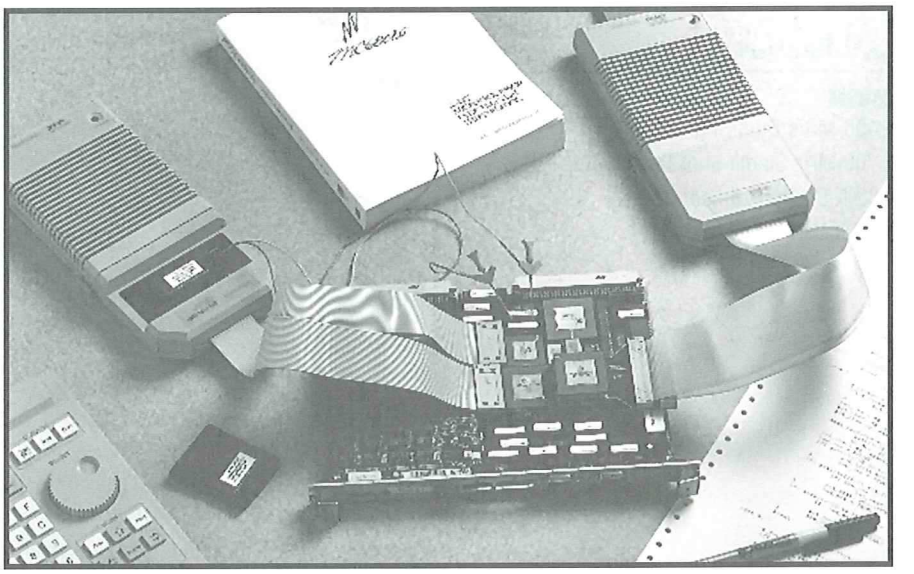
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Software/Hardware Integration
PDT

Features

PDT

- Adds ROM Emulation Capability
- Real-time Operation
- Assembly Level Debug
- Ideal for ROM Based Systems Development
  - Device Drivers
  - Diagnostic Code
  - Boot Code
- Ideal for Bringing up Prototypes
- Debug New Kernels



Connection to your prototype is a simple matter of plugging EPROM probe adapters into your ROM sockets.

The PDT Advantage

When logic analyzer users were asked what features they would most like to add to their logic analyzer, the majority answered that they would like a way to control the microprocessor. Tektronix responded to this challenge with the Prototype Debug Tool (PDT).

PDT adds ROM emulation capability to the 32GPX, 32GPD, and the 30MPX modules through an innovative EPROM probe adapter (30RP2 probe). PDT supports any microprocessor by plugging the 30RP2 probes into your system's EPROM sockets. With PDT you can:

- Emulate your system EPROM
- Download code
- Set hardware breakpoints
- Patch EPROM memory
- Stop your application program

To add microprocessor control to your 32GPX, 32GPD or 30MPX module, you simply add the appropriate number of 30RP2 EPROM probe adapters and PDT software (standard with the 30RP2).

SOFTWARE/HARDWARE INTEGRATION WITH PDT

Many people integrate their hardware and software by simply using a logic analyzer along with an EPROM burner. They burn an EPROM, plug it into their circuit, connect a state analyzer to the microprocessor, start their program with the reset button, and trace their program flow with the logic analyzer. For many applications this is a tedious but adequate process. With PDT, the above process can be improved by an order of magnitude without expensive new tools.

By adding the PDT option to your logic analyzer you can bring up new hardware and perform all of your initial hardware and software integration with a single instrument.

INTEGRATION WITH OTHER 3000 SERIES MODULES

PDT links with all other parts of the system through TekLink. This means you can use PDT with the 30HSM High-speed Timing Analyzer or the 30DSM Digitizing Oscilloscope to bring up new boards and verify signal integrity. In addition you can use up to four 30MPX, 32GPX, or 32GPD modules with PDTs to control up to four microprocessors at the same time.

The key advantages of PDT over other types of microprocessor debug tools is its real-time operation, high-speed timing analysis, real-time performance analysis, and tight integration with other engineering tools, all in one system.

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Configurations
3000 Series

Features

3000 SERIES

- 131 MB Hard Disk
- MS-DOS Compatible, 3.5 in. Disk
- PostScript/EPSON Printer Support
- Universal Printer Utility
- Full Size QWERTY Keyboard
- RS-232 and GPIB Support
- Quick Start Learning Kit
- One Button Help Function

Multiple Mainframes to Meet Your Needs

The 3000 Series was designed with a flexible architecture which enables Tektronix to offer all of the capability of the application modules in a package that best fits your needs. The different packages are:

- 3002C – Benchtop, two-slot color mainframe
- 3002P – Portable, two-slot mainframe
- 3002E – Two-slot expansion mainframe
- 3001 – Low cost portable system

3002C MAINFRAME

The 3002C is a two-slot benchtop mainframe that can be extended to add two additional slots with the 3002E expansion mainframe. This unit features a full QWERTY keyboard, a high resolution 14-inch color display, 3.5 in. MS-DOS compatible floppy, and a 131 MB hard disk.

3002P MAINFRAME

The 3002P is a combination of the portability features of the 3001 with the expansion capability of the 3002C. The 3002P is identical to the 3002C except that the high resolution color CRT is replaced with a nine-inch high resolution flat panel display. The display folds down and is secured to the top of the mainframe and the keyboard is stored safely under the mainframe, making it easy to move from one location to another.

3002E EXPANSION MAINFRAME

The 3002E is a two-slot expansion mainframe that contains a power supply and interconnect cables. This low cost expansion enables you to add two additional application modules to either a 3002 or 3001 mainframe.

3001 SYSTEMS

The 3001 is a low cost standalone mainframe that is factory configured with one application module. There are three versions available:

- 3001GPX – General Purpose and µP analysis
- 3001MPX – 8/16/32-Bit µP analysis
- 3001HSM – High-speed timing analysis

These traditional logic analyzers contain a nine-inch CRT, function key pads and control knob (a keyboard is optional), an optional 131 MB hard disk, and a MS-DOS compatible floppy.

For use in the lab, the 3001 can be expanded with a 3002E mainframe for an additional two slots.

3002 SYSTEMS

Eleven pre-configured 3002 systems are available. Each system can be expanded by adding the 3002E expansion mainframe for an additional two slots.

3000 SERIES SYSTEM SELECTION GUIDE

Product	Description	Module	Display	Mass Storage
3001GPX*1 with Opt. 1S	1-slot portable	one 32GPX™ or one 32GPD	9 in. mono	3.5 in. FD/HD (opt.)
3001MPX	1-slot portable	one 30MPX	9 in. mono	3.5 in. FD/HD (opt.)
3001HSM	1-slot portable	one 30HSM	9 in. mono	3.5 in. FD/HD (opt.)
3002CG with Opt. 1S	2-slot system	one 32GPX™ or one 32GPD	14 in. color	3.5 in. FD/HD
3002CGG with Opt. 1S	2-slot system	two 32GPX™ or two 32GPD	14 in. color	3.5 in. FD/HD
3002CGH*1 with Opt. 1S	2-slot system	one 32GPX™ or one 32GPD, one 30HSM	14 in. color	3.5 in. FD/HD
3002CGD*1 with Opt. 1S	2-slot system	one 32GPX™ or one 32GPD, one 30DSM	14 in. color	3.5 in. FD/HD
3002CX	2-slot system	one 30MPX	14 in. color	3.5 in. FD/HD
3002CXX	2-slot system	two 30MPX	14 in. color	3.5 in. FD/HD
3002CH	2-slot system	one 30HSM	14 in. color	3.5 in. FD/HD
3002CHH	2-slot system	two 30HSM	14 in. color	3.5 in. FD/HD
3002CXH	2-slot system	one 30MPX, one 30HSM	14 in. color	3.5 in. FD/HD
3002CXD	2-slot system	one 30MPX, one 30DSM	14 in. color	3.5 in. FD/HD
3002CHD	2-slot system	one 30HSM, one 30DSM	14 in. color	3.5 in. FD/HD

**1 The 32GPX and 32GPD modules can be configured for 20, 40, 60, or 80 channels. Prices are for fully configured 80 channel modules.*

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Configurations
3000 Series

DIFFERENT MAINFRAMES, SAME USER INTERFACE
To make your design team more productive, the 3001 and 3002 configurations share the same user interface and operation. Thus, you can use a 3002 in the lab for design, and a 3001 in the field for repair without having to learn a new instrument.

HELP IS JUST A BUTTON AWAY
If you ever have a question about how a certain function works or what an option does, simply press the NOTES key and a detailed description will be displayed.

QUICK START LEARNING KIT
All 32GPX/32GPD based systems come standard with a demo board, tutorial manual, and set-up disk to help you quickly learn how to use the system and make advanced measurements.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

Our most popular configurations are listed here. For complete ordering information please see configuration guide. Part number 5EA 8297-4 (U.S.) or 5EW 8385-4 (International).

3001 SERIES LOGIC ANALYZERS

3001GPX
General Purpose and Microprocessor Analysis Instrument.
Includes: 16-CH @ 1 GHz Timing, 80-CH @ 200 MHz Timing, 80-CH @ 80 MHz State, 8 K Acquisition Memory, 4 P6490 Probes, and 720 KB Floppy.

Opt. 1A – 32PA Performance Analysis Software.
Opt. 1D – Delete 20 Channels (60 total).
Opt. 2C – GPIB Support.
Opt. 2D – Delete 40 Channels (40 total).
Opt. 3D – Delete 60 Channels (20 total).
Opt. 4D – Delete 80 Channels.
Opt. 1K – Add QWERTY Keyboard.
Opt. 1M – Add Hard Disk.
Opt. 1S – Substitute 32 K Acquisition Memory.
Opt. 1Z – Add Keyboard and Hard Disk (Value Pack).

3001MPX
8/16/32-Bit Microprocessor Analysis Instrument.
Includes: 96-CH State and 9-CH @ 200 MHz Timing (req. Opt. 1H), P6480 State Probe without Leadset, and 720 KB Floppy.

Opt. 1A – 30DA01 Performance Analysis Software.
Opt. 1F – P6480 General Purpose Probe Adapter.
Opt. 1H – One P6486 Timing Probe.
Opt. 1K – Add QWERTY Keyboard.
Opt. 1L – One P6486 High Performance Leadset.
Opt. 1M – Add Hard Disk.

3001HSM
High-speed Acquisition Instrument.
Includes: 20-CH @ 400 MHz, or 4-CH @ 2 GHz, or 20-CH @ 200 MHz Dual Threshold Timing, Two P6487 High-speed Probes with Standard Leadsets, and 720 KB Floppy.

Opt. 1K – Add QWERTY Keyboard.
Opt. 1L – Add Two 400 MHz Leadsets.
Opt. 4L – Add One 2 GHz Leadset.
Opt. 5L – Add Two 2 GHz Leadsets.
Opt. 1M – Add Hard Disk.
Opt. 2A – Add 18-CH 95 MHz Sync Mode (req. 1L).

PRECONFIGURED 3002 LOGIC ANALYZERS

3002CG
3002C M/F with One 32GPX.
Includes: 3002C, 14 in. Color Monitor, HDD, 720 KB Floppy, Keyboard, One 32GPX, Four P6490s and Performance Analysis SW.

Opt. 1S – Substitute one 32GPD with 32 K Acquisition Memory.

3002CGG
3002C M/F with Two 32GPXs.
Includes: 3002C, 14 in. Color Monitor, HDD, 720 KB Floppy, Keyboard, Two 32GPXs, Eight P6490s and Performance Analysis SW.

Opt. 1S – Substitute two 32GPDs with 32 K Acquisition Memory.

3002CGH
3002C M/F with One 32GPX and One 30HSM.
Includes: 3002C, 14 in. Color Monitor, HDD, 720 KB Floppy, Keyboard, One 32GPX, Four P6490s, One 30HSM, Two P6487s and Performance Analysis SW.

Opt. 1S – Substitute one 32GPD with 32 K Acquisition Memory.

3002CGD
3002C M/F with One 32GPX and One 30DSM.
Includes: 3002C, 14 in. Color Monitor, HDD, 720 KB Floppy, Keyboard, One 32GPX, Four P6490s, One 30DSM, Two P6109Bs, and Performance Analysis SW.

Opt. 1S – Substitute One 32GPD with 32 K Acquisition Memory.

3002CX
3002C M/F with One 30MPX.
Includes: 3002C, 14 in. Color Monitor, HDD, 720 KB Floppy, Keyboard, One 30MPX, One P6480 and Performance Analysis SW.

3002CXX
3002C M/F with Two 30MPXs.
Includes: 3002C, 14 in. Color Monitor, HDD, 720 KB Floppy, Keyboard, Two 30MPXs, Two P6480s, and Performance Analysis SW.

3002CH
3002C M/F with One 30HSM.
Includes: 3002C, 14 in. Color Monitor, HDD, 720 KB Floppy, Keyboard, One 30HSM, and Two P6487s.

3002CHH
3002C M/F with Two 30 HSMs.
Includes: 3002C, 14 in. Color Monitor, HDD, 720 KB Floppy, Keyboard, Two 30HSMs, and Four P6487s.

3002CXH
3002C with One 30MPX and One 30HSM.
Includes: 3002C, 14 in. Color Monitor, HDD, 720 KB Floppy, Keyboard, One 30MPX, One P6480, One 30HSM, Two P6487s and Performance Analysis SW.

3002CXD
3002C with One 30MPX and One 30DSM.
Includes: 3002C, 14 in. Color Monitor, HDD, 720 KB Floppy, Keyboard, One 30MPX, One P6480, One P6486, One 30DSM, Two P6109Bs, and Performance Analysis SW.

3002CHD
3002C with One 30HSM and One 30DSM.
Includes: 3002C, 14 in. Color Monitor, 100 MB HDD, 720 KB Floppy, Keyboard, One 30HSM, Two P6487s, One 30DSM, and Two P6109Bs.

The above 3002 systems have options to substitute the color monitor with a flat panel display, add additional leadsets, and other options to customize the systems to your needs.

3002 SERIES MAINFRAMES

3002C
Two-slot System Mainframe with Color Monitor.
Includes: 14 in. Color Monitor, Hard Disk, 720 KB Floppy, QWERTY Keyboard.

3002P
Two-slot System Mainframe with EL Flat-panel Display.
Includes: 9 in. Electroluminescent Flat-panel Display, Hard Disk, 720 KB Floppy, and QWERTY Keyboard.

Configurations
3000 Series

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

3002E
Two-slot System Expansion Mainframe.
Includes: 9 in. and 4 ft. TekLink Cable, Mainframe Mounting Plate.

INTERNATIONAL POWER PLUGS OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz.
Opt. A2 – United Kingdom 240 V, 50 Hz.
Opt. A3 – Australian 240 V, 50 Hz.
Opt. A4 – North American 240 V, 60 Hz.
Opt. A5 – Switzerland 220 V, 50 Hz.
See Customer Information Section for additional description.

3002 SERIES INSTRUMENT MODULES
32GPX™
General Purpose and Microprocessor Analysis Module.
Includes: 8 K Acquisition Memory and Four P6490 Probes and Leadsets.
Opt. 1A – 32PA Performance Analysis Software.
Opt. 2W – Add One Welding Connector.

32GPD
General Purpose and Microprocessor Analysis Module.
Includes: 32 K Acquisition Memory and Four P6490 Probes and Leadsets.
Opt. 1A – 32PA Performance Analysis Software.
Opt. 2W – Add One Welding Connector.

30MPX
8/16/32-Bit Microprocessor Analysis Application Module.
Includes: P6480 State Probe without Leadset.
Opt. 1A – 30DA01 Performance Analysis Software.
Opt. 1F – P6480 General Purpose Probe Adapter.
Opt. 1H – One P6486 Timing Probe.
Opt. 1L – One P6486 High-performance Leadset.

30HSM
High-speed Application Module.
Includes: Two P6487s with Standard Leadset.
Opt. 2A – 18-CH 95 MHz Sync Mode Adapter (req. Opt. 1L).
Opt. 1L – Add Two High-performance Leadsets.
Opt. 4L – Add One 2 GHz Leadset.
Opt. 5L – Add Two 2 GHz Leadsets.

30DSM
Digitizing Oscilloscope Module.
Includes: Two P6109Bs – 10:1 Probes.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection
30DSM/30HSM/30MPX, .
3001GPX/3001HSM.
3001MPX.
3002C.
3002CG.
3002CGD/3002CGG/3002CGH.
3002CH/3002CHD3002CHH/3002CX/
3002CXD/3002CXH/3002CXX.
3002E.
3002ED.
3002P.
32GPD.
32GPX™.

Opt. Q0 Onsite Installation –
32GPX.
32GPD.

ADDITIONAL ACCESSORIES
Also see page 434.
Cart – K475 Workstation Tower.

P6490
32GPX Data Acquisition Probe.

P6480
30MPX State Data Acquisition Probe Without Lead.
Opt. 1F – Add General Purpose Probe Adapter.

P6486
High-speed Data Acquisition Probe with Standard Leadset for 30MPX.
Opt. 1L – Add One High-performance Leadset.

P6487
High-speed Data Acquisition Probe with Standard Leadset for 30HSM.
Opt. 1L – Add One High-performance Leadset.
FasTrak – Micro-Training Package.
CenTrak – High-speed Demo Fixture.

1200C01
RS-232 COMM Pack.

30C02
GPIB COMM Pack.

PROTOTYPE DEBUG TOOL SUPPORT PACKAGES
30RP2
General Purpose PDT with ROM Probe.
Opt. 01 – Add 24/28/32-Pin General Purpose ROM Probe Adapter.
Opt. 02 – Add 40-Pin DIP ROM Probe Adapter.

32GPX/32GPD MICROPROCESSOR SUPPORT PACKAGES
32DM02
8085 Support, DIP.

32DM04
8086/8088/80C86/80C88 Support, Socketed 40-Pin DIP.

32DM06
80186/80188/80C186/80C188 Support, Socketed 68-Pin PGA.
Opt. 1S – Substitute Socketed 68-Lead PLCC.

32DM07
8031/8051 Support, Socketed 40-Pin DIP.

32DM08
80286/80C286 Support, Supports Socketed 69-Pin PGA.
Opt. 1S – Substitute Socketed 68-Lead PLCC.

32DM09
80386DX Support, Socketed 132-Pin PGA.
Opt. 1S – Substitute Soldered 132-Lead JEDEC PQFP (AMD Devices only).

32DM10
80386SX Support, Soldered 100-Lead JEDEC PQFP.

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Microprocessor Support
3000 Series

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32DM11
80386EX Support, Soldered 132-Lead QFP.

32DM12A
80486DX/DX2/486SX/487SX Support, Socketed 168-Pin PGA.
Opt. 01 – Add Extended Power Supply.

32DM13A
P5 Pentium Support, Socketed 273-Pin PGA.

32DM14
P54C/CM Pentium Support.
Opt. 01 – Add 192-CH Hi-density Probe .
Opt. 1S – Substitute Low Profile Probe Adapter.

32DM21
6800/2/8 Support, Socketed 40-Pin DIP.

32DM24
6809/6809E Support, Socketed 40-Pin DIP.

32DM27
68000/68010/68HC000/68HC001/68EC000 Support, Socketed 64-Pin DIP (68000/010/HC000).
Opt. 1S – Substitute Socketed 68-Pin PGA (68000/010/HC000/HC001).
Opt. 2S – Substitute Socketed 68-Lead PLCC (68EC000).
Opt. 3S – Substitute Socketed 68-Lead PLCC (68HC000).

32DM31
68020/68EC020 Support, Socketed 114-Pin PGA (68020).
Opt. 1S – Substitute Socketed 100-Pin PGA (68EC020).
Opt. 2S – Substitute Soldered 132-Lead JEDEC CQFP (68020).

32DM33
68030/68EC030 Support, Socketed 128-Pin PGA.
Opt. 1S – Substitute Soldered 132-Lead JEDEC CQFP.

32DM34
68040/ECO40/LC040 Support, Socketed 179-Pin PGA.

32DM36
68060 Support, Socketed 206-Pin PGA.

32DM41
Z80 Support, Supports Socketed 40-Pin DIP.

32DM55
SCSI Bus Support.

32DM81
8096/C196 Support, Socketed 68-Pin PGA.
Opt. 1S – Substitute 68-Lead PLCC.

32DM91
68HC11 Support, Socketed 52-Lead PLCC.

32DM92
68302 Support, Socketed 132-Lead PGA.
Opt. 1S – Substitute Soldered 132-Lead JEDEC CQFP/PQFP.

32DM93A
68331/68332 Support, CPU32 Support. Soldered 132-Lead JEDEC PQFP/CQFP.
Opt 1A – Add Preconfigured Interface for Motorola M68331/68332EVS Evaluation Board.
Opt. 1S – Substitute Soldered 145-Pin PGA for 68340.

32DM94
68360 Support, Socketed 241-Pin PGA.

32DM96
68HC16 Support, Soldered 132-Lead JEDEC PQFP/CQFP.

32DM101
DSP56000/1/2 Support, Socketed 88-Pin PGA (56000/1).
Opt. 1S – Substitute Soldered 132-Lead JEDEC CQFP (56000/1).
Opt. 2S – Substitute Socketed 132-Lead PGA (56002).
Opt. 3S – Substitute Soldered 132-Lead CQFP/PQFP (56002).

32DM122
TMS32020/TMS320C25/TMS320C26 Support, Socketed 68-Pin PGA.
Opt. 1S – Substitute Socketed 68-Lead PLCC.

32DM123
TMS320C30/31 Support, Socketed 181-Pin PGA.
Opt. 1S – Substitute soldered 132-Lead PLCC.

32DM921
TMS320C40 Support, Socketed 181-Pin PGA.

32DM923
88110 Support, Socketed 300-Pin PGA.

32DM924
6805 Support.

32DM925
R3051/52/81 Support, Socketed 84-Pin PGA.
Opt. 1S – Substitute PLCC84 Probe Adapter.

32DM926
DSP3210 Support.

32DM927
29205 Support, Soldered 100-Lead QFP.

32DM930
1553 A/B Support.

32PA
32GPX Performance Analysis Software.

30DA01
30MPX Performance Analysis Software.

LADM932 – Power PC 60X Support.
Opt. 1D – Delete Probe Adapter.
Opt. 01 – Add 192-CH Hi-Density Probe.
Opt. 02 – Add PPC/MPC 601 Package Adapter (QFP-304).
Opt. 03 – Add MPC 603 Package Adapter (QFP-240).
Opt. 04 – Add PPC 603 Package Adapter (QFP-240).
Opt. 05 – Add MPC/PPC 604 Package Adapter (QFP-304).

LADM933 – 80C166 Support (QFP).
Opt 1D – Delete Probe Adapter.

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Microprocessor Support Chart

MICROPROCESSOR SUPPORT SELECTION GUIDE

Microprocessor Type & Package	TLA 500/DAS® 92A96/C96 D/XD/SD/UD	3000 Series 32GPX/GPD	3000 Series 30MPX
AMD			
AM80386DX QFP-132 (soldered)	√	√	√
AM80486DX PGA-168 (socketed)	√	√	
AM80486DX2 PGA-168 (socketed)	√	√	
AM80486SX PGA-168 (socketed)	√	√	
AM80486SX2 PGA-168 (socketed)	√	√	
29000 PGA-169 (socketed)	√		
29050 PGA-169 (socketed)	√		
29205 QFP-100 (soldered)	√	√	
29030 (any)	√	√	
29035 (any)	√	√	
29040 (any)	√	√	
AT&T			
DSP3210 QFP-132 (soldered)	√	√	
CYPRESS SEMICONDUCTOR			
CY7C601 Sparc PGA-208 (socketed)	√		
DIGITAL EQUIPMENT CORP.			
Alpha AXP 21064 PGA-431 (socketed)	√		
FUJITSU			
MB86903 Sparc PGA-208 (socketed)	√		
IBM			
PPC601 QFP-304 (soldered)	√	√	
PPC603 QFP-240 (soldered)	√	√	
PPC603e	√	√	
PPC604 QFP-304 (soldered)	√	√	
INTEGRATED DEVICE TECHNOLOGY (IDT)			
R3000 PGA-145 (socketed)	√		
R3000A PGA-175 (socketed)	√		
R3051 PGA-88 (socketed)	√	√	
R3051 PLCC-84 (socketed)	√	√	
R3052 PGA-88 (socketed)	√	√	
R3052 PLCC-84 (socketed)	√	√	
R3081 PGA-88 (socketed)	√	√	
R3081 PLCC-84 (socketed)	√	√	
R4000PC PGA-179 (socketed)	√		
R4000SC PGA-447 (socketed)	√		
R4000MC PGA-447 (socketed)	√		
R4400PC PGA-179 (socketed)	√		
R4400SC PGA-447 (socketed)	√		
R4400MC PGA-447 (socketed)	√		
R4600PC PGA-179 (socketed)	√		
R4650SC PGA-179 (socketed)	√		
R4700MC PGA-179 (socketed)	√		
INTEL			
8031 DIP-40 (soldered)	√	√	√
8031 DIP-40 (socketed)	√	√	√
8031 PLCC-44 (socketed)	√	√	√
8031 PLCC-44 (soldered)	√	√	√
8032 DIP-40 (soldered)	√	√	√
8032 DIP-40 (socketed)	√	√	√
8032 PLCC-44 (socketed)	√	√	√
8032 PLCC-44 (soldered)	√	√	√
8051 DIP-40 (soldered)	√	√	√
8051 DIP-40 (socketed)	√	√	√
8051 PLCC-44 (socketed)	√	√	√
8051 PLCC-44 (soldered)	√	√	√
8052 DIP-40 (soldered)	√	√	√
8052 DIP-40 (socketed)	√	√	√
8052 PLCC-44 (socketed)	√	√	√
8052 PLCC-44 (soldered)	√	√	√
80C152 DIP-48 (socketed)	√	√	√
80C152 DIP-48 (soldered)	√	√	√
80C152 PLCC-68 (socketed)	√	√	√
80C152 PLCC-68 (soldered)	√	√	√
80C452 PLCC-68 (socketed)	√	√	√
80C452 PLCC-68 (soldered)	√	√	√
80515 PLCC-68 (socketed)	√	√	√
80515 PLCC-68 (soldered)	√	√	√
80532 PLCC-68 (socketed)	√	√	√
80532 PLCC-68 (soldered)	√	√	√
80535 PLCC-68 (socketed)	√	√	√
80535 PLCC-68 (soldered)	√	√	√
83C152 DIP-48 (socketed)	√	√	√
83C152 DIP-48 (soldered)	√	√	√
83C152 PLCC-68 (socketed)	√	√	√
83C152 PLCC-68 (soldered)	√	√	√
83C452 PLCC-68 (socketed)	√	√	√
83C452 PLCC-68 (soldered)	√	√	√
83C537 PLCC-84 (socketed)	√	√	√
83C537 PLCC-84 (soldered)	√	√	√
8096BH PLCC-68 (socketed)	√	√	
8096BH PLCC-68 (soldered)	√	√	
8096BH PGA-68 (socketed)	√	√	
8396BH PLCC-68 (socketed)	√	√	
8396BH PLCC-68 (soldered)	√	√	
8396BH PGA-68 (socketed)	√	√	
8097BH PLCC-68 (socketed)	√	√	
8097BH PLCC-68 (soldered)	√	√	
8097BH PGA-68 (socketed)	√	√	
8097JF PLCC-68 (socketed)	√	√	
8097JF PLCC-68 (soldered)	√	√	
8097JF PGA-68 (socketed)	√	√	

SUPPORT FOR DAS®, TLA AND 3000 SERIES PRODUCTS

Exclusive microprocessor support with many features not found on other logic analyzers is available for the DAS®, TLA and 3000 Series Products.

When selecting microprocessor support there are three areas that you should consider: (1) connecting your device, (2) acquiring data, and (3) viewing your data.

PLEASE NOTE: Support for new microprocessors is constantly being introduced and our support is continually expanding and being updated. Please consult your local sales engineer if the device or package that you are using is not listed.

Microprocessor Support Chart

Microprocessor Type & Package	TLA 500/DAS® 92A96/C96 D/XD/SD/UD	3000 Series 32GPX/GPD	3000 Series 30MPX
8397BH PLCC-68 (socketed)	√	√	
8397BH PLCC-68 (soldered)	√	√	
8397BH PGA-68 (socketed)	√	√	
8397JF PLCC-68 (socketed)	√	√	
8397JF PLCC-68 (soldered)	√	√	
8397JF PGA-68 (socketed)	√	√	
8797BH PLCC-68 (socketed)	√	√	
8797BH PLCC-68 (soldered)	√	√	
8797BH PGA-68 (socketed)	√	√	
8797JF PLCC-68 (socketed)	√	√	
8797JF PLCC-68 (soldered)	√	√	
8797JF PGA-68 (socketed)	√	√	
80C196KB PLCC-68 (socketed)	√	√	
80C196KB PLCC-68 (soldered)	√	√	
80C196KB PGA-68 (socketed)	√	√	
80C196KB16 PGA-68 (socketed)	√	√	
80C196KB16 PLCC-68 (socketed)	√	√	
80C196KB16 PLCC-68 (soldered)	√	√	
80C196KC PGA-68 (socketed)	√	√	
80C196KC PLCC-68 (socketed)	√	√	
80C196KC PLCC-68 (soldered)	√	√	
80C196KD PGA-68 (socketed)	√	√	
80C196KD PLCC-68 (socketed)	√	√	
80C196KD PLCC-68 (soldered)	√	√	
87C196KB16 PGA-68 (socketed)	√	√	
87C196KB16 PLCC-68 (socketed)	√	√	
87C196KB16 PLCC-68 (soldered)	√	√	
87C196KC PGA-68 (socketed)	√	√	
87C196KC PLCC-68 (socketed)	√	√	
87C196KC PLCC-68 (soldered)	√	√	
87C196KD PGA-68 (socketed)	√	√	
87C196KD PLCC-68 (socketed)	√	√	
87C196KD PLCC-68 (soldered)	√	√	
8085 DIP-40 (socketed)	√	√	
8085 DIP-40 (soldered)	√	√	
8086 DIP-40 (socketed)	√	√	√
8086 DIP-40 (soldered)	√	√	√
8086 PLCC-44 (socketed)	√	√	√
8086 PLCC-44 (soldered)	√	√	√
80C86 DIP-40 (socketed)	√	√	√
80C86 DIP-40 (soldered)	√	√	√
80C86 PLCC-44 (socketed)	√	√	√
80C86 PLCC-44 (soldered)	√	√	√
8088 DIP-40 (socketed)	√	√	√
8088 DIP-40 (soldered)	√	√	√
8088 PLCC-44 (socketed)	√	√	√
8088 PLCC-44 (soldered)	√	√	√
80C88 DIP-40 (socketed)	√	√	√
80C88 DIP-40 (soldered)	√	√	√
80C88 PLCC-44 (socketed)	√	√	√
80C88 PLCC-44 (soldered)	√	√	√
80186 PGA-68 (socketed)	√	√	√
80186 LCC-68 (socketed)	√	√	√
80186 PLCC-68 (socketed)	√	√	√
80186 PLCC-68 (soldered)	√	√	√
80186 QFP-80 (soldered)	√	√	√

Microprocessor Type & Package	TLA 500/DAS® 92A96/C96 D/XD/SD/UD	3000 Series 32GPX/GPD	3000 Series 30MPX
80C186/EA/XL PGA-68 (socketed)	√	√	√
80C186/EA/XL LCC-68 (socketed)	√	√	√
80C186/EA/XL PLCC-68 (socketed)	√	√	√
80C186/EA/XL PLCC-68 (soldered)	√	√	√
80C186/EA/XL QFP-80 (soldered)	√	√	√
80188 PGA-68 (socketed)	√	√	√
80188 LCC-68 (socketed)	√	√	√
80188 PLCC-68 (socketed)	√	√	√
80188 PLCC-68 (soldered)	√	√	√
80188 QFP-80 (soldered)	√	√	√
80C188/EA/XL PGA-68 (socketed)	√	√	√
80C188/EA/XL LCC-68 (socketed)	√	√	√
80C188/EA/XL PLCC-68 (socketed)	√	√	√
80C188/EA/XL PLCC-68 (soldered)	√	√	√
80C188/EA/XL QFP-80 (soldered)	√	√	√
80286 PGA-68 (socketed)	√	√	√
80286 LCC-68 (socketed)	√	√	√
80286 PLCC-68 (socketed)	√	√	√
80286 PLCC-68 (soldered)	√	√	√
80376 PQFP-100 (soldered)	√	√	√
80376 PGA-100 (socketed)	√	√	√
80386EX	√	√	√
80386SX PQFP-100 (soldered)	√	√	√
80386DX PGA-132 (socketed)	√	√	√
80486SX PGA-168 (socketed)	√	√	
80486SX QFP-196 (soldered)	√	√	
80486DX PGA-168 (socketed)	√	√	
80486DX-50 PGA-168 (socketed)	√	√	
80486DX2 PGA-168 (socketed)	√	√	
80486DX4 PGA-168 (socketed)	√	√	
80486DX QFP-208	√	√	
80486DX2 QFP-208	√	√	
80486DX4 QFP-208	√	√	
80487SX PGA-168 (socketed)	√	√	
Pentium™ 60/66 PGA-273 (socketed)	√	√	
P5 PGA-273 (socketed)	√	√	
Pentium™ 90/100 PGA-296 (socketed)	√	√	
P54C PGA-296 (socketed)	√	√	
P54CM PGA-296 (socketed)	√	√	
P54CS	√	√	
P55C	√	√	
APIC Bus	√		
P6	√		
80960KA PGA-132 (socketed)	√		
80960KA QFP-164 (soldered)	√		
80960KB PGA-132 (socketed)	√		
80960KB QFP-164 (soldered)	√		
80960MC PGA-132 (socketed)	√		
80960MC QFP-164 (soldered)	√		
80960CA QFP-196 (socketed)	√	√	
80960CA PGA-168 (socketed)	√	√	
80960CF PGA-168 (socketed)	√	√	
80960CF QFP-196 (soldered)	√	√	
80960JA	√	√	
80960JD	√	√	
80960JF	√	√	
80960HA	√	√	
80960HD	√	√	
80960HT	√	√	
i860XP	√		

Microprocessor Support Chart

Microprocessor Type & Package	TLA 500/DAS® 92A96/C96 D/XD/SD/UD	3000 Series 32GPX/GPD	3000 Series 30MPX
LSI LOGIC			
64811 Sparc PGA-208 (socketed)	√		
R3000 PGA-145 (socketed)	√		
R3000A PGA-175 (socketed)	√		
LR33000/050 (S/W only)	√	√	
R4000PC PGA-179 (socketed)	√		
R4000SC PGA-447 (socketed)	√		
R4000MC PGA-447 (socketed)	√		
R4400PC PGA-179	√		
R4400SC PGA-447	√		
R4400MC PGA-447	√		
MOTOROLA			
6800 DIP-40 (socketed)		√	
6800 DIP-40 (soldered)		√	
6802 DIP-40 (socketed)		√	
6802 DIP-40 (soldered)		√	
68HC05 DIP-40 (Eval. Board)		√	
6809 DIP-40 (socketed)		√	
6809 DIP-40 (soldered)		√	
6809 PLCC-44 (socketed)		√	
6809E DIP-40 (socketed)		√	
6809E DIP-40 (soldered)		√	
68HC11 DIP-40 (socketed)	√	√	√
68HC11 DIP-40 (soldered)	√	√	√
68HC11 DIP-48 (socketed)	√	√	√
68HC11 DIP-48 (soldered)	√	√	√
68HC11 PLCC-44 (socketed)	√	√	√
68HC11 PLCC-44 (soldered)	√	√	√
68HC11 PLCC-52 (socketed)	√	√	√
68HC11 PLCC-52 (soldered)	√	√	√
68HC11 PLCC-68 (socketed)	√	√	√
68HC11 PLCC-68 (soldered)	√	√	√
68HC11 PLCC-84 (socketed)	√	√	√
68HC11 PLCC-84 (soldered)	√	√	√
68HC16 QFP-132 (soldered)	√	√	
68HC16 Eval. Brd.	√	√	
68302 PGA-132 (socketed)	√	√	√
68302 QFP-132 (soldered)	√	√	√
68331 QFP-132 (socketed)	√	√	√
68332 QFP-132 (socketed)	√	√	√
68340 PGA-145 (socketed)	√	√	
68340 QFP-144 (soldered)	√	√	
68349 QFP-160 (soldered)	√	√	
68360 PGA-241 (socketed)	√	√	
68360 QFP-240 (soldered)	√	√	
CPU-32 BCC	√	√	
68000 DIP-64 (socketed)	√	√	√
68000 PGA-68 (socketed)	√	√	√
68000 PLCC-68 (soldered)	√	√	√
68000 PLCC-68 (socketed)	√	√	√
68EC000 PLCC-68 (socketed)		√	
68EC000 PLCC-68 (soldered)		√	
68HC000 PGA-68 (socketed)	√	√	√
68HC000 DIP-64 (socketed)	√	√	√
68HC000 PLCC-68 (soldered)	√	√	√
68HC000 PLCC-68 (socketed)	√	√	√

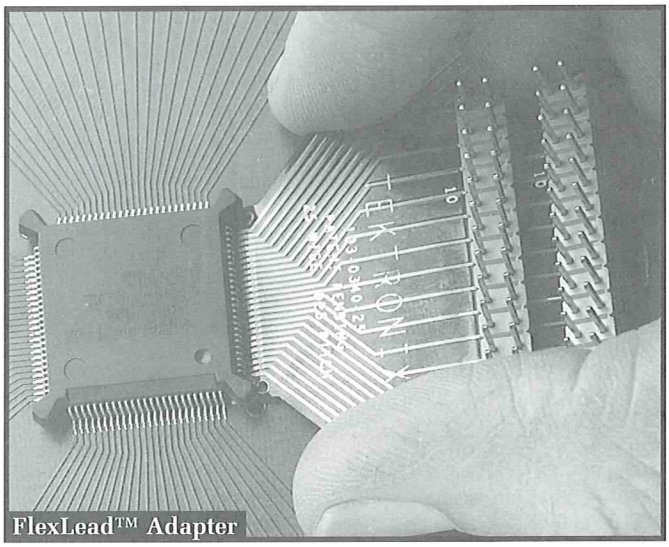
Microprocessor Type & Package	TLA 500/DAS® 92A96/C96 D/XD/SD/UD	3000 Series 32GPX/GPD	3000 Series 30MPX
68HC001 PGA-68 (socketed)		√	
68HC001 PLCC-68 (socketed)		√	
68HC001 PLCC-68 (soldered)		√	
68010 DIP-64 (socketed)	√	√	√
68010 PGA-68 (socketed)	√	√	√
68010 PLCC-68 (soldered)	√	√	√
68010 PLCC-68 (socketed)	√	√	√
68020 PGA-114 (socketed)	√	√	√
68020 QFP-132 (soldered)	√	√	
68020 QFP-132 (socketed)	√	√	
68EC020 PGA-100 (socketed)	√	√	
68EC020 QFP-100 (socketed)	√	√	
68030 PGA-128 (socketed)	√	√	√
68030 QFP-132 (soldered)	√	√	
68030 QFF-132 (socketed)	√	√	
68EC030 PGA-128 (socketed)	√	√	
68040 PGA-179 (socketed)	√	√	
68EC040 PGA-179 (socketed)	√	√	
68LC040 PGA-179 (socketed)	√	√	
68060 PGA-223 (socketed)	√	√	
68EC060 PGA-223 (socketed)	√	√	
68LC060 PGA-223 (socketed)	√	√	
88100 PGA-181 (socketed)	√		
88110 PGA-300 (socketed)	√	√	
56000 PGA-88 (socketed)	√	√	√
56000 QFP-132 (soldered)	√	√	
56001 PGA-88 (socketed)	√	√	√
56001 QFP-132 (soldered)	√	√	
56002 PGA-132 (socketed)		√	
56002 QFP-132 (soldered)		√	
56116 (S/W only)		√	
56156 (S/W only)		√	
96002 PGA-223 (socketed)	√		
MPC601	√	√	
MPC603	√	√	
MPC603e	√	√	
MPC604	√	√	
NEC			
R3000 PGA-145 (socketed)	√		
R3000A PGA-175 (socketed)	√		
R4000PC PGA-179 (socketed)	√		
R4000SC PGA-447 (socketed)	√		
R4000MC PGA-447 (socketed)	√		
R4200PC PGA-179 (socketed)	√		
R4400PC PGA-179 (socketed)	√		
R4400SC PGA-447 (socketed)	√		
R4400MC PGA-447 (socketed)	√		
V25 (S/W only)	√	√	
PERFORMANCE SEMICONDUCTOR			
R3000 PGA-145 (socketed)	√		
R3000A PGA-175 (socketed)	√		
R3400 PGA-145 (socketed)	√		
R3400A PGA-175 (socketed)	√		
R4000PC PGA-179 (socketed)	√		
R4000SC PGA-447 (socketed)	√		
R4000MC PGA-447 (socketed)	√		

Microprocessor Support Chart

Microprocessor Type & Package	TLA 500/DAS® 92A96/C96 D/XD/SD/UD	3000 Series 32GPX/GPD	3000 Series 30MPX
R4400PC PGA-179 (socketed)	√		
R4400SC PGA-447 (socketed)	√		
R4400MC PGA-447 (socketed)	√		
SIEMENS			
80C166 QFP-100 (socketed)	√	√	
80C166 QFP-100 (soldered)	√	√	
ROCKWELL			
6502 (S/W only)	√		
65C02 (S/W only)	√		
65RC02 (S/W only)	√		
65802 (S/W only)	√		
TEXAS INSTRUMENTS			
TMS32020 PGA-68 (socketed)	√	√	
TMS32020 PLCC-68 (socketed)	√	√	
TMS320C25 PGA-68 (socketed)	√	√	
TMS320C25 PLCC-68 (socketed)	√	√	
TMS320C26 PLCC-68 (socketed)	√	√	
TMS320C30 PGA-181 (socketed)	√	√	
TMS320C31 QFP-132 (soldered)	√	√	
TMS320C40 PGA-325 (socketed)	√	√	
TMS320C50 QFP-132 (soldered)	√		
TMS320C51 QFP-132 (soldered)	√	√	
SuperSparc MBus	√	√	
ZILOG			
Z80 DIP-40 (socketed)	√	√	√
Z80 DIP-40 (soldered)	√	√	√
MIL-STD 1750A			
PACE 1750A (S/W only)	√	√	
Bendix BX1750A (S/W only)	√	√	
Generic 1750A (S/W only)	√	√	
BUS Support			
Futurebus+	√		
MBus (w/ Super Sparc CPU)	√		
MIL-STD 1553 (single or dual redundant)	√	√	
SCSI I/II "A" (8-Bit unshielded ribbon)	√	√	
SCSI I/II "A" (8-Bit shielded ribbon)	√	√	
SCSI I/II "A" (8-Bit shielded high-density)	√	√	
SCSI III "P" (8-Bit shielded high-density)	√	√	
VME	√	√	
ISA	√	√	
EISA	√	√	
Micro Channel	√	√	
PCI	√	√	
PCMCIA	√	√	

Flex Lead Adaptors

Package Type	Nomenclature (Package of 8)
JEDEC, 0.025 in. Pitch 100 lead (20 x 30) (soldered)	PJ22030
JEDEC, 0.025 in. Pitch 68 lead (17 x 17) (soldered)	PJ25X17
JEDEC, 0.025 in. Pitch 80 lead (20 x 20) (soldered)	PJ25X20
JEDEC, 0.025 in. Pitch 84 lead (21 x 21) (soldered)	PJ25X21
JEDEC, 0.025 in. Pitch 100 lead (25 x 25) (soldered)	PJ25X25
JEDEC, 0.025 in. Pitch 120 lead (30 x 30) (soldered)	PJ25X30
JEDEC, 0.025 in. Pitch 132 lead (33 x 33) (soldered)	PJ25X33
JEDEC, 0.025 in. Pitch 164 lead (41 x 41) (soldered)	PJ25X41
JEDEC, 0.025 in. Pitch 196 lead (49 x 49) (soldered)	PJ25X49
JEDEC, 0.025 in. Pitch 208 lead (52 x 52) (soldered)	PJ25X52
JEDEC, 0.025 in. Pitch 240 lead (60 x 60) (soldered)	PJ25X60
EIAJ, 0.5 mm Pitch 80 lead (20 x 20) (soldered)	PE50X20
EIAJ, 0.5 mm Pitch 100 lead (25 x 25) (soldered)	PE50X25
EIAJ, 0.5 mm Pitch 104 lead (26 x 26) (soldered)	PE50X26
EIAJ, 0.5 mm Pitch 144 lead (36 x 36) (soldered)	PE50X36
EIAJ, 0.5 mm Pitch 152 lead (38 x 38) (soldered)	PE50X38
EIAJ, 0.5 mm Pitch 160 lead (40 x 40) (soldered)	PE50X40
EIAJ, 0.5 mm Pitch 208 lead (52 x 52) (soldered)	PE50X52
EIAJ, 0.5 mm Pitch 240 lead (60 x 60) (soldered)	PE50X60
EIAJ, 0.5 mm Pitch 304 lead (76 x 76) (soldered)	PE50X76
EIAJ, 0.65 mm Pitch 80 lead (20 x 20) (soldered)	PE65X20
EIAJ, 0.65 mm Pitch 112 lead (28 x 28) (soldered)	PE65X28
EIAJ, 0.65 mm Pitch 144 lead (36 x 36) (soldered)	PE65X36
EIAJ, 0.65 mm Pitch 160 lead (40 x 40) (soldered)	PE65X40
EIAJ, 0.65 mm Pitch 184 lead (46 x 46) (soldered)	PE65X46



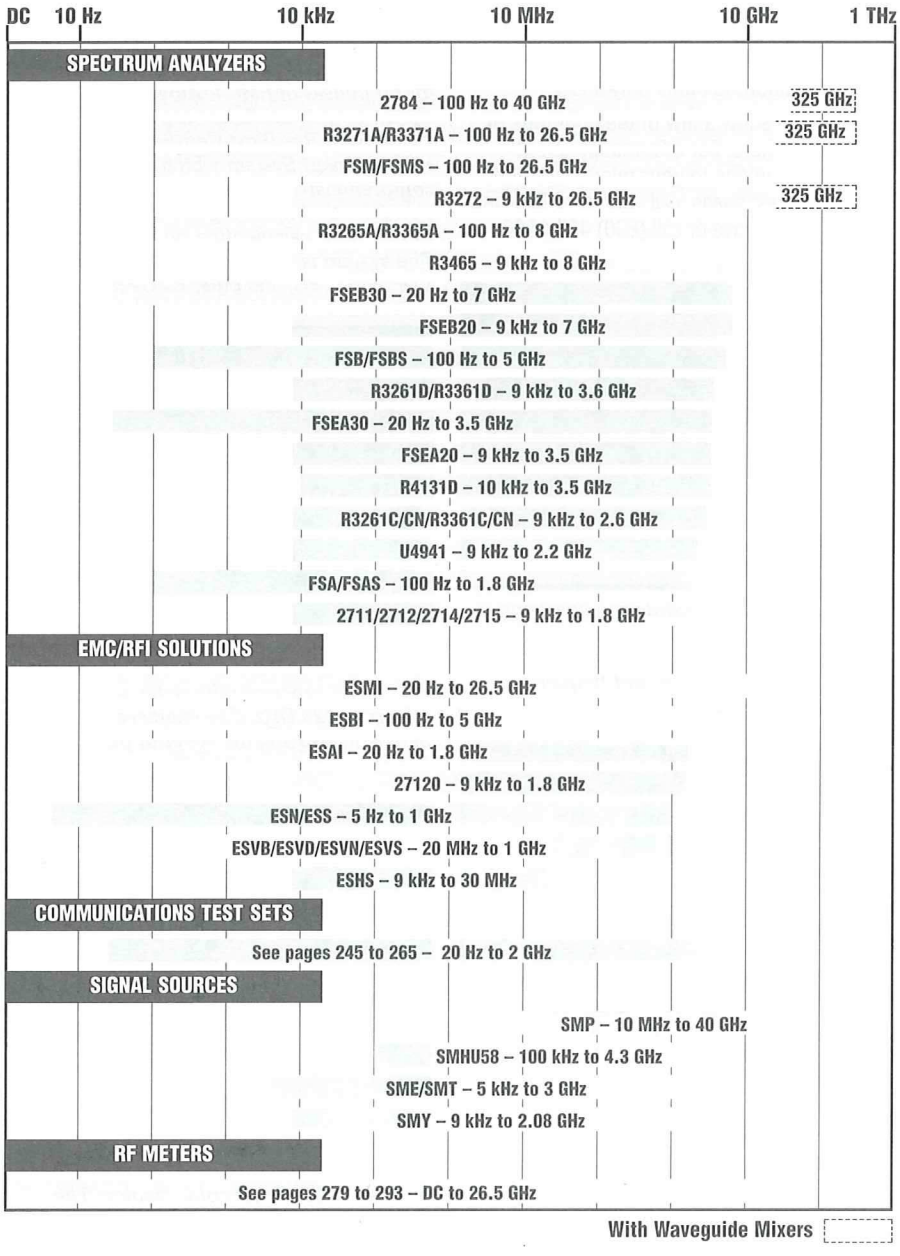
FlexLead™ Adapter

RF and Wireless Test Products

Tektronix RF and Wireless Test Capabilities Cover a Broad Spectrum!

Tektronix offers a value-packed line of RF and microwave products. The list includes a wide selection of spectrum analyzers, signal analyzers, network analyzers, signal sources, communications test sets, RF meters, frequency counters, along with complementary ancillary equipment and software. The chart below provides an overview of the span of frequencies covered by these products. For further information on specific products, refer to the following catalog pages.

RF AND WIRELESS TEST PRODUCTS PERFORMANCE CHART



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FULL RANGE MICROWAVE SPECTRUM ANALYZERS
100 Hz to 40 GHz 164, 170, 174, 181

QUASI MICROWAVE SPECTRUM ANALYZERS
20 Hz to 7 GHz 170, 174, 183, 189

UPPER RANGE RF SPECTRUM ANALYZERS
20 Hz to 3.6 GHz 183, 204, 208

RF/VHF/UHF SPECTRUM ANALYZERS
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RF and Wireless Test Products

Applications

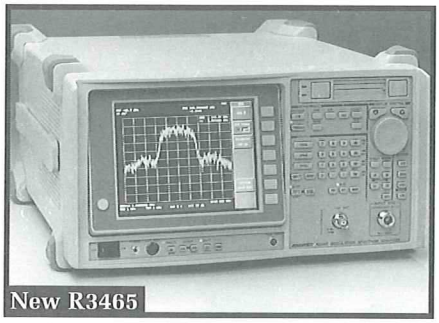
- Avionics
- Bio-Medical
- Cable TV
- Common Carrier
- Design and Development
- Education
- EMC
- EW
- Manufacturing Test
- Millimeter Wave R & D
- Radar
- Research
- Satellite Communication
- Service
- TV/Radio Broadcasting
- Wireless Communications

Tektronix Microwave and RF Products – At Home Where Your Measurements Are!

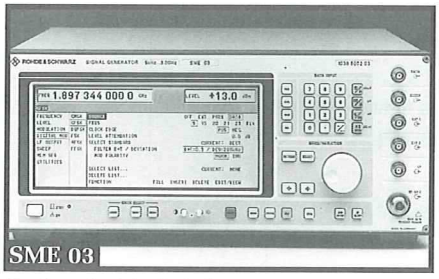
Tektronix Microwave and RF Products are versatile performers – they're at home wherever your measurements are – in the lab, in the field, or on the manufacturing floor.

Tektronix products cover a broad spectrum of applications in the time and frequency domain – Bio-medical, Cable TV, Education, EMC, Design and Development, Manufacturing Test, Research, Service, Satellite Communication, to name only a few.

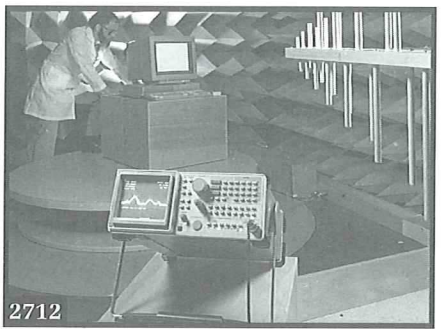
We can only show a few of the hundreds of applications here. For information about Tektronix solutions to your microwave and RF or other test needs, call your local Tektronix sales representative or call (800) 426-2200.



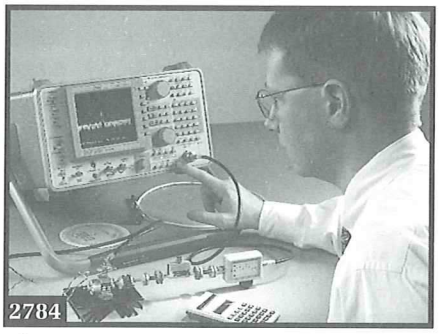
A 9 kHz to 8 MHz modulation spectrum analyzer for digital mobile radio applications with I/Q origin offsets, error vector magnitude, phase error, and frequency error measurements.



Designed with digital communications in mind, the 5 kHz to 3 GHz SME03 Signal Generator provides frequency accuracy, spectral purity, and all common digital modulation modes.



Tektronix spectrum analyzers offer solutions for all phases of EMC testing. The 2712 shown here is available as part of the 27120 EMC Pre-/Post-Certification Measurement System which provides a comprehensive and affordable means of significantly improving the probability of formal EMC certification on the first try. The system is designed for testing to FCC, VDE, VCCI, EC, and other EMC requirements.



The 2784 Spectrum Analyzer is available with a full range of millimeter waveguide mixers to 325 GHz. The engineer shown here is measuring the spectral purity of an Impatt oscillator at 75 GHz.

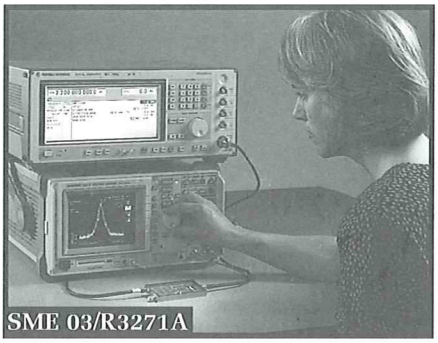


The lightest weight and smallest size of any spectrum analyzer in its class, the U4941 features a flat-panel color display. The U4941 covers a frequency range from 9 kHz to 2.2 GHz and weighs just 14.3 lbs. (6.5 kg).

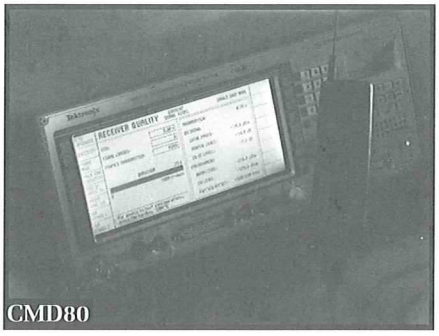
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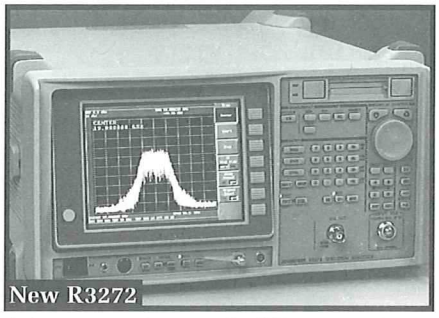
RF and Wireless Test Products



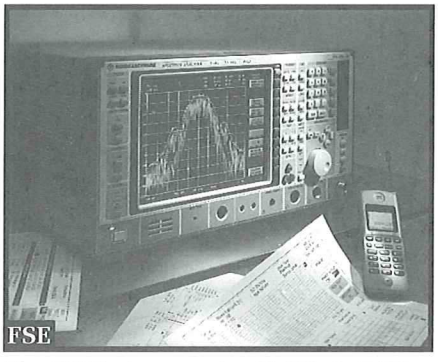
Simulating burst transmission (TDMA) is critical for cellular system design. The engineer shown here is using the SME03 Signal Generator and R3271A Spectrum Analyzer designed for burst transmission simulation and recovery.



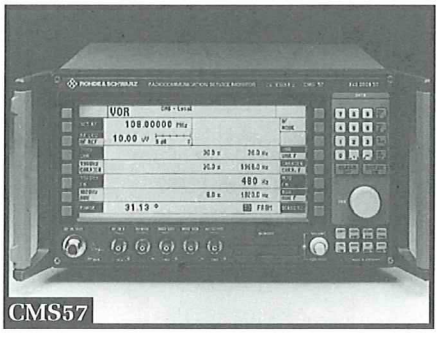
The CMD Series provides the ideal one-box solution for testing digital mobile radio equipment – CDMA, GSM, DCS 1800, DCS 1900.



A frequency of range of 9 kHz to 26.5 GHz, extendable to 325 GHz with external mixers, makes the R3272 ideal for point-to-point microwave and satellite link manufacture, installation, and maintenance.



The FSE Series, covering 20 GHz to 7 GHz with its range of modular options, provides an ideal measurement platform for spectrum, time, and modulation domain measurements.



The CMS57 Radio Communications Service Monitor covers the 0.4 to 1,000 MHz frequency range and can be used for all transmitter and receiver measurements on transceivers with AM, FM, SSB, and phase modulation. The CMS57 can also generate all avionics test signals for VOR, ILS, and MB.



Cable TV proof-of-performance measurements in the field have never been easier. With the 2714 or 2715 Cable TV Spectrum Analyzer, all commonly needed cable TV measurements can be preconfigured for simple push-button execution and data collection. High portability allows the automatic measurement power to be applied anywhere in the field. Back at the office, measurements can be downloaded from memory to the accompanying PC software for report generation.

Spectrum Analyzers

Full Range Microwave Spectrum Analyzers

2784
- 100 Hz to 40 GHz premier performance portable spectrum analyzer

R3271A
- 100 Hz to 26.5 GHz digital wireless featured portable spectrum analyzer

R3371A
- 100 Hz to 26.5 GHz digital wireless featured portable spectrum analyzer with tracking generator

FSM
- 100 Hz to 26.5 GHz laboratory measurement standard spectrum analyzer

FSMS
- 100 Hz to 26.5 GHz laboratory measurement standard spectrum analyzer with tracking generator

R3272
- 9 kHz to 26.5 GHz portable spectrum analyzer

SPECTRUM ANALYZER SELECTION GUIDE

Specifications	2784	R3271A R3371A	FSM FSMS	R3272
Frequency Range	100 Hz to 40 GHz	100 Hz to 26.5 GHz	100 Hz to 26.5 GHz	9 kHz to 26.5 GHz
Frequency Measurement Accuracy	±145 Hz @ 20 GHz CF	±211 Hz @ 10 GHz CF	±25 Hz @ 10 GHz CF	±211 Hz @ 10 GHz CF
Resolution BW Range	3 Hz to 10 MHz 1, 3, 10 sequence	10 Hz to 3 MHz 1, 3, 10 sequence	10 Hz to 3 MHz 1, 3, 10 sequence	300 Hz to 3 MHz, 5 MHz 1, 3, 10 sequence
Residual FM	≤1 Hz	3 Hz	≤1 Hz p-p in 10 s +0.6 Hz/GHz >2 GHz	<(3 Hz x N_{p-p}/0.1 s)
Phase Noise	–105 dBc/Hz @ 20 GHz CF, 10 kHz offset	–102 dBc/Hz @ 10 GHz CF, 10 kHz offset	–98 dBc/Hz @ 20 GHz CF, 10 kHz offset	–98 dBc/Hz @ 7.5 GHz CF, 10 kHz offset
CRT Display Range	100 dB	100 dB	100 dB	100 dB
Frequency Response	±5.0 dB	±4.0 dB 15.4 to 26.5 GHz	±2.5 dB to 26.5 GHz	±4.0 dB 15.4 to 26.5 GHz
Sensitivity	–125 dBm @ 20 GHz CF	–123 dBm @ 10 GHz CF	–135 dBm to 26.5 GHz	–108 dBm @ 10 GHz CF (typical)
Environmental	MIL-T-28800C Class 3	MIL-T-28800 Class 5	0 to 55°C 80% RH	0 to 50°C ≤85% RH
Weight	20 kg (44 lb.)	22 kg (48.5 lb.)	60 kg (145 lb.)	15 kg. (33 lb.)
Features/Options				
Intelligent Markers	2	8	4	10
Tracking Generator	No	Yes, R3371A	Yes, FSMS	No
Card Reader/Floppy Disk	No	Yes, Card	No	Yes, Card (2)
Preamplifier	No	No	No	No
Quasi Peak Detector	No	Yes	No	No
CISPR Bandwidths	No	Yes	No	No
Frequency Counter	Yes	Yes	Yes	Yes
Analog Display	Yes	Yes, Pseudo Analog	No	No
75 Ω Input	No	No	No	No
AM/FM Demodulator	No	Yes	Yes	Yes
Modulation Analysis	No	Yes, R3541C	No	No
GPIB	Yes, 2 ports	Yes	Yes	Yes
RS-232	No	No	Yes	No
Page	**164**	**170**	**174**	**181**

Spectrum Analyzers

Quasi Microwave Spectrum Analyzers

R3265A
- 100 Hz to 8 GHz digital wireless featured portable spectrum analyzer

R3365A
- 100 Hz to 8 GHz digital wireless featured portable spectrum analyzer with tracking generator

R3465
- 9 kHz to 8 MHz spectrum analyzer for digital mobile radio applications

FSB
- 100 Hz to 5 GHz laboratory measurement standard spectrum analyzer

FSBS
- 100 Hz to 5 GHz laboratory measurement standard spectrum analyzer with tracking generator

FSEB20/FSEB30
- 20 Hz (9 kHz FSEB20) to 7 GHz spectrum analyzer for digital mobile radio applications

SPECTRUM ANALYZER SELECTION GUIDE

Specifications	R3265A R3365A	R3465	FSB FSBS	FSEB30	FSEB20
Frequency Range	100 Hz to 8 GHz	9 kHz to 8 GHz	100 Hz to 5 GHz	20 Hz to 7 GHz	9 kHz to 7 GHz
Frequency Measurement Accuracy	±106 Hz @ 5 GHz CF	±26 Hz @ 1 GHz CF	±22 Hz @ 5 GHz CF	±11 Hz @ 1 GHz CF	±1.01 kHz @ 1 GHz CF
Resolution BW Range	10 Hz to 3 MHz 1, 3, 10 sequence	300 Hz to 3 MHz, 5 MHz 1, 3, 10 sequence	10 Hz to 3 MHz 1, 3, 10 sequence	1 Hz to 10 MHz 1, 2, 3, 5 sequence	10 Hz to 10 MHz 1, 2, 3, 5 sequence
Residual FM	≤3 Hz	<3 Hz p-p/0.1 s	≤1 Hz p-p in 10 s	–	–
Phase Noise	–108 dBc/Hz @ 8 GHz CF, 10 kHz offset	–100 dBc/Hz @ 10 kHz offset	–109 dBc/Hz @ 5 GHz CF, 10 kHz offset	–117 dBc/Hz @ 500 MHz CF, 10 kHz offset	–95 dBc/Hz @ 500 MHz CF, 10 kHz offset
CRT Display Range	100 dB	100 dB	100 dB	200 dB	200 dB
Frequency Response	±2.0 dB	±1.5 dB	±1.0 dB to 5.0 GHz	±1 dB total to 1 GHz total power measurement error	±1 dB total to 1 GHz total power measurement error
Sensitivity	–135 dBm @ 5 GHz CF	–118 dBm (typical) @ 1 GHz CF	–137 dBm to 5.0 GHz	–152 dBm	–142 dBm
Environmental	MIL-T-28800 Class 5	0 to 50°C 85% RH	0 to 55°C 80% RH	5 to 40°C	5 to 40°C
Weight	22 kg (48.5 lb.)	16 kg (35.3 lb.)	60 kg (145 lb.)	23 kg (50.6 lb.)	21.8 kg (48 lb.)
Features/Options					
Intelligent Markers	8	10	6	8	8
Tracking Generator	Yes, R3365A	No	Yes, FSBS	No	No
Card Reader/Floppy Disk	Yes, Card	Yes, Card (2)	No	Yes, Floppy	Yes, Floppy
Preamplifier	No	No	Yes, Opt. 03	No	No
Quasi Peak Detector	Yes	No	No	No	No
CISPR Bandwidths	Yes	No	No	No	No
Frequency Counter	Yes	Yes	Yes	Yes	Yes
Analog Display	No	No	No	Yes (Quasi)	Yes (Quasi)
75 Ω Input	No	No	No	No	No
AM/FM Demodulator	Yes	Yes	Yes	Yes	Yes
Modulation Analysis	Yes, R3541C	Yes	No	Yes, Opt. 07	Yes, Opt. 07
GPIB	Yes	Yes	Yes	Yes	Yes
RS-232	No	Yes	Yes	Yes	Yes
Page	**170**	**189**	**174**	**183**	**183**

Spectrum Analyzers

Upper Range RF Spectrum Analyzers

FSEA20/FSEA30
- 20 Hz (9 kHz FSEA20) to 3.5 GHz spectrum analyzer for digital mobile radio applications

R3261D
- 9 kHz to 3.6 GHz digital wireless featured portable spectrum analyzer

R3361D
- 9 kHz to 3.6 GHz digital wireless featured portable spectrum analyzer with tracking generator

R4131D
- 10 kHz to 3.5 GHz versatile, economical 1 kHz RBW spectrum analyzer

R3261C/R3261CN
- 9 kHz to 2.6 GHz digital wireless featured portable spectrum analyzer

R3361C/R3261CN
- 9 kHz to 2.6 GHz digital wireless featured portable spectrum analyzer with tracking generator

SPECTRUM ANALYZER SELECTION GUIDE

Specifications	FSEA30	FSEA20	R3261D R3361D	R4131D	R3261C/CN R3361C/CN
Frequency Range	20 kHz to 3.5 GHz	9 kHz to 3.5 GHz	9 kHz to 3.6 GHz	10 kHz to 3.5 GHz	9 kHz to 2.6 GHz
Frequency Measurement Accuracy	±11 kHz @ 1 GHz CF	±1.01 kHz @ 1 GHz CF	±26 Hz @ 1 GHz CF	100 kHz ±1 kHz @ 1 GHz CF	±26 Hz @ 1 GHz CF
Resolution BW Range	1 Hz to 10 MHz 1, 2, 3, 5 sequence	1 Hz to 10 MHz 1, 2, 3, 5 sequence	30 Hz to 1 MHz 1, 3, 10 sequence	1 kHz to 1 MHz 1, 3 sequence	30 Hz to 1 MHz 1, 3, 10 sequence
Residual FM	–	–	≤20 Hz	≤2 kHz p-p	≤20 Hz
Phase Noise	–120 dBc/Hz @ 500 MHz CF, 10 kHz offset	–102 dBc/Hz @ 500 MHz CF, 10 kHz offset	–105 dBc/Hz @ 3 GHz CF, 20 kHz offset	–110 dBc/Hz 20 kHz offset	–105 dBc/Hz @ 3 GHz CF, 20 kHz offset
CRT Display Range	200 dB	200 dB	80 dB	80 dB	80 dB
Frequency Response	±1 dB total to 1 GHz total power measurement error	±1 dB total to 1 GHz total power measurement error	±1 dB	±1 dB 100 kHz to 2 GHz	±0.5 dB
Sensitivity	–155 dBm	–145 dBm	–119 dBm @ 1 GHz CF	–116 dBm 10 kHz to 1 GHz	–119 dBm @ 1 GHz CF
Environmental	5 to 40°C	5 to 40°C	MIL-T-28800 Class 5	0 to 50°C	MIL-T-28800 Class 5
Weight	22.7 kg (49.9 lb.)	21.5 kg (47.3 lb.)	15 kg (33.1 lb.)	10 kg (22 lb.)	15 kg (33.1 lb.)
Features/Options					
Intelligent Markers	8	8	2	2	2
Tracking Generator	No	No	Yes, R3361D	Yes, external TR4153A	Yes, R3361C, R3361CN
Card Reader/Floppy Disk	Yes, Floppy	Yes, Floppy	Yes, Card	No	Yes, Card
Preamplifier	No	No	No	Yes, external R14601	No
Quasi Peak Detector	No	No	Yes	Yes	Yes
CISPR Bandwidths	No	No	Yes	9 kHz, 120 kHz	Yes
Frequency Counter	Yes	Yes	Yes	No	Yes
Analog Display	Yes (Quasi)	Yes (Quasi)	No	No	No
75 Ω Input	No	No	No	Yes, R4131DN	Yes, R3261CN
AM/FM Demodulator	Yes	Yes	Yes	No	Yes
Modulation Analysis	Yes, Opt. 07	Yes, Opt. 07	No	No	No
GPIB	Yes	Yes	Yes	Yes	Yes
RS-232	Yes	Yes	Yes, Opt. 02	No	Yes, Opt. 02
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Spectrum Analyzers

RF/VHF/UHF Spectrum Analyzers

U4941/U4941N
- 9 kHz to 2.2 GHz lightweight battery-operated portable spectrum analyzer

FSA
- 100 Hz to 1.8 GHz laboratory measurement standard spectrum analyzer

FSAS
- 100 Hz to 1.8 GHz laboratory measurement standard spectrum analyzer with tracking generator

2712
- 9 kHz to 1.8 GHz full-featured portable spectrum analyzer

2714/2715
- 9 kHz to 1.8 GHz CATV measurement portable spectrum analyzer

2711
- 9 kHz to 1.8 GHz versatile, economical portable spectrum analyzer

SPECTRUM ANALYZER SELECTION GUIDE

Specifications	U4941/U4941N	FSA/FSAS	2712	2714/2715	2711
Frequency Range	9 kHz to 2.2 GHz	100 Hz to 1.8 GHz	9 kHz to 1.8 GHz	9 kHz to 1.8 GHz	9 kHz to 1.8 GHz
Frequency Measurement Accuracy	±2 kHz @ 1 GHz	±20 Hz @ 1 GHz CF	±510 Hz @ 1 GHz CF	±510 Hz @ 1GHz CF	±15 kHz @ 1 GHz CF
Resolution BW Range	1 kHz to 3 MHz 1, 3 sequence	10 Hz to 3 MHz 1, 3, 10 sequence	300 Hz, 3 kHz 30 kHz, 300 kHz, 5 MHz	300 Hz to 5 MHz 1, 3, 10 sequence	3 kHz, 30 kHz, 300 kHz, 5 MHz
Residual FM	3 kHz p-p	≤1 Hz p-p in 10 s	≤100 Hz	≤100 Hz	≤2 kHz
Phase Noise	–100 dBc/Hz @ 1 GHz CF, 20 kHz offset	–115 dBc/Hz @ 1 GHz CF, 10 kHz offset	–97 dBc @ 1 GHz CF, 10 kHz offset	–97 dBc @ 1 GHz CF, 10 kHz offset	–97 dBc @ 1 GHz CF, 10 kHz offset
CRT Display Range	90 dB	100 dB	80 dB	80 dB	80 dB
Frequency Response	±1.0 dB 100 kHz to 2 GHz	±0.6 dB to 1.8 GHz	±1.5 dB	±1.5 dB	±1.5 dB
Sensitivity	–117 dBm 9 kHz to 2.2 GHz	–145 dBm to 1.8 GHz	–127 dBm, –139 dBm with Preamp @ 1 GHz CF	–78 dBmV, –90 dBmV with Preamp @ 1 GHz CF	–117 dBm, –129 dBm with Preamp @ 1 GHz CF
Environmental	0 to 50°C 85% RH	0 to 55°C 80% RH	MIL-T-28800 Class 5	MIL-T-28800 Class 5	MIL-T-28800 Class 5
Weight	6.5 kg (14 lb.)	60 kg (140 lb.)	10 kg (22 lb.)	10 kg (22 lb.)	10 kg (22 lb.)
Features/Options					
Intelligent Markers	2	6	2	2	2
Tracking Generator	No	Yes, FSAS	Yes, Opt. 04 internal, Opt. 05 external	Yes, Opt. 05 external	Yes, Opt. 04 internal, Opt. 05 external
Card Reader/Floppy Disk	Yes, Card (2)	No	No	No	No
Preamplifier	Yes, internal	Yes, Opt. 03	Yes	Yes	Yes
Quasi Peak Detector	Yes	No	Yes, Opt. 12	No	No
CISPR Bandwidths	9 kHz, 120 kHz	No	Yes, Opt. 12	No	No
Frequency Counter	Yes	Yes	Yes	Yes	Yes, Opt. 02
Analog Display	No	No	Yes	Yes	Yes
75 Ω Input	Yes, U4941N	No	Yes, external matching pad	Yes	Yes, external matching pad
AM/FM Demodulator	Yes	Yes	Yes	Yes	Yes
Modulation Analysis	No	No	No	No	No
GPIB	Yes	Yes	Yes	Yes, Opt. 03	Yes, Opt. 03
RS-232	Yes	Yes	Yes, Opt. 08 (N/C)	Yes, Opt. 08 (N/C)	Yes, Opt. 08(N/C)
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Spectrum Analyzers
2784

Features

2784

- 100 Hz to 40 GHz Coaxial Frequency Range
- External Waveguide Mixer Support to 325 GHz
- Full-range Sweep from 0 Hz to 40 GHz
- Resolution BW from 3 Hz to 10 MHz in a 1, 3, 10 Sequence
- 100 dB Display Dynamic Range
- Phase Noise Performance as Low as –105 dBc/Hz at 10 kHz Offset up to 21 GHz
- Built-in Math Functions
- Intelligent Markers/Signal Processing: Search, Sort, and Mark CW, Pulse, or All Signals
- Occupied Bandwidth Mode
- Signal Tracking
- Built-in 100 Hz to 1.2 THz Frequency Counter with Frequency Measurement Accuracy of ≤400 Hz at 40 GHz
- Fully Programmable with Two GPIB Interfaces
- Built-in Automation
- Macro Downloading to 40 K of NVRAM
- Store up to 20 Front-panel Key Sequences
- Store up to 20 Waveforms with Readout Information
- Store up to 20 Instrument States

Applications

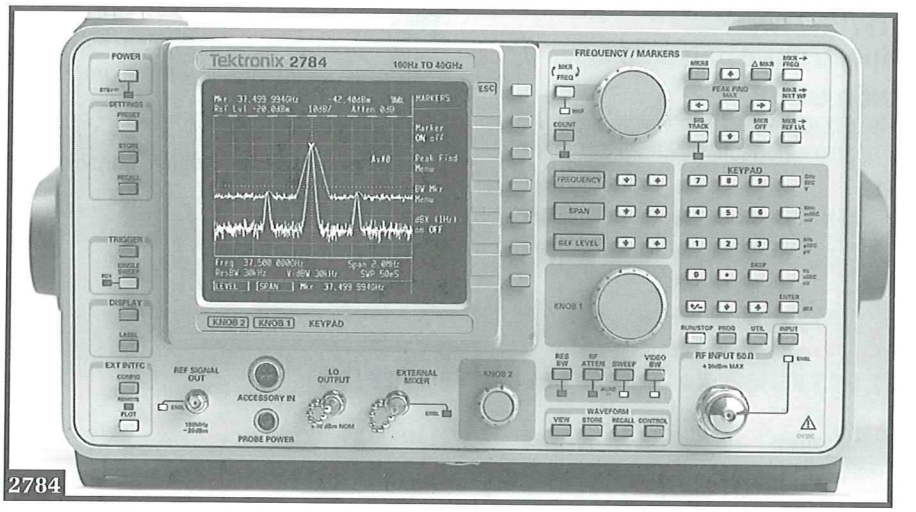
- Digital Microwave Radio
- Satellite Communication
- Microwave and RF Source Design
- Avionics
- Millimeter Wave R&D

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GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

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ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*



2784 Spectrum Analyzers

The Tektronix 2784 offers exceptional measurement performance. Whatever you need to measure, from close-in phase noise to demodulated pulsed RF, the 2784 provides the capabilities, such as substantially better phase noise, and resolution bandwidth selections from 3 Hz to 10 MHz. This is further backed with standard-setting dynamic range and improved sensitivity from direct fundamental mixing to 28 GHz, plus a host of other performance firsts: for example, a +15 dBm TOI, a 0 dBm –1 dB compression point, and a compression-to-noise dynamic range of more than 100 dB at 40 GHz.

When you need to go above 40 GHz and external mixers are used, the 2784 provides as much as 25 dB better measurement sensitivity than ever before possible. Setup is simple as well. All you need is one cable and the WM782 Waveguide Mixers and you are set; you don't even have to peak these mixers.

SOFT KEY, MENU, AND MACRO CONVENIENCE

The 2784 is rich in measurement features that are quickly and easily accessible through softkeys and menus that rarely go three deep. Often your most frequently used feature can be assigned to one of two soft knobs for immediate access and control.

In addition, you can store front-panel keystroke sequences to simplify complex measurements, or even create single-key executable macros for the most complex applications.

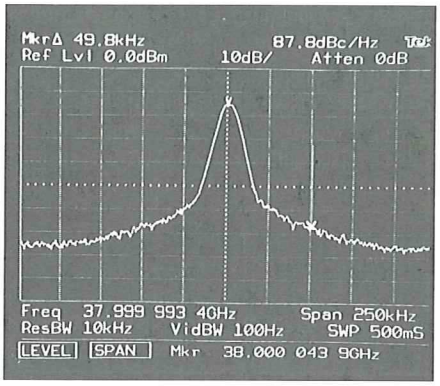
GPIB CAPABILITY WITH DUAL LANGUAGES

The 2784 provides GPIB interfacing with dual language capability – Tektronix Codes and Formats and HP8566B. This means you can write new software with full Tektronix Codes and Formats compatibility with other test equipment. It also means you can use many existing HP8566B compatible programs with minimal modification.

HIGHLY EFFICIENT SYSTEMS COMPONENT

With full programmability and two GPIB ports, the 2784 offers a new level in systems convenience and efficiency. For example, the 2784 can communicate with the system host on one GPIB port and control a synthesizer on its other port. The host never has to deal with the synthesizer. The measurement host can be unburdened even further by downloading measurement-specific macros and key sequences to the 2784. And with its small size, the 2784 provides more performance in less rack space than any other spectrum analyzer on the market.

Spectrum Analyzers
2784



Exceptional close-to-carrier spectral purity.

Characteristics

Except as noted, the following tables of electrical characteristics and features apply after a 30-minute warmup.

FREQUENCY RELATED

Frequency Range – 100 Hz to 40 GHz in coax, to 325 GHz with external waveguide mixers.

Frequency Readout Accuracy –
$\pm[F(RE + 10^{-10})] + D + (M \times N)$
F = center frequency.
RE = reference error.
D = 2% of span or 20% of resolution bandwidth, whichever is greater.
M>2 MHz span = (100N) kHz.
M≤2 MHz span = (10N) Hz.
N = LO harmonic.

Counter – Range: 100 Hz to 1.2 THz.
Resolution: Selectable from 1 Hz to 1 GHz
$\pm[F(RE + 10^{-10})] + 15N$ Hz + 1 LSD.
Δ Count accuracy (S/N≥20 dB):
$\pm[\Delta F (RE + 10^{-10})] + 30N$ Hz + 2 LSD.
F = counter frequency.
RE = reference error.
N = LO harmonic.
LSD = least significant digit.

Frequency Reference Accuracy –
Aging <1 x 10^{-6}/year <7 x 10^{-9}/day. Drift <5 x 10^{-7} over instrument temperature range of –10°C to +40°C.

Frequency Span – Range: 0, 10 Hz to 40 GHz in coax to 600 GHz in external mixer bands. Resolution: ≥100 Hz, selectable in 1% increments. Accuracy: >2 MHz, ±2%, 1 kHz to 2 MHz, ±1%, 100 Hz to 1 kHz, ±7%.

Resolution Bandwidth (6 dB) –
3 Hz to 10 MHz in 1, 3, 10 sequence. Accuracy: 10 MHz, 3 MHz ±20%, 1 MHz to 100 Hz ±15%, 30 Hz, 10 Hz ±20%, 3 Hz +50%, –10% (typical). Selectivity (–60 dB/–6 dB): <10:1. Shape: Synchronously tuned, six-pole filters.

Video Bandwidth – Range: 0.03 Hz to 7 MHz (Nominal).

Stability – Residual FM: ≤2 MHz span, 1N Hz p-p over one second; >2 MHz span, 25N kHz p-p over 500 ms. Drift (after one hour warmup): ≤2 MHz span 5N kHz/minute of sweep time, >2 MHz span 5N kHz/minute of sweep time (typical).

Notes: N = LO Harmonic. Errors due to drift are not cumulative from sweep to sweep.

Resolution Filter Bandwidths –

6 dB (Specified)	3 dB (Typical)	Random Noise (Typical)	Impulse (Typical)
3 Hz	2.1 Hz	2.3 Hz	3 Hz
10 Hz	6.9 Hz	7.6 Hz	10 Hz
30 Hz	21 Hz	23 Hz	30 Hz
100 Hz	69 Hz	76 Hz	100 Hz
300 Hz	206 Hz	227 Hz	300 Hz
1000 Hz	686 Hz	758 Hz	1 kHz
3 kHz	2.1 kHz	2.3 kHz	3 kHz
10 kHz	6.9 kHz	7.6 kHz	9 kHz
30 kHz	21 kHz	23 kHz	30 kHz
100 kHz	69 kHz	76 kHz	100 kHz
300 kHz	206 kHz	227 kHz	270 kHz
1 MHz	686 kHz	758 kHz	720 kHz
3 MHz	2.1 MHz	2.3 MHz	2.5 MHz
10 MHz	6.9 MHz	7.6 MHz	4.5 MHz

Spectral Purity –

Noise Sidebands dBc/Hz — Center Frequency

Freq. Offset	Spec. 6.5 GHz	Spec. 12 GHz	Typical 21 GHz	Typical 33 GHz	Typical 40 GHz
100 Hz	–85	–80	–75	–70	–65
1 kHz	–97	–95	–90	–86	–81
10 kHz	–105	–105	–105	–97	–94
100 kHz	–105	–105	–105	–97	–94
1 MHz	–112	–112	–112	–102	–99

AMPLITUDE RELATED

Maximum Amplitude Range – –135 dBm to +30 dBm.

Displayed Average Noise Level (10 Hz RBW, 0 dB atten.) –

Frequency	Level
100 Hz to 50 kHz	–78 dBm
50 kHz to 10 MHz	–105 dBm
10 MHz to 2.5 GHz	–135 dBm
2.5 GHz to 6.5 GHz	–132 dBm
6.5 GHz to 21.25 GHz	–125 dBm
21.25 GHz to 28 GHz	–120 dBm
28 GHz to 40 GHz	–107 dBm

Spectrum Analyzers
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Using WM782 Waveguide Mixer Series (10 Hz RBW) –

Band	Frequency	Harmonic No.	Level
A	26.5 to 40 GHz	2/4	–135 dBm
Q	33 to 50 GHz	4	–135 dBm
U	40 to 60 GHz	4	–135 dBm
V	50 to 75 GHz	6	–130 dBm
E	60 to 90 GHz	6	–125 dBm
W	75 to 110 GHz	8	–125 dBm
Typical with 100 Hz RBW			
F	90 to 140 GHz	8	–105 dBm
D	110 to 170 GHz	10	–100 dBm
G	140 to 220 GHz	14	–95 dBm
J	220 to 325 GHz	20	–85 dBm

Display Range – Log amplifier: 100 dB. Display law range – Log: 1 dB/div to 15 dB/div. Linear: 5 nV/div to 22 V/div. Square law: 2 aW/div to 100 W/div. Reference level range: –140 dBm to +30 dBm. Resolution: 0.1 dB.

Accuracy – Log (measurements marker): 0.2 dB/1 dB incremental, ±1.5 dB cumulative over 90 dB range, +2/ –3.5 dB cumulative over 100 dB range at self-correction temp.

Accuracy – Lin: ±5%. Square law: ±8%.

Frequency Response (≥10 dB RF attenuation) – 20° to 30°C.

Frequency Range	Variation
100 Hz to 6.5 GHz	±1.0 dB
6.5 GHz to 28 GHz	±4.0 dB
28 GHz to 33 GHz	±4.5 dB
33 GHz to 40 GHz	±5.0 dB

(Attenuator accuracy over frequency included in frequency response.)

Attenuator – Range: 0 to 70 dB, 10 dB steps. Accuracy @ 100 MHz: ±0.5 dB.

IF Gain – Range: 0 to 140 dB. Resolution: 0.1 dB. Accuracy: ±1.0 dB, 0 to 50 dB; ±1.5 dB, 0 to 100 dB; at self-correction temperature.

Gain Variation Between Resolution Filters – (Measured at –20 dBm reference level, 10 dB RF atten., and after two-hour warmup at self-correction temperature).

Frequency –

10 MHz to 30 Hz	0.5 dB p-p
10 MHz to 10 Hz	0.75 dB p-p
10 MHz to 3 Hz	2.0 dB p-p

Reference Level Calibration Error – ±0.25 dB (Ref. level –20 dBm, with respect to –20 reference in 3 MHz RBW at self-correction temperature).

Band Switching Uncertainty – ±1.5 dB referred to 100 MHz reference signal.

SPURIOUS RESPONSES

Spurious Responses – <–80 dBc + 20 Log N except as noted below.
Residual signals: <–77 dBm, 100 Hz to 10 MHz; Mixer level: –30 dBm:
<–70 dBm at 2 MHz with 10 kHz and wider resolution bandwidth;
<–100 dBm, 10 MHz to 6.5 GHz;
<–92 dBm, 6.5 GHz to 21 GHz;
<–82 dBm, 21 GHz to 28 GHz;
<–80 dBm, 28 GHz to 40 GHz.

Maximum Dynamic Range – Compression-to-noise: 132 dB (10 MHz to 6.5 GHz); 117 dB (to 28 GHz); 101 dB (to 40 GHz). Signal-to-harmonic distortion: 80 dB (50 MHz to 6.5 GHz); 100 dB (6.5 GHz to 40 GHz). Signal-to-intermodulation distortion: 98 dB (10 MHz to 6.5 GHz); 83 dB (to 28 GHz); 81 dB (to 40 GHz).

1 dB Gain Compression –
100 Hz to 21 GHz: 0 dBm.
21 GHz to 28 GHz: –3 dBm.
28 GHz to 40 GHz: –6 dBm.

Intermodulation Rejection – Second order intercept: >+28 dBm, 1 MHz to 6.5 GHz. Third order intercept: With signal separation <150 MHz and >20 kHz. Mixer Level –30 dBm:
>+15 dBm, 1 MHz to 6.5 GHz, (–90 dBc);
>+10 dBm, 6.5 GHz to 28 GHz (–80 dBc).

Second Harmonic Distortion – Mixer level: –40 dBm; <–70 dBc, 50 MHz to 6.5 GHz; <–100 dBc (typical), 6.5 GHz to 40 GHz.

Out of Band Responses for Input Frequencies <35 GHz –

	Center Frequency Range 100 Hz to 28 GHz	28 to 40 GHz
Image Response	<–65 dBc	<–65 dBc
Harmonic Conversions	<–65 dBc (typical)	<–55 dBc (typical)

SWEEP GENERATOR AND TRIGGERING

Sweep Generator – Sweep speed range: 200 s to 2 µs. Accuracy: ±5%, 50 µs and slower; ±10%, 20 µs and faster.

Triggering – Adjustable trigger level and slope. Internal: AC coupled; 10 Hz to 1 MHz. External: DC coupled; 0 Hz to 5 MHz or 0 Hz to 1.5 kHz. Line: Copy of AC line.

DISPLAY RELATED

Display Type – Liquid crystal color shutter, 10 x 10 division graticule.

Digital Storage – Maximum sweep rate: 10 ms with 10-Bit resolution, 2 ms with reduced horizontal resolution. Vertical digitizer uncertainty: ±0.4%.

Spectrum Analyzers
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Non-volatile Memory – CMOS battery backed-up RAM, memory retention guaranteed to –10°C. Battery type: Lithium cells. Battery life (typical): 1.8 years @ 20°C, 1 year @ 50°C. (Batteries are not used when instrument is connected to power source.) Waveforms: 20 waveforms with screen readouts and labels or date/time stamps. Front-panel setups: 20 complete front-panel setups. Front-panel sequences: 20 sequences, 64 keystrokes/sequence. Macros: 40 K of RAM. Instrument calibration data: Separate EEPROM.

INPUTS/OUTPUTS

RF Input – Frequency range: 100 Hz to 40 GHz. Coupling: DC. Connector: Planar crown system connector with K compatible and N-type adapters as standard accessories. Impedance: 50 Ω.

VSWR	Center Frequency Ranges			
RF Atten.	100 Hz to 6.5 GHz	6.5 GHz to 28 GHz	28 GHz to 33 GHz	33 GHz to 40 GHz
≥10 dB	<1.4:1	<1.7:1	<2.0:1	<2.25:1

Maximum Safe Input Power – AC average power: +30 dBm with ≥10 dB attenuation. Pulse power: 50 W peak, 1 µs and <0.005 duty factor with ≥50 dB attenuation. DC: 0 V, <100 mA.

Local Oscillator Emission (at 0 dB RF attenuation) – ≤–75 dBm, 100 Hz to 6.5 GHz; ≤–65 dBm, 6.5 GHz to 40 GHz.

External Mixer Input (diplexer built in) – Impedance: 50 Ω; VSWR <1.9:1 at 525 MHz and <2.2:1 at 3.525 GHz (typical). LO output power: ≥15 dBm at 8.1 to 17.9 GHz.

LO Output – Provides access to output of 1st LO at +4 dBm (typical).

Reference Signal Out – Amplitude: –20 dBm. Amplitude accuracy: ±0.3 dB. Frequency: 100 MHz (derived from reference oscillator).

Ref. In/Out – Impedance: 50 Ω nominal. Input frequency: 10 MHz ±5 Hz. Input signal amplitude range: 0 dBm minimum to +15 dBm maximum. Output signal (when selected): Nominally 0 dBm at 10 MHz. Allowable phase noise: ≤–100 dBc/Hz at 1 Hz offset (without degrading instrument phase noise performance).

Ext. Trig/Horiz – External trigger input, or external sweep input.

Accessory Connector – 15-Pin connector for external inputs and outputs. Ext. In display blanking: Provides external access to CRT beam blanking. Ext. In display horizontal and vertical: Provides external access to real-time channel of the instrument; DC coupled; Vert –5 MHz bandwidth (typical). Sweep output: Provides copy of analog sweep. Ext. In video: Provides external access to instrument's video processing system; 7.5 MHz bandwidth (typical). Penlift: TTL level output to lift plotter pen. YIG coil tune voltage and return: Provides external output of the YTO coil tuning voltage and a return path.

Ext. V Out – External display horizontal signal output; jumper selectable between full deflection amplifier signal or the real-time signal.

Ext. H Out – External display horizontal signal output; jumper selectable between full deflection amplifier signal or the real-time signal.

Ext. Z Out – External display blanking signal output.

IF Output – Frequency: 25 MHz (3 MHz and 10 MHz resolution bandwidth). Amplitude: 3 dBm nominal (–30 dBm reference level, 0 dB RF attenuation, –30 dBm RF input). Frequency: 4 MHz (1 MHz or less resolution bandwidth). Amplitude: +9 dBm nominal (–30 dBm reference level, 0 dB attenuation, –30 dBm RF input). Impedance: Nominal 50 Ω. VSWR: ≤1.5:1 (Typical).

EXTERNAL INTERFACE PORTS

Two GPIB ports (IEEE Std. 488-1978) are standard.

GPIB Interface – Port 1: SH1, AH1, T5, L3, SR1. Functions: RLO/RL1, PPO, DC1, DT1, CO. Port 2: SH1, AH1, T5, L3, SRO, RLO, PPO, DCO, DTO, C1, C2, C3, C27, (CO selectable).

Probe Power – Provides operating voltage for active probes; Output voltages are:
Pin 1: +5 V ±5% @ 100 mA max;
Pin 2: ground;
Pin 3: –15 V ±5% @ 100 mA max;
Pin 4: +15 V ±5% @ 100 mA max.

Power Requirements –
Input voltage: 90 to 132 V AC, 47 to 440 Hz, 180 to 250 V AC, 47 to 63 Hz. Power: At 115 V AC, 60 Hz, 250 W maximum, 2.8 A. Standby power: 25 W maximum. Leakage current: 3.5 mA maximum.

ENVIRONMENTAL CHARACTERISTICS

(Per MIL-T-28800C, Type III, Class 3, Style C).

Temperature – Operating: –10°C to +55°C. Nonoperating: –62°C to +85°C.

Humidity – 5 cycles per MIL-STD-810D Procedure III (modified).

Altitude – Operating: 4.6 km (15,000 ft.); Nonoperating: 12.2 km (40,000 ft.).

Vibration – Resonant search in all axes from 5 to 15 Hz with displacements up to 0.060 inch, 15 to 25 Hz with displacements up to 0.040 inch, and 25 to 55 Hz with displacements up to 0.020 inch.

Shock – Operating and nonoperating: Tested to withstand three shocks of 30 g, one-half sine, 11 ms duration each direction along each major axis.

Transit Drop – Tested to withstand eight-inch drops, one per each of six faces and eight corners.

Accessories

PRODUCT COMPATIBILITY

HC100

- Compatible with TDS Series, 11000 Series, and Most PC Systems
- Direct Plots from Most Tektronix Digitally-based Instruments Without Using a Controller
- Four Color
- Standard Interfaces
  - Centronics Parallel
  - GPIB
- A4 and US Letter Sizes
- Four Plotting Modes, Including HPGL

K420

- Stable/Mobile Platform
- Tiltable Shelf for Optimum Viewing
- Work-bench Height
- Heavy-duty Nylon Instrument Straps
- Surge and Noise Suppression
- Surge-protected Four Outlet Power Strip Accessory
- Shipped Ready to Assemble

Spectrum Analyzers
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ELECTROMAGNETIC INTERFERENCE
MIL-STD 461C Part 4 –
Conducted emissions: CE01 – 60 Hz to 15 kHz, 15 dB relaxation below 2 kHz; CE03 – 15 kHz to 50 MHz power leads; Narrowband and broadband full limits (Navy).

Conducted susceptibility: CS01 – 30 Hz to 50 kHz power leads, full limits; CS02 – 50 kHz to 400 MHz power leads, 10 dB relaxation at the IF frequencies; CS06 – Spike power leads, full limits.

Radiated emissions: RE01 – 30 Hz to 50 kHz magnetic field, 5 dB relaxation below 1 kHz and 10 dB relaxation from 1 kHz to 50 kHz; RE02 – 14 kHz to 1 GHz; meets MIL-STD-461C Part 7 to full limits.

Radiated susceptibility: RS01 – 30 Hz to 50 kHz magnetic field, full limits; RS02 – magnetic induction, 30 dB relaxation at 60 Hz; 20 dB @ 440 Hz; RS03 – limited to 1 V/m from 14 kHz to 1 GHz, with 20 dB relaxation at IF frequencies.

VDE – Meets VDE 0871 Class 1B – Regulations for RFI Suppression of High Frequency Apparatus and Installations.

FCC – Meets FCC Part 15 Subpart J Class A – EMI Compatibility.

German RöV – Meets German RöV, X-Ray Decree, Section 5, March 1973.



Convenient rackmounting with the rack adapter or Option 30.



Microwave Chip Research and Development: The 2784 is shown here monitoring microwave component research and development in a lab clean room.

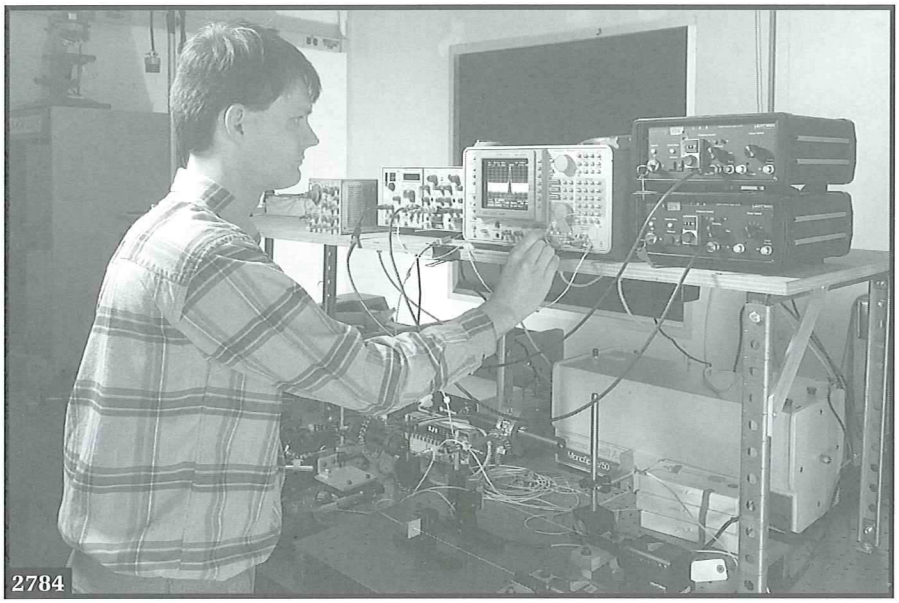
PHYSICAL CHARACTERISTICS

Dimensions	in.	mm
Height	8.05*1	204.47*1
	8.05*2	213.36*2
	8.05*3	204.47*3
Width	12.90*1	327.66*1
	15.75*2	400.05*2
	15.75*3	400.05*3
Depth	18.59*1	472.19*1
	21.64*2	549.11*2
	24.75*3	624.28*3
Weight	**lb.**	**kg**
Net	44*4	20*4

*1 Without front cover, handle, or feet.
*2 With front cover, handle folded back, and feet.
*3 With front cover, handle fully extended, and feet.
*4 With standard accessories, cover, and no manuals.

Safety – Meets the following industry safety standards:
CSA Standard C22.2 No. 231 – Electrical and Electronic Measurement and Testing Equipment.
ANSI/ISA S82 – Safety Requirements for Electronic Measuring and Controlling Instrumentation.
IEC 348, 2nd Edition – Safety Requirements for Electronic Measuring Apparatus.
FM – Electrical Utilization Standard Class 3810.
UL 1244, 2nd Edition – Electrical and Electronic Measuring and Testing Equipment.

Spectrum Analyzers
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Opto-electronic Research and Development: The 2784 finds wide use in opto-electric modulator-demodulator design and development.

Accessories

HC100

- Compatible with TDS Series, 11000 Series, and Most PC Systems
- Direct Plots from Most Tektronix Digitally-based Instruments Without Using a Controller
- Four Color
- Standard Interfaces
  – Centronics Parallel
  – GPIB
- A4 and US Letter Sizes
- Four Plotting Modes, Including HPGL

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

2784
Microwave Spectrum Analyzer.
Includes: N-male to BNC-female Adapter (103-0045-00); N to Planar Crown Adapter (131-4329-00); 50 Ω SMA Cable (012-0649-00); Line Fuses: 4 A, 125 V AC (159-0319-00); 4 A, 250 V AC (159-0320-00); Power Cord (161-0104-00). Operator's Manual (070-8240-00); Operator's Reference Guide (070-8249-00); Programmer's Manual (070-8241-00); Programmer's Reference Guide (070-8242-00); Installation and Performance Verification Manual (070-8067-00).

Opt. 16 – 49X/275X/279X Series GPIB Language.

Opt. 18 – WM782 Bands Q, U, V, E, and W (frequency coverage from 33-110 GHz).

Opt. 19 – WM782 Bands A, U, E, F, G, and J (frequency coverage from 26-325 GHz).

Opt. 20 – Utility Software for PC, includes GPIB Card.

Opt. 30 – Rackmount Adapter (19 in.).

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – United Kingdom 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.
See Customer Information Section for additional description.

Opt. B1 – Service Manual prepared to module level.

Opt. B2 – Complete set of manuals, including Service Manual.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

SOFTWARE
See page 219 for complete description.

2784 PC Utility – Order S26UT00.

RECOMMENDED ACCESSORIES

PROBES

P6201 – 900 MHz, 1.5 pF/100 kΩ.
P6217 – 4 GHz, 0.4 pF/100 kΩ, (Requires 1103 Power Supply).
1103 – Power Supply.

CAMERAS/PLOTTERS/PRINTERS

Camera – Low Cost.
Order C-9 Opt. 1A and Opt. 20.

Plotter – Four Color. Order HC100 Opt. 01.

Cart – Order K420.

GPIB Cables –
0.5 m. Order 012-1282-00.
1 m. Order 012-0991-01.
2 m. Order 012-0991-00.
4 m. Order 012-0991-02.

Waveguide Mixer Cables – Use with WM782 Waveguide Mixers. Order 012-1346-00.

GPIB CARDS

PC-GPIB Card – IBM PC, AT, and Compatibles. Order S3FG210.
AT-GPIB Card – IBM AT Bus (High-speed Card). Order S3FG220.
MC-GPIB Card – IBM PS/2 with Microchannel Bus. Order S3FG230.

ADDITIONAL ACCESSORIES
Also see page 434.

EMC Ancillary Devices – See page 225.

Rackmount Adapter – Order 016-1019-00.

Optical-to-Electrical Converter – Order SA-42.

Service Manual – Module Level. Order 070-8244-00.

Transit Case – Order 016-0658-00.

Soft Side Case – Order 016-0659-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*

Spectrum Analyzers

R3271A • R3371A • R3265A • R3365A

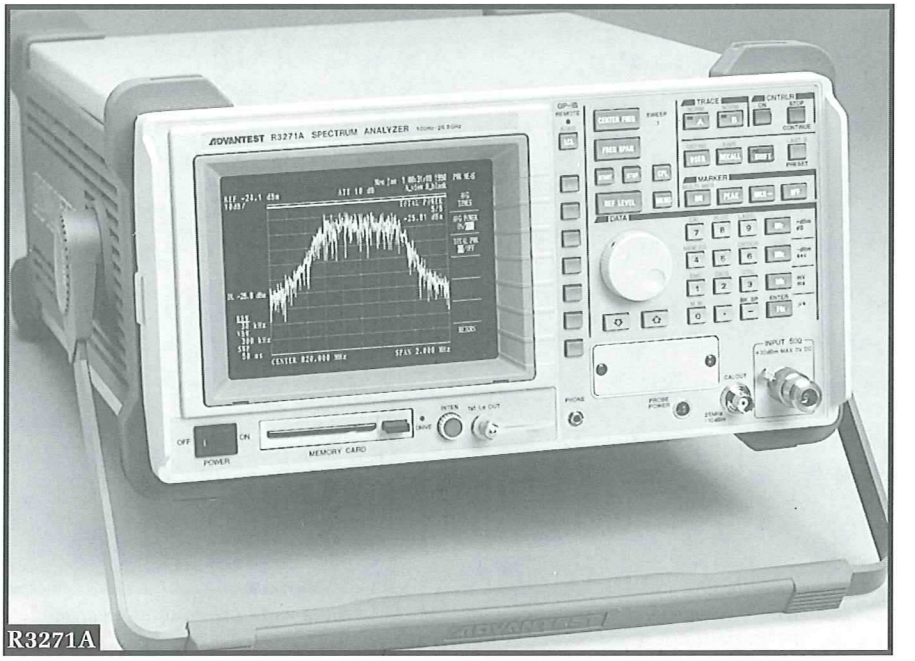
Features

R3271A/R3371A, R3265A/R3365A

- Excellent Spectral Purity: –110dBc/Hz (10 kHz Away from Carrier)
- Resolution Bandwidth of 10 Hz to 3 MHz
- Built-in Frequency Counter with 1 Hz Resolution
- Audio Demodulation with Internal Speaker
- Portable System with a Large CRT Display
- High-speed 5 µs/div Sweep
- TDMA Signal Analysis
- Memory Card Function
- Multi-marker with up to Eight Points
- Extensive Built-in EMC Measurement Functions
- Conforms to MIL-T-28800 Standards
- Built-in Tracking Generator (R3365A and R3371A)

Applications

- Digital Mobile Radio Test
- Antenna and Base Station Test
- Radio Communications System Test
- Microwave Device Test



R3271A

R3271A/R3371A Spectrum Analyzer

The R3271A/R3371A spectrum analyzer is designed to analyze pulse RF signals used for radar or to analyze the spectra of microwaves and quasi-millimeter waves used for satellite broadcasting, satellite communications, and mobile communication.

The R3271A/R3371A can measure the ultra-wide frequency range of 100 Hz to 26.5 GHz in one sweep operation. It can also perform the sweep continuously and repeatedly. A newly developed high-purity synthesizer enables a high signal purity of –110 dBc/Hz at 2.6 GHz and –108 dBc/Hz at 7.5 GHz (10 kHz offset).

The R3271A/R3371A spectrum analyzer is thus ideally suited for mobile radio communication, for which narrower signal bandwidths and digital transmission are being implemented. In the past, such high-performance equipment was used only for advanced research and development; however, this level of performance is now needed on a commercial level.

R3265A/R3365A Spectrum Analyzer

The R3265A/R3365A is a quasi-microwave spectrum analyzer designed to meet user needs and to ensure easy operations. The R3265A/R3365A incorporates a time domain function so it can be used for both digital and analog mobile communication. The R3265A/R3365A can measure a wide frequency range of 100 Hz to 8 GHz in one sweep over a wide dynamic range. Even at a frequency of 2.6 Hz, a newly developed high-purity synthesizer enables a high signal purity of –110 dBc/Hz (offset frequency of 10 kHz).

This unit performs especially well in measuring the spurious emission intensity of mobile communications equipment, the bandwidth of occupied frequencies, and signal leakage from adjacent channels. In the low-noise mode, the R3265A/R3365A has a high-input sensitivity of –145 dBm (1 MHz to 3.6 GHz), so it can easily measure faint signals.

In addition to its popular user-defined functions, the R3265A/R3365A incorporates a multi-marker function, as well as a function to list the frequency and level displayed by the multi-marker. A memory card function can save or recall measurement settings, measurement data, and user definitions. Using this function, the time needed for measurement and panel resetting operations can be significantly shortened.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1.*

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

Spectrum Analyzers
R3271A • R3371A • R3265A • R3365A

TRACKING GENERATOR
The R3365A and R3371A are identical to the R3265A and R3271A respectively, except that the R3365A and R3371A include a built-in tracking generator to facilitate frequency response measurements and provide scalar network analyzer capability (with an external SWR bridge).

BURST SIGNAL ANALYSIS FUNCTIONS
- **Fast Digitized Sweep.** The R3265A/R3365A, R3271A/R3371A use a high-speed digitizer to perform high-speed sweeps of 5 µs/div during zero span. This data can also be averaged. This function is ideally suited for monitoring the mean transmission power and duration of Time Division Multi-Access (TDMA) signals that are used in the Global System for Mobile Communication (GSM) systems in Europe and in the next-generation mobile telephone systems in Japan and the U.S.A. (e.g., digital mobile telephones). An arbitrary range can be expanded using the delayed sweep function.
- **Gated Sweep Function.** The burst signal (TDMA and video signals) analysis function, when combined with the high-speed sweep, can be used to monitor the transmission power in an arbitrary one-time slot of a TDMA signal or to analyze the noise in one horizontal line of a TV signal. Until now, the gated sweep function required an external gated sweep signal. The R3265A/R3271A standard configuration permits analysis of the spectrum of a burst signal without the need for an external gate or trigger signal.
- **Delayed Sweep.** Delayed sweep can be used to zoom in on detail in the time domain. The user can set a delay time following an internal or external trigger event.

MEASUREMENT OF OCCUPIED FREQUENCY BANDWIDTHS AND ADJACENT-CHANNEL LEAKAGE POWER
By calculating from the measured spectrum data, the occupied frequency bandwidth of a radio transmission characteristic and the leakage power of an adjacent channel can be easily measured. The carrier frequency is also displayed when the occupied frequency bandwidth is measured. The leakage from an adjacent channel can be measured in a dynamic range of 70 dB (typical value) with high signal purity.

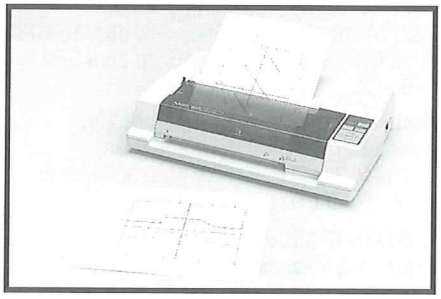
INTERNAL TRACKING GENERATOR
The R3365A and R3371A include an internal tracking generator to dynamically measure the resonant characteristic of a high-Q element or the frequency response of a dielectric filter. In addition, the 120 dB dynamic-range display guarantees a 110 dB dynamic measurement range for frequency response measurement with the tracking generator. Therefore, even high stop-band attenuation can be measured.

OPTICAL MODULATION SPECTRUM ANALYZER
Addition of the Q32605 Optical Receiver plug-in allows the R3265A/R3271A to function as an optical modulation spectrum analyzer.

Optical input sensitivity with the Q32605 is –160 dBm/Hz, frequency range of 6 MHz to 2.4 GHz, and a frequency flatness of ±1.8 dB.

The R3265A/R3271A/Q32605 can be used to measure RIN (Relative Intensity Noise) of optical analog transmission LDs and optical transmitters, modulation degree, C/N, and the noise level of optical fiber amplifiers.

DIGITAL RADIO TRANSMITTER ANALYSIS
The R3265A/R3365A, R3271A/R3371A are also available in a configuration along with the R3541C Modulation Accuracy Measurement Unit specifically designed for digital radio transmitter analysis. See information on the R2465A/R2471A on page 193.



Accessory

HC100
Low-cost, Four-color Plotting

- Compatible with GPIB, RS-232, Centronics interfaces
- Plots both U.S. and A4 formats on paper, mylar and overhead material
- Graphics and text capability
- Compact package

Characteristics

FREQUENCY RELATED
Frequency Range – 100 Hz to 8 GHz, R3265A. 100 Hz to 26.5 GHz, R3271A. (extended to 325 GHz, with Tektronix WM780 Series waveguide mixers – see page 215):

Harmonic Mode (N), R3265A – =1.

Harmonic Mode (N), R3271A –

Frequency Band	Harmonic Mode (N)
100 Hz to 3.6 GHz	1
3.5 GHz to 7.5 GHz	1
7.4 GHz to 15.4 GHz	2
15.2 GHz to 23.3 GHz	3
23 GHz to 26.5 GHz	4

Preselector – 3.5 GHz to 8 GHz (26.5 GHz for R3271A) using YIG-tuned preselector.

Frequency Readout Accuracy (Start, Stop, CF, Marker) – ±(freq. readout x freq. reference accuracy + span x span accuracy + 0.15 x res BW + 10 Hz).

Span Accuracy – Span >2 MHz: ±3%, Span ≤2 MHz: ±5%.

Count Frequency Marker –
Resolution: 1 Hz to 1 kHz.
Count accuracy (S/N >25 dB): ±(marker freq. x freq. reference accuracy + 5 Hz x N + 1 LSD).
Delta marker count accuracy: (S/N ≥25 dB) ±(delta marker freq. x freq. reference accuracy + 10 Hz x N + 2 LSD).

Frequency Reference Accuracy –
R3265A: $\pm 2 \times 10^{-8}$/day, $\pm 1 \times 10^{-7}$/year, $\pm 5 \times 10^{-9}$/day with Option 21.
R3271A: $\pm 2 \times 10^{-8}$/day, $\pm 1 \times 10^{-7}$/year, $\pm 5 \times 10^{-9}$/day with Option 21.

Frequency Stability –
Residual FM (zero span): <3 Hz x N_{p-p}/0.1 s.
Drift (after 1 hour warmup): Span 50 kHz <span ≤2 MHz, <2.5 kHz x sweep time (minute) x N. Span ≤50 kHz, <60 Hz x sweep time (minute) x N.

Spectral Purity – Noise sidebands.

Offset	f ≤2.6 GHz	f ≥2.6 GHz
1 kHz	<–100 dBc/Hz	≤(–95 + 20 logN) dBc/Hz
10 kHz	<–110 dBc/Hz	≤(–108 + 20 logN) dBc/Hz
20 kHz	<–110 dBc/Hz	≤(–108 + 20 logN) dBc/Hz
100 kHz	<–114 dBc/Hz	≤(–110 + 20 logN) dBc/Hz

Spectrum Analyzers
R3271A • R3371A • R3265A • R3365A

FREQUENCY SPAN

Linear Span –
Range (zero span): 200 Hz to 8 GHz (R3265A), 200 Hz to 26.5 GHz (R3271A).
Accuracy: ±3% (span >2 MHz), ±5% (span ≤2 MHz).

Log Span –
Range: 1 kHz to 1 GHz, 1, 2, 3 decades selected.
Accuracy: ±(10% + stop freq. x 0.1%).

Resolution Bandwidth (–3 dB) –
Range: 10 Hz to 3 MHz 1, 3, 10 sequence.
Accuracy: 100 Hz to 1 MHz: ±15%. 30 Hz to 3 MHz (25°C ±10°C): ±25%. 10 Hz to 100 Hz (digital IF): ±50%.
Selectivity (–60 dB/–3 dB): 100 Hz to 3 MHz: <15:1. 30 Hz: <20:1. 10 Hz to 100 Hz (digital IF): 5:1 (nominal).
Bandwidth (–6 dB): 200 Hz, 9 kHz, 120 kHz. Conformed to CISPR standard.

Video Bandwidth Range – 1 Hz to 3 MHz, 1, 3, 10 sequence.

AMPLITUDE RELATED

Amplitude Range – +30 dBm to noise level.

Maximum Input –
Average continuous power (Input attenuation ≥10 dB): +30 dBm (1 W). DC: 0V.

Display Range –
Scale calibration: 10x10 division graticule.
Log: 10, 5, 2, 1, 0.5, 0.2, 0.1 dB/div.
Linear: 10% of reference level/div.
QP log: 40 dB (5 dB/div).

Input Attenuator Range – 0 to 70 dB (10 dB step).

DYNAMIC RANGE

Maximum Dynamic Range –
1 dB Compression-to-noise level:
R3265A: 200 MHz to 3.6 GHz, 135 dB – 1.55f (GHz).
R3271A: 10 MHz to 3.6 GHz, 130 dB – 1.55f (GHz).
Second harmonic distortion:
R3265A: 100 MHz to 1.8 GHz, 87 dB. 10 MHz to 3.6 GHz, 82.5 dB. >3.5 GHz, 112 dB.
R3271A: 10 MHz to 3.6 GHz, 85 dB. >3.5 GHz, 110 dB.
Third order intermodulation:
R3265A: >200 MHz, 93 dB.
R3265A, R3271A: >10 MHz, 90 dB.

Displayed Average Noise Level (10 Hz RBW, 0 dB 1/p attenuation, 20x average) –
R3265A and R3271A: 1 kHz, –100 dBm. 10 kHz, –110 dBm. 100 kHz, –111 dBm. 1 MHz, –135 dBm.
R3265A: 10 MHz to 3.6 GHz; Normal mode, –140 + 1.55f (GHz) dBm. Low-noise Mode, –145 – 1.55f (GHz) dBm. 3.5 GHz to 8 GHz; –135 dBm.
R3271A: 1 MHz to 3.6 GHz, –135 + 1.55f (GHz) dBm. 3.5 to 7.5 GHz, –130 dBm. 7.5 to 15.4 GHz, –123 dBm. 15.2 to 23.3 GHz, –116 dBm. 23 to 26.5 GHz, –110 dBm.

Gain Compression (1 dB) –
R3265A: >10 MHz, –10 dBm (mixer level). >250 MHz, –5 dBm (mixer level).
R3271A: >10 MHz, 5 dBm (mixer level).

Second Harmonic Distortion –
R3265A: 100 MHz to 1.8 GHz, <–70 dBc (–30 dBm at mixer). 10 MHz to 1.8 GHz, <–60 dBc (–30 dBm at mixer). >1.75 GHz, <–100 dBc (–10 dBm at mixer).
R3271A: 10 MHz to 1.8 GHz, <–70 dBc (–30 dBm at mixer). >1.75 GHz, <–100 dBc (10 dBm at mixer).

Third Order Distortion (30 dBm mixer level) –
R3265A: 200 MHz to 3.6 GHz, <–70 dBc. 10 MHz to 3.6 GHz, <–60 dBc). >3.5 GHz, <–75 dBc.
R3271A: 10 MHz to 3.6 GHz, <–70 dBc, >3.5 GHz, <–75 dBc.

Image Multiple, Out-of-band Response –
R3265A: 10 MHz to 8 GHz, <–70 dBc.
R3271A: 10 MHz to 18 GHz, <–70 dBc. 10 MHz to 23 GHz, <–60 dBc. 10 MHz to 26.5 GHz, <–50 dBc.

Residual Response (no signal at 1/p, attenuator 0 dB, 50 Ω termination) –
1 MHz to 3.6 GHz, <–100 dBm. 300 kHz to 8 GHz (26.5 GHz), <–90 dBm.

AMPLITUDE ACCURACY

Frequency Response – In band flatness (10 dB input attenuation): 100 Hz to 3.6 GHz, ±1.5 dB. 50 MHz to 2.6 GHz, ±1.0 dB. 3.5 GHz to 7.5 GHz, ±1.5 dB.
R3265A, 7.4 GHz to 8 GHz: ±1.5 dB.
R3271A, 7.4 GHz to 15.4 GHz: ±3.5 dB. 15.4 GHz to 23.3 GHz: ±4.0 dB. 23 GHz to 26.5 GHz: ±4.0 dB.

Additional Uncertainly Due to Band Switching – ±0.5 dB.

Frequency Response Referenced to CAL Signal – ±3 dB (R3265A), ±5 dB (R3271A).

Calibrator Accuracy – –10 dBm ±0.3 dB.

IF Gain Uncertainty (after automatic calibration) – 0 dBm to –50 dBm: ±0.5 dB.
0 dBm to –80 dBm: ±0.7 dB.

Scale Fidelity –
Log: ±0.2 dB/1 dB, ±1 dB/10 dB, ±1.5 dB/90 dB.
Linear: ±5% of reference level.
QP mode log: ±1.0 dB/30 dB, ±2 dB/40 dB, ±1.0 dB/40 dB (25°C ±10°C).

Input Attenuator Switching Accuracy (20 to 70 dB settings referenced to 10 dB) –
±1.1 dB/10 dB step, 2.0 dB max., 0 to 12.4 GHz.
±1.3 dB/10 dB step, 2.5 dB max., 12.4 GHz to 18 GHz.
±1.8 dB/10 dB step 3.5 dB max., 18 GHz to 26.5 GHz.

Resolution Bandwidth Switching Uncertainty (at reference BW, 300 kHz, after automatic calibration) –
100 Hz to 3 MHz: ≤±0.3 dB. 30 Hz: ≤±1 dB.
10 Hz to 100 Hz (digital IF): ≤±1.5 dB.

Pulse Digitization Uncertainty (pulse response mode PRF >700/sweep time) Peak-to-Peak –
Log: RBW ≤1 MHz, 1.2 dB; RBW ≤3 MHz: 3 dB.
Linear: RBW ≤1 MHz, 4% of reference level; RBW 3 MHz, 12% of reference level.

SWEEP RELATED

Sweep Time –
SPAN = 0: 50 µs to 1000 s and manual sweep.
SPAN ≥200 Hz: 20 ms to 1000 s and manual sweep.
Accuracy: ±3%.

Sweep Trigger – Free run, line, single, video, TV-H, TV-V, external.

Demodulation –
Spectrum demodulation: Modulation type, AM and FM.
Audio output: Speaker and phone jack with volume control.
Marker pause time: 100 ms to 1000 s.

DELAYED SWEEP

Trigger Signal Source – External trigger signal (input from the external trigger input connector).
Trigger mode: VIDEO and TV-V.

Delay Time – 200 ns to 1.5 s with a resolution of 100 ns.

Delayed Sweep Time – 50 µs to 1000 s (resolution is the same as that set in the sweep time).

Spectrum Analyzers
R3271A • R3371A • R3265A • R3365A

GATED SWEEP
Trigger Signal Source – Frequency or time domain analysis: External trigger input (TTL), gate input (TTL), IF detection trigger (Trigger level variable, span ≤7 MHz – frequency domain analysis – 1/p pulse >100 µs).

Gate Position – 300 ns to 100 ns with resolution of 100 ns.

Gate Width – 1 µs to 1.5 s with resolution of 100 ns.

TRACKING GENERATOR (R3365A/R3371A)
Frequency Range – 100 kHz to 3.6 GHz.

Output Level Range – –3 dBm to –30 dBm (0.1 dB steps).

Output Level Accuracy – ±0.5 dB (25 MHz, –10 dBm, 25°C, ±10°C).

Vernier Accuracy – ±0.5 dB (25 MHz, –10 dBm, 25°C, ±10°C).
Dynamic Range –
1 MHz to 3 GHz: –110 dBm.
3 GHz to 3.6 GHz: –100 dBm.

Power Sweep Range – 30 dB (in 0.1 dB steps).

INPUTS/OUTPUTS
External Memory Function – IC memory card.

RF Input –
Connector type: N type (adaptable to SMA type for R3271A).
Impedance: 50 Ω (nominal).
VSWR (input attenuation ≥10 dB, at tuned frequency): ≤3.6 GHz (nominal): <2.0:1 (R3265A), >3.6 GHz (nominal) <2.5:1 (R3271A).
LO emission level (average): <–80 dBm (nominal), 10 dB input attenuation, 0 to 26.5 GHz.

Video Output –
Connector: BNC female, rear panel.
Impedance (AC coupled): 75 Ω (nominal).
Amplitude: Approx. 1 V p-p (composite video signal).

Probe Power –
Connector: 4-Pin, front panel.
Voltage: +15 V, –15 V.
Current: 150 mA max., each.

Demodulated Audio Output –
Connector: Subminiature monophonic jack, front panel.
Power output: 0.2 W, 8 Ω (nominal).

Phone Output – Demodulated audio.
Connector: Subminiature monophonic jack, front panel.
Power output: 0.2 W, 8 Ω (nominal).

GPIB Interface – Standard GPIB function enables remote operation and data input/output.
Connector: IEEE-488 bus connector.
Direct plotter output: Supports Tektronix HC100 Option 01, HP7470A, HP7475A, HP7440A, and HP7550A, or other HPGL plotters.

POWER REQUIREMENTS
Operating Voltage – Automatically selects between 100 V AC and 220 V AC.
100 V AC: 90 V to 132 V.
220 V AC: 198 V to 250 V.

Power Consumption – Max. 400 VA.

Frequency –
100 V AC: 48 to 440 Hz.
200 V AC: 48 to 66 Hz.

GENERAL SPECIFICATIONS
Environmental –
Operating temperature: 0°C to +50°C.
Nonoperating temperature: –20°C to +60°C.
Humidity: 85% RH.

Safety – This product has been safety tested by Advantest to IEC 348 specifications.

PHYSICAL CHARACTERISTICS

Dimensions*1	mm	in.
Height	177	7.0
Width	353	13.9
Depth	450	17.7
Weight	**kg**	**lb.**
Nominal	22	48.5

*1 *Without handle, feet, and front cover.*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

R3265A
Spectrum Analyzer.
Includes: Power Cord, BNC-to-BNC Cable, N-Type-to-BNC Cable, N-to-BNC Adapter, Memory Card, Front Cover, Instruction Manual.

R3365A
Spectrum Analyzer with Tracking Generator.
Includes: Power Cord, BNC-to-BNC Cable (short), BNC-to-BNC Cable, N-to-BNC Adapter, Memory Card, Front Cover, Instruction Manual.

R3271A
Spectrum Analyzer.
Includes: Power Cord, BNC-to-BNC Cable (short), BNC-to-BNC Cable, N-to-BNC Adapter, Memory Card, Front Cover, Instruction Manual.

R3371A
Spectrum Analyzer with Tracking Generator.
Includes: Power Cord, BNC-to-BNC Cable (short), BNC-to-BNC Cable, N-to-BNC Adapter, Memory Card, Front Cover, Instruction Manual.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES
Q32605A
Optical Receiver.

R3271A Waveguide Mixers –
Tektronix WM780 Series (see page 215).

Plotter – Order Tektronix HC100 Opt. 01.

PROBES
FET Probe – DC to 900 MHz (Requires 1101A). Order P6201.

FET Probe – DC to 500 MHz. Order P6202A.

50 Ω Divider Probe – DC to 3.5 GHz, 6 ft. Order P6156.

Current Probe – 935 Hz to 120 MHz. Order P6022.

Preamplifier – 9 kHz to 1 GHz, ≥25 dB. Order R14601.

Memory Card – Set of five 32 KB Cards. Order A09505.

Memory Card – Set of five 128 KB Cards. Order A09506.

Aluminum Transit Case – Order R16059.

Rackmount Adapter – Order A02459.

ADDITIONAL ACCESSORIES
See page 434.

Cart – Order K420.

Plotter – Order HC100.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1.*

ADVANTEST
Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

Spectrum Analyzers

FSA • FSAS • FSB • FSBS • FSM • FSMS

Features

FSA/FSB/FSM

- Exceptional High Sensitivity
- Large Dynamic Range
- Flat RF Frequency Range
- Extremely Low Phase Noise
- High Frequency Accuracy
- Quasi-continuously Variable Resolution Bandwidth
- Single-knob Operation
- Mono-function Hardkeys
- Softkey-controlled Menus
- Parameter Entry on Keyboard or Variation Using Spinwheel
- Status Display

FSAS/FSBS/FSMS

- Built-in Tracking Generator
- Selective Scalar Network Analysis for Measuring Transmission and Reflection Parameters As Well As Voltage and Power

Applications

FSA/FSB/FSM

- Satellite Communications Design and Test
- Radar Systems
- EW Systems
- Mobile Radio and Terrestrial Microwave Systems

FSAS/FSBS/FSMS

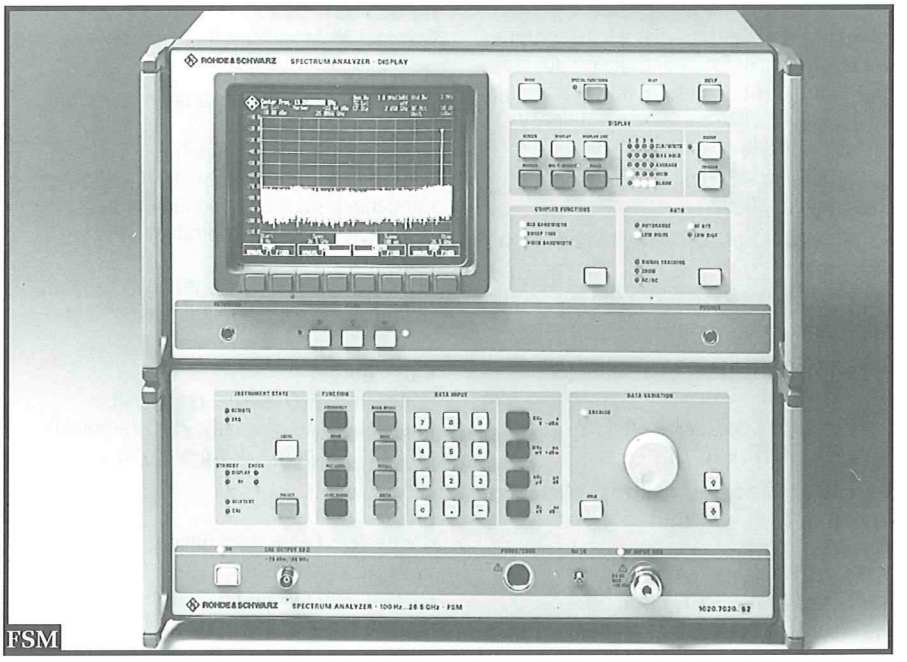
- Measurements on (Coaxial) Cables
- Measurements on Circuits with Low Input Levels
- Filter Measurements (Drift Measurements)
- Antenna Measurements

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



FSM

FSA/FSB/FSM Spectrum Analyzers

The FS Series spectrum analyzers consist of the 100 Hz to 1.8 GHz FSA, 100 Hz to 5 GHz FSB, and 100 Hz to 26.5 GHz FSM. These spectrum analyzers are used to measure the spectral distribution of signals. The quasi-continuously variable frequency resolution and the precise synthesizer tuning with long-term stability allow the FS Series to be used both as a spectrum analyzer in swept-frequency analysis and as selective level meters in fixed-frequency mode.

The large range of resolution bandwidths, the frequency span, and the level display with wide dynamic range make the FSA, FSB, and FSM ideal for all selective level measurements.

The FSA, FSB, and FSM provide the following:

- Numerous automatic test routines such as marker functions, level frequency and bandwidth correction, self-test, and adaptation to signal type
- Integrated AM/FM demodulator for identification of unknown signals via headphones
- Clear color display; one or several external color monitors or an oscilloscope can be connected
- Hardcopy output on printer, video printer, or plotter (labeling via external keyboard)
- Remote-control capability via IEC bus (IEC625-1, IEEE 488), programmable user port
- Broadband (output) power meter
- Selective voltmeter
- AM measuring and calibration instrument
- Adjacent-channel power meter
- SSB measuring instrument
- Linearity measuring instrument
- Selective, highly sensitive frequency counter
- Two-port measuring instrument (in conjunction with a signal generator)
- VSWR meter (in conjunction with a directional coupler and signal generator)
- Measuring instrument for thermal noise (in conjunction with a noise source)

Spectrum Analyzers
FSA • FSAS • FSB • FSBS • FSM • FSMS

FS-SERIES CAPABILITIES

The FSA provides the features required for state-of-the-art testing. Wide dynamic range, fast sweep rates, clear-cut operating concept, and flexible software make the FSA ideal for current and future measurement needs. It provides measurement accuracy and repeatability plus measuring convenience, such as eight markers, parameter corrections, and selectable operating modes. An external keyboard provides even greater convenience for screen documentation. Results are displayed on a 9-inch color screen.

The FSB adds to the basic features of the FSA to open up a wide variety of uses in communications measurements that place extremely high demands on the dynamic range, operating range, spectral purity, and sensitivity of the measuring instrument. The expanded frequency range up to 5 GHz covers many different applications such as satellite, navigation and radiocommunication service, radio-astronomy research, industry, and medicine.

The FSM is a top-class instrument for microwave measurements building upon the foundation of the FSA and FSB. Excellent RF and system characteristics make the FSM an all-around measuring instrument for every RF and microwave laboratory. Directional and mobile radio are typical fields of application for the FSM, as well as measurements in the sub-millimeter range with the aid of optional input mixers. Broadband measurements are supported by extremely fast sweep rates (typically 80 ms for 26.5 GHz sweep width), dynamic correction of the preselector tuning voltage being the necessary precondition. The microwave synthesizer features excellent spectral purity. This allows phase noise measurements to be conveniently performed, even in the microwave range.

COMMON FEATURES

The FSA, FSB, and FSM share the following common features except where noted:

Frequency Accuracy and Stability – The use of a modern synthesizer concept allows a frequency resolution of 0.1 Hz at extremely low phase noise. For frequency spans equal to or less than 5 MHz, the frequency variation is obtained by very small phase-synchronized frequency steps (0.003 Hz). For spans greater than 5 MHz, high frequency accuracy is achieved by synchronization with the start and stop frequencies.

Quasi-continuous Frequency Resolution – The five-stage electronic analyzer filter allows the resolution bandwidth to be varied in very small steps throughout the entire range from less than 10 Hz (typically 6 Hz) up to 3 MHz.

Wide Dynamic Range with Flat Frequency Response – An excellent thermal noise characteristic has been achieved by optimization of the signal/noise ratio of all stages in the RF and IF branches and the use of a balanced mixer with a wide dynamic range and a low-noise GaAs FET amplifier. The RF attenuation is adjustable in 1-dB steps (FMS: 5-dB steps) and enables optimum adaptation of the input level to the most favorable mixer level. The balanced configuration of this mixer largely suppresses even-order noise products.

The mixer loss which is almost independent of the frequency, together with electronic frequency-response correction, results in a constant-amplitude display over the complete frequency range.

Level Display Range – The level display range can be modified from a high-level resolution (LIN or 0.1 dB per division) up to a high-level range display (LOG 100 or 110 dB). The high resolution of the internal A/D converter also results in a high and useful resolution of the measured levels. Level display is possible in all common units. Transducers of all types connected at the input can be considered in the level display by way of a level offset.

FS-SERIES OPERATION

The FS Series spectrum analyzers are easy to operate, even for complex measurements. A single spinwheel, a clearly divided front panel, and softkeys at the bottom edge of the screen simplify operation, reduce the error liability and speed up measurements. Parameters are entered via the numeric keypad and varied with the step keys or spinwheel.

The status display provides an overview of the currently active settings using the help menus. The status list can be output as a hardcopy just as the display contents. All device functions can be remotely controlled via the IEC/IEEE-bus interface.

FS-SERIES DESIGN FEATURES

The FS Series operates on the principle of search-tone analysis. This means that the frequency range to be analyzed can be scanned by varying the internal oscillator frequency with the aid of an analysis filter with matched resolution bandwidth. The scan can be defined by any combination of start, center, and stop frequency, as well as span.

The resolution bandwidth, video bandwidth, and sweep-time parameters are linked by an algorithm as a function of the displayed frequency range. The results of analysis are displayed on the built-in color monitor – frequency on the X axis and the associated amplitudes on the Y axis.

The modular design of the FS Series provides the flexibility that is required for measurements today and in the future. For example, an internal tracking generator enables selective network analysis (see details of FSAS, FSBS, and FSMS).

FSM-SPECIFIC FEATURES

A six-section YIG filter with a resonant frequency tunable over a wide range using a homogeneous magnetic field forms the microwave core. The front end consists of a receive section for 100 Hz to 5 GHz with high IF and a receive section from 5 to 26.5 GHz. Switchover between the receiving bands is made electronically via an internal diplexer. Fundamental mixing in conjunction with comprehensive preselection covers all applications in the RF and microwave range.

In addition to its high level measurement accuracy and wide dynamic range, the FSM features an exceptional sensitivity throughout the entire frequency range from 100 Hz up to 26.5 GHz.

For high sensitivity and level measurements, the optional FS-Z15 Adapter System provides extremely short connections in the microwave circuitry to ensure low insertion loss and to avoid multiple reflections. This allows the user to install the preferred connector system as the FSM device interface. Low-loss test cables, specially tailored to the adapters, are also available. With optional mixers, the FSM can make measurements up to the millimeter band.

BUILT-IN TRACKING GENERATOR WITH FSAS/FSBS/FSMS

The FSAS, FSBS, and FSMS add tracking generator capability to the comparable FSA, FSB, and FSM. The tracking generator provides high level accuracy, wide dynamic range, and excellent frequency stability for reproducible measurements of passband and stopband characteristics.

Spectrum Analyzers
FSA • FSAS • FSB • FSBS • FSM • FSMS

CHARACTERISTICS

Specification	FSA/FSAS	FSB/FSBS	FSM/FSMS
Frequency-related			
Frequency Range			
Internal Mixer	100 Hz to 1.8 GHz	100 Hz to 5.2 GHz	100 Hz to 26.5 GHz
External Mixers			26.5 to 110 GHz
Readout Accuracy (Center or Markers)	3.5 kHz @ 1 GHz, 1 MHz SPAN, 1 kHz RBW	3.5 kHz @ 1 GHz 1 MHz SPAN, 1 kHz RBW	3.5 kHz @ 1 GHz, 1 MHz SPAN, 1 kHz RBW
Frequency Measurement Accuracy (Counter Mode)	±20 Hz @ 1 GHz CF	±20 Hz @ 1 GHz CF	±20 Hz @ 1 GHz CF
Delta (Δ) Frequency Measurement Accuracy (Counter Mode)	104 Hz @ 1 GHz, 1 MHz Δ frequency	104 Hz @ 1 GHz, 1 MHz Δ frequency	104 Hz @ 1 GHz, 1 MHz Δ frequency
Reference Frequency			
Stability	1 x 10^{-7}/yr aging	1 x 10^{-7}/yr aging	1 x 10^{-7}/yr aging
Settability	1 x 10^{-8}	1 x 10^{-8}	1 x 10^{-8}
Frequency Stability			
Residual FM	1 Hz p-p in 10 s	1 Hz p-p in 10 s	1 Hz p-p in 10 s +0.6 Hz/GHz above 2 GHz
Drift	5 x 10^{-10}/day 5 MHz span	5 x 10^{-10}/day 5 MHz span	5 x 10^{-10}/day 5 MHz span
Phase Noise	–109 dBc/Hz @ 10 kHz offset, 1 GHz CF	–104 dBc/Hz @ 10 kHz offset, 5 GHz CF	–98 dBc/Hz @ 10 kHz offset, 20 GHz CF
Frequency Span			
Range (Per Div)	0 Hz, 10 Hz to 200 MHz	0 Hz, 10 Hz to 200 MHz	0 Hz, 10 Hz to 26.5 GHz total span
Accuracy	<0.5%	<0.5%	<0.5%
Resolution BW (RBW)			
Selection	10 Hz to 3 MHz	10 Hz to 3 MHz	10 Hz to 3 MHz
Range	3 dB, 10 Hz to 3 MHz 1, 3, 10 sequence	3 dB, 10 Hz to 3 MHz 1, 3, 10 sequence	3 dB, 10 Hz to 3 MHz 1, 3, 10 sequence
Resolution Selectivity	12:1 (–60 dB/–6 dB)	12:1 (–60 dB/–6 dB)	12:1 (–60 dB/–6 dB)
Video Bandwidth Range	1 Hz to 3 MHz 1, 3, 10 sequence	1 Hz to 3 MHz 1, 3, 10 sequence	1 Hz to 3 MHz 1, 3, 10 sequence
Amplitude-related			
Reference Level Range	–140 to +30 dBm	–140 to +30 dBm	–140 to +30 dBm
Maximum Safe Input Power			
CW	0.1 W (+20 dBm) 0 RF atten.	0.1 W (+20 dBm) 0 RF atten.	0.1 W (+20 dBm) 0 RF atten.
PULSE	225 W, 150 V 10 dB RF atten.	225 W, 150 V 10 dB RF atten.	225 W, 150 V 10 dB RF atten.
CRT Display Range (LOG)	1, 2, 5, 10 dB/div	1, 2, 5, 10 dB/div	1, 2, 5, 10 dB/div
CRT Scale Fidelity (LOG)	±1 dB over 100 dB range	±1 dB over 100 dB range	±1 dB over 100 dB range
CRT Display Range (LINEAR)	–130 to +30 dBm	–130 to +30 dBm	–130 to +30 dBm
CRT Scale Fidelity (LINEAR)	5% of full scale, 10 Hz RBW	5% of full scale, 10 Hz RBW	5% of full scale, 10 Hz RBW
Input Attenuator Range	0 to 81 dB in 1 dB steps	0 to 81 dB in 1 dB steps	0 to 81 dB in 1 dB steps
Dynamic Range (maximum)			
Compression to Noise	145 dB	145 dB	145 dB
Signal to Distortion			
Harmonic	80 dB	80 dB	80 dB
Intermod	100 dB	100 dB	100 dB
Viewable on CRT Screen	100 dB	100 dB	100 dB
Residual Response (0 Signal/0 ATTN)	–110 dBm	–110 dBm	–110 dBm

Continued on next page.

Spectrum Analyzers
FSA • FSAS • FSB • FSBS • FSM • FSMS

Specification	FSA/FSAS	FSB/FSBS	FSM/FSMS
Amplitude-related (Continued)			
2nd Harmonic Distortion (mixer level –30 dBm)	100 Hz to 1.8 GHz ≤20 MHz: –65 dBc, ≥20 MHz: –80 dBc	100 Hz to 5 GHz f <40 MHz: –60 dBc, f ≥40 MHz: –70 dBc	100 Hz to 26.5 GHz f <40 MHz: –60 dBc, f 40 MHz to 5 GHz: –70 dBc, f >5 GHz: –95 dBc
3rd Order Intermod Distortion	–75 dBc, mixer level –30 dBm –100 dBm mixer level, –40 dBm	–75 dBc, mixer level –30 dBm –100 dBm mixer level, –40 dBm	–75 dBc, mixer level –30 dBm
3rd Order Intercept (TOI)	+7.5 dBm @ –30 dBm mixer input	+7.5 dBm @ –30 dBm mixer input, +10 dBm @ –40 dBm	+7.5 dBm @ –30 dBm mixer input
Calibrator Accuracy	±0.2 dB	±0.2 dB	±0.2 dB
Gain Compression Level	0 dBm	–10 dBm input	–5 dBm input (f >5 GHz)
Frequency Response (10 dB Attenuator Calibrator Reference)			
100 kHz to 1.8 GHz	<±1 dB	<±1 dB	<±1 dB
100 kHz to 5 GHz	N/A	<±1 dB	<±1 dB
5 GHz to 26.5 GHz	N/A	N/A	<±2.5 dB
Displayed Inherent Noise Level (10 Hz RBW, VBW 1 Hz, RF ATTN 0 dB)			
200 Hz to 1 kHz	<–100 dBm	<–85 dBm	–185 dBm
1 kHz to 10 kHz	<–110 dBm	<–105 dBm	–105 dBm
10 kHz to 100 kHz	<–115 dBm	<–110 dBm	–110 dBm
100 kHz to 1 MHz	<–120 dBm	<–115 dBm	–115 dBm
1 MHz to 40 MHz	<–130 L.C.M.	<–130 L.C.M.	–140 L.C.M.
40 MHz to 4.8 GHz	<–145 dBm	<–140 dBm	–135 dBm
4.8 GHz to 6 GHz	N/A	<–137 dBm (4.8 to 5 GHz)	<–135 dBm
6 GHz to 21 GHz	N/A	N/A	<–138 dBm
21 GHz to 26.5 GHz	N/A	N/A	<–135 dBm
IF Gain Switching Uncertainty	1 dB to –60 dBm, 1.3 dB to –120 dBm	1 dB to –60 dBm, 1.3 dB to –120 dBm	1 dB to –60 dBm, 1.3 dB to –120 dBm
RF Attenuator Switching Accuracy			
0 to 1.8 GHz	±0.2 dB/5 dB, 1.6 dB max	±0.2 dB/5 dB, 1.6 dB max	±0.2 dB/5 dB, 1.6 dB max
1.8 to 18.0 GHz	N/A	2 dB max to 5 GHz	2.5 dB max
18.0 to 26.5 GHz	N/A	N/A	2.5 dB max
RBW Switching Uncertainty	±0.3 dB ≥10 Hz RBW, ±1.0 dB <10 Hz RBW	±0.3 dB ≥10 Hz RBW, ±1.0 dB <10 Hz RBW	±0.3 dB ≥10 Hz RBW, ±1.0 dB <10 Hz RBW
Sweep Time Range			
Frequency Display	20 ms to 1980 s	20 ms to 1980 s	20 ms to 1980 s
Time Display	100 µs to 1980 s	100 µs to 1980 s	100 µs to 1980 s
Sweep Time Accuracy	$\pm 10^{-3}$	$\pm 10^{-3}$	$\pm 10^{-3}$
Marker Time Measurement Accuracy	1% 100 µs to 10 ms, 0.3% 20 ms to 1980 s	1% 100 µs to 10 ms, 0.3% 20 ms to 1980 s	1% 100 µs to 10 ms, 0.3% 20 ms to 1980 s
Delta Marker Time Measurement Accuracy	1% 100 µs to 10 ms, 3% 20 ms to 1980 s	1% 100 µs to 10 ms, 0.3% 20 ms to 1980 s	1% 100 µs to 10 ms, 0.3% 20 ms to 1980 s
Sweep Trigger Modes	Free Run, Line, Video, External	Free Run, Line, Video, External	Free Run, Line, Video, External

Continued on next page.

Spectrum Analyzers
FSA • FSAS • FSB • FSBS • FSM • FSMS

Input/Output Characteristics	FSA/FSAS	FSB/FSBS	FSM/FSMS
RF Input Impedance	50 Ω	50 Ω	50 Ω
VSWR (10 dB RF Attenuation)			
<2.5 GHz	<1.5:1	<1.5:1	<1.5:1
2.5 to 5 GHz	N/A	<1.8:1	<1.8:1
5 to 26.5 GHz	N/A	N/A	<2.0:1 (with 20 dB RF atten.)
External Mixer Input Frequency	N/A	N/A	221 MHz
External Reference Input Frequency	10 MHz	10 MHz	10 MHz
Horizontal/Trigger Input Level	5 V	5 V	5 V
Calibrator	100 MHz, ±0.2 dB	100 MHz, ±0.2 dB	100 MHz, ±0.2 dB
1st LO	5.1 to 13.4 GHz, –5 dBm	5.1 to 13.4 GHz, –5 dBm	5.1 to 13.4 GHz, –5 dBm
Video Output	0 to +5 V into 75 Ω	0 to +5 V into 75 Ω	0 to +5 V into 75 Ω
Sweep Output	0 to +5 V into 500 Ω	0 to +5 V into 500 Ω	0 to +5 V into 500 Ω
IF Output			
Narrow Bandwidth	21.4 MHz (BW = RBW)	21.4 MHz (BW = RBW)	21.4 MHz (BW = RBW)
Wide Bandwidth	21.4 MHz (BW ≥10 MHz)	221.4 MHz (BW ≥36 MHz)	221.4 MHz (BW ≥36 MHz)
Probe Power	10 V @ 100 mA	10 V @ 100 mA	10 V @ 100 mA
IEEE Std. 488 Interface Functions	AHI, SHI, T6, L4, SRI, RLI, PPI, DCI	AHI, SHI, T6, L4, SRI, RLI, PPI, DCI DTI, CIC2, C3, C27	AHI, SHI, T6, L4, SRI, RLI, PPI, DCI DTI, CIC2, C3,C27

Specification	FSAS	FSBS	FSMS
Tracking Generator-related			
Frequency	100 Hz to 2 GHz	100 Hz to 5 GHz	100 Hz to 26.5 GHz
Output			
Range (adjustable)	–100 to –5 dBm	–81 to 0 dBm	–75 to 0 dBm
Level (mechanical)	1-dB steps	1-dB steps	5-dB steps
Level (electronic)	0.1-dB steps	0.1-dB steps	N/A
Suppression of Spurious (frequency offset 0 Hz)			
Harmonics			
1 kHz to 2 GHz	>25 dB	>25 dB	>25 dB
2 GHz to 5 GHz	N/A	>20 dB	>20 dB
4.8 GHz < f >13.25 GHz	N/A	N/A	>7 dB
Other (carrier offset >20 kHz)	>30 dB	>30 dB	>30 dB
Residual FM, RMS			
Measurement BW 30 Hz to 3 kHz	<300 Hz	<300 Hz	<300 Hz
Measurement BW 30 Hz to 20 kHz	<1 kHz	<1 kHz	<1 kHz
Level control (selected with softkey)	Internal/External	Internal/External	Internal/External
Modulation (AM <30%)			
Frequency (external AF source, softkey selection)	10 Hz to 20 kHz	10 Hz to 20 kHz	10 Hz to 20 kHz

Continued on next page.

Spectrum Analyzers
FSA • FSAS • FSB • FSBS • FSM • FSMS

Specification	FSA/FSAS	FSB/FSBS	FSM/FSMS
Other Features			
RS-232C Interface	YES	YES	YES
Direct Plot Output	YES	YES	YES
Digital Storage	1000 points Horizontal, 512 points Vertical	1000 points Horizontal, 512 points Vertical	1000 points Horizontal, 512 points Vertical
Digitizing Rate	8.9 µs	8.9 µs	8.9 µs
Non-volatile Memory Capability	YES	YES	YES
Help Mode (ROM)	YES	YES	YES
Intelligent Markers	YES, 6	YES, 6	YES, 6
Tracking Generator	YES, FSAS 100 Hz to 1.8 GHz	YES, FSBS 100 Hz to 5.2 GHz	YES, FSMS26 100 Hz to 26.5 GHz
Waveguide Mixers	N/A	N/A	26.5 to 110 GHz
Download Programs	YES (with FS-Z4)	YES (with FS-Z4)	YES (with FS-Z4)
Occupied BW Measurement	YES	YES	YES
Direct Plot	YES	YES	YES
Color Display	YES	YES	YES
Preamplifier	YES (FSAC) 20 MHz to 1.8 GHz	YES (FSBC) 40 MHz to 5 GHz	N/A
Quasi Peak Detector	Incorporated in ESAI EMI Test Receiver	Incorporated in ESBI EMI Test Receiver	Incorporated in ESMI EMI Test Receiver
CISPR Bandwidths	Incorporated in ESAI EMI Test Receiver	Incorporated in ESBI EMI Test Receiver	Incorporated in ESMI EMI Test Receiver
TV Video Out	YES	YES	YES
AM/FM Demod Speaker	YES	YES	YES
Environmental Characteristics			
Operating Temperature	0 to 55°C	0 to 55°C	0 to 55°C
Humidity	80% RH	80% RH	80% RH
Calibration Interval	1 year	1 year	1 year
Power Requirements			
Line Voltage	100 to 240 V	100 to 240 V	100 to 240 V
Line Frequency	47 to 440 Hz	47 to 440 Hz	47 to 440 Hz
Power Consumption	500 VA	500 VA	500 VA
Physical			
Dimensions (without handle, feet, cover)	**mm** / **in.**	**mm** / **in.**	**mm** / **in.**
Height	435 / 17.1	435 / 17.1	435 / 17.1
Width	413 / 16.3	413 / 16.3	413 / 16.3
Depth	590 / 23.2	590 / 23.2	590 / 23.2
Weight	**kg** / **lbs.**	**kg** / **lbs.**	**kg** / **lbs.**
(Carrying)	60 / 145	60 / 145	60 / 145

Spectrum Analyzers
FSA • FSAS • FSB • FSBS • FSM • FSMS

DEMODULATION RELATED

General – Receiver mode: Demodulation of received RF signal. Display of demodulated signal: Vertically on 10-line graticule as function of horizontal time base. Marker function for measuring: Modulation depth, frequency deviation, center frequency offset.

FM Demodulator –
Center frequency offset after AF calibration FM deviation: 2 kHz / 20 kHz / 200 kHz, <2% of deviation; 200 Hz, <40 Hz. Drift: <10 Hz/min. FM deviation display error (deviation 2 kHz, 20 kHz, 200 kHz). 100 Hz to 5 kHz modulation frequency: <3% of measured value. DC to 15 kHz modulation frequency: <5% of measured value. FM linearity error (deviation <20 kHz, modulation frequency <5 kHz): <1%. Residual FM (p-p/2) averaged over 5 sweeps: <20 Hz. Incidental FM at 50% AM (modulation frequency 1 kHz, VBW 3 kHz): <500 Hz, typically <100 Hz.

AM Demodulator – Center offset of unmodulated signal: Measurement range: 100%: <2% of f_s, Measurement range: 10%: <5% or f_s.
Error of displayed modulation depth (AM <80%, plus residual AM, f_{mod} 0.4 to 10 kHz): Measurement range: 100%: <6% of measured value, Measurement range: 10%: <8% of measured value. Residual AM p-p/2: <1%. Weighted to CCITT: Typically <0.1%. Incidental AM (RBW = 3 MHz, FM deviation = 50 kHz, f_{mod} = 1 kHz): <3%.

DISPLAY RELATED

Monitor – 9-inch color CRT with 0.29 mm shadow mask pitch.

Brightness – Adjustable in 64 steps.

Colors – Selectable (16 from 4096).

Number of Display Memories – 4.

Resolution (electrical) – 1024 x 512 points.

Scaling – Electronically superimposed, calibrated graticule.

Additional Information – Alphanumeric display of essential parameters as well as hints in English.

Output to Plotter –
Interface: HPGL.
Functions: Curve arithmetic (swap, subtract), comparison with tolerance curves, averaging, peak hold.

Markers – Reference marker, delta marker, six multimarkers.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

FSA
Spectrum Analyzer.
Includes: Power Cable, Connecting Cables (Upper-lower Unit), 3.5 mm Female Adapter, N-female Adapter, Manual.

FSB
Spectrum Analyzer.
Includes: Power Cable, Connecting Cables (Upper-lower Unit), 3.5 mm Female Adapter, N-female Adapter, Manual.

FSM
Spectrum Analyzer.
Includes: Power Cable, Connecting Cables (Upper-lower Unit), 3.5 mm Female Adapter, N-female Adapter, Manual.

FSAS
Spectrum Analyzer with Tracking Generator.
Includes: Power Cable, Connecting Cables (Upper-lower Unit), 3.5 mm Female Adapter, N-female Adapter, Manual.

FSBS
Spectrum Analyzer with Tracking Generator.
Includes: Power Cable, Connecting Cables (Upper-lower Unit), 3.5 mm Female Adapter, N-female Adapter, Manual.

FSMS26
Spectrum Analyzer with Tracking Generator.
Includes: Power Cable, Connecting Cables (Upper-lower Unit), 3.5 mm Female Adapter, N-female Adapter, Manual.

Opt. 01 – FSA-B1 (FSA) – Tracking Generator.

Opt. 01 – FSB-B1 (FSB) – Tracking Generator.

Opt. 01 – FSM-B1 (FSM) – Tracking Generator.

Opt. 02 – FSA-B3 – RF Filter/RF Preamplifier for FSA, FSB (requires Opt. 01).

Opt. 03 – FSA-B5 – Special IF Channel Filter, Shape Factor 3:1.

Opt. 05 – FSA-B9 – Wideband IF Output.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

COMMUNICATION ANALYZERS

FSAB 100 Hz to 5.2 GHz Communication Analyzer – Adds Preamplifier, Tracking Generator, and RF filters to standard FSA Spectrum Analyzer capabilities. Standard FSA options apply. Order FSAC.

FSAC 100 Hz to 1.8 GHz Communication Analyzer – Adds Preamplifier, Tracking Generator, and RF filters to standard FSB Spectrum Analyzer capabilities. Standard FSB options apply. Order FSBC.

RECOMMENDED ACCESSORIES

Computer Function Kit – Keyboard PCA-Z1, Floppy Disk Station Pz-11, two 3.5 in. Floppy Disk Drives PCA-B36, Software FS-K1. Order FS-Z4.

Software – Computer Function, MS-DOS and BASIC. Order FS-K1. Noise Measurement. Order FS-K3.

Service Kit – Extender Boards and Coaxial Cables. Order FS-Z1.

Cables –
Extension Cable for Servicing. Order FS-Z2.
Microwave Cable and Adapter. Order FS-Z15.

Mixer Sets –
26.5 to 110 GHz (Includes LO Amplifier FS-Z17). Order FS-Z16.

16.5 to 40 GHz. Order FS-Z18.

LO Amplifier – Order FS-Z17.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Spectrum Analyzers
New R3272

Features

R3272

- Compact and Lightweight – 15 kg (33 lb.)
- 9 kHz to 26.5 GHz Frequency Measurement Range
- 300 Hz to 5 MHz Resolution Bandwidth
- –110 dBm Sensitivity at 7 GHz (1 kHz RBW)
- ±1% Span Accuracy
- Delayed and Gated Sweep
- Large TFT Color Liquid Crystal Display with Multi-screen Functionality
- 10 Markers
- Independent Function Keys for Ease of Operation
- Highly Reliable, Narrowband Sweep Capability Based on Direct Digital Synthesizer Technology
- GPIB and Centronics Interfaces
- Two IC Memory Card Slots

Applications

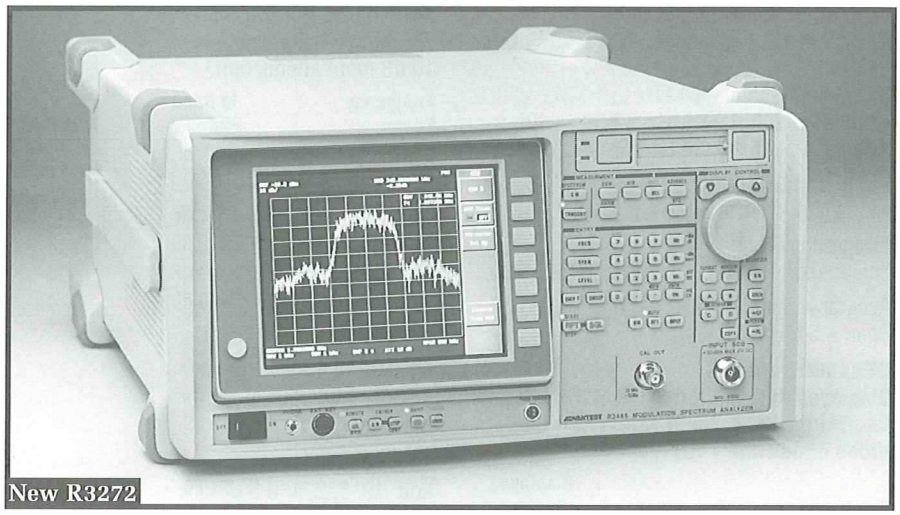
- Manufacturing, Installation, and Maintenance of Microwave Point-to-Point Links
- PCS 38 GHz Link Measurement with External Mixers
- Satellite Link Manufacture, Installation, and Maintenance

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2.*

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.


New R3272

R3272 9 kHz to 26.5 GHz Portable Spectrum Analyzer

Today's advanced information society is driven and supported by radio communications technology in which microwave and submillimeter wave communications are playing an increasingly important role.

The R3272 spectrum analyzer allows engineers to easily and quickly perform spectrum analysis of microwave and submillimeter wave bands. This high performance, portable spectrum analyzer covers a frequency range between 9 kHz and 26.5 GHz (up to 325 GHz using an external mixer) with an input range between +30 dBm and –120 dBm, an amplitude display dynamic range of 100 dB, and a resolution bandwidth of 300 Hz. In addition to these standard capabilities, the R3272 offers a 1 Hz resolution frequency counter.

The R3272 is optimized for radio and spurious measurements for microwave and satellite communication.

PORTABILITY ASSURES MOBILITY
The R3272 is designed to assure maximum mobility. A robust design, conforming to MIL standards that demand high tolerance to vibration and accidental drops, is impeccably housed within a compact package. This allows the engineer to quickly move to any remote location for on-the-spot testing.

USER-FRIENDLY PANEL DESIGN
The R3272 uses a TFT color LCD to provide a clear and accurate display of an array of data and information. The panel includes independent function keys, such as Occupied Bandwidth, Adjacent Channel Power, and Harmonic Measurements, which are essential for special transmitter tests. It also includes frequently used parameter setting keys such as BW, ATT, and SWEEP TIME.

Characteristics

MEASUREMENT FUNCTION
CW Mode – Spectrum measurement, power measurement, counter, spurious, OBW/ACP/HARM measurement.

FREQUENCY
Frequency Range –
Standard: 9 kHz to 26.5 GHz.
With external mixer: 18 GHz to 325 MHz.

Frequency Reference Accuracy –
$\pm 2 \times 10^{-8}$ /day, $\pm 1 \times 10^{-7}$ /year.

Frequency Stability –
Residual FM (zero span): $<(3\ \text{Hz} \times N_{p\text{-}p} / 0.1\ \text{s})$.
Drift (after 1 hour warmup): <(20 Hz x sweep time (minutes) x N).

Spectral Purity Noise Side Bands –

Offset	f ≤ 3 GHz	f > 3 GHz
10 kHz	<–100 dBc/Hz	<(98 + 20 log N) dBc/Hz
100 kHz	<–110 dBc/Hz	<(–108 + 20 log N) dBc/Hz

Spectrum Analyzers
New R3272

Resolution Bandwidth (3 dB) –
Range (1, 3, 10 sequence): 300 Hz to 3 MHz, 5 MHz.
Accuracy: Resolution 1 kHz to 1 MHz: ±20%.
Resolution 300 Hz, 3 MHz, 5 MHz: ±30%.
Selectivity: <15:1 (300 Hz to 5 MHz).

Video Bandwidth Range – Range (1, 3, 10 sequence): 1 Hz to 3 MHz, 5 MHz.

Frequency Span –
Linear span (zero span): 2 kHz to 26.5 GHz.

Accuracy: Span > 5 MHz: ±4%.
Span ≤ 5 MHz: ±1%.

DYNAMIC RANGE
Displayed Average Noise Level (Resolution Bandwidth 1 kHz, Input Attenuator 0 dB, Video Bandwidth 1 Hz) –

Frequency Range	Frequency Band (N)	Displayed Average Noise Level
10 kHz	1	–70 dBm
100 kHz	1	–80 dBm
1 MHz to 3.1 GHz	1	–(115 – 1.55 x f(GHz)) dBm
3.0 to 7.5 GHz	1	–110 dBm
7.4 to 15.4 GHz	2	–103 dBm
15.2 to 23.3 GHz	3	–96 dBm
23.0 to 26.5 GHz	4	–90 dBm

Spurious Response –
Second harmonic distortion:

Frequency Range	Second Harmonic Distortion	Mixer Level
10 MHz to 3 GHz	<–70 dBc	–30 dBm
>3 GHz	<–100 dBc	–10 dBm

Third harmonic distortion (12.5 kHz Separation, Resolution Bandwidth 300 Hz):

Frequency Range	Third Harmonic Distortion	Mixer Level
10 MHz to 3 GHz	<–75 dBc	–30 dBm
>3 GHz	<–75 dBc	–30 dBm

AMPLITUDE ACCURACY
Frequency Response –
10 dB input attenuation:

Frequency Range	In Band Flatness	Frequency Band (N)
9 kHz to 3.1 GHz	±1.5 dB	1
50 MHz to 3.1 GHz	±1.0 dB	1
3 to 7.5 GHz	±1.5 dB	1
7.4 to 15.4 GHz	±3.5 dB	2
15.4 to 23.3 GHz	±4.0 dB	3
23 to 26.5 GHz	±4.0 dB	4

Amplitude Range –
+30 dBm to noise level.

DISPLAY RANGE

10 x 10 Divisions –
Log: 10, 5, 2, 1, 0.5 dB/div.
Linear: 10% of reference level/div.

SWEEP
Sweep Time – 50 ms to 1000 s.

Accuracy – ±5%.

Sweep Trigger – Free, run, line, single, video, external.

ANALOG DEMODULATION
Spectrum Demodulation –
Modulation type: AM, FM.
Audio output: Speaker and phone jack with volume control.
Marker pause time: 100 ms to 1000 s.

CALIBRATOR
Accuracy – –10 dBm ±0.3 dB.

IF GAIN UNCERTAINTY
(after automatic calibration at 15° to 35°C) –

0 to –50 dBm: 0.5 dB.
0 to –70 dBm: 0.7 dB.

SCALE FIDELITY
(after automatic calibration at 15° to 35°C)

Log –

1 dB: ±0.2 dB
10 dB: ±1 dB
90 dB: ±1.5 dB.

Linear – ±15% of reference level.

INPUTS AND OUTPUTS
Front Panel –
1st LO output: Connector type: SMA female; Impedance: 50 Ω, nominal; Frequency range: 3.421 to 7.921 GHz; Amplitude: >+5 dBm.
Memory card: Two IC memory card slots.

Rear Panel –
GPIB: IEEE 488 bus connector.
Centronics: D-Sub 25-pin.

ENVIRONMENTAL CHARACTERISTICS
Operating Temperature – 0 to 50°C.

Non-operating Temperature – –20 to 60°C.

Humidity – ≤85% relative humidity.

POWER REQUIREMENTS
AC Line – 90 V to 132 V or 198 V to 250 V, auto-switching.

Line Frequency – 48 to 66 Hz.

Power Consumption – ≤300 V A.

PHYSICAL CHARACTERISTICS

Dimensions (without handle, feet, and front cover)

	mm	in.
Width	350	13.8
Height	178	7.0
Depth	420	16.5
Weight	**kg**	**lb.**
Net	15	33

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

R3272
9 kHz to 26.5 GHz Portable Spectrum Analyzer.
Includes: Power Cable, Input Cable, Connector Adapter, 6.3 A Power Fuse.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES
Memory Card – Set of five 64 KB cards. Order A09507.

Waveguide Mixers – Tektronix WM780 Series (see page 215).

PROBES
FET Probe – DC to 900 MHz (Requires 1101A). Order P6201.

FET Probe – DC to 500 MHz. Order P6202A.

50 Ω Divider Probe – DC to 3.5 GHz, 6 ft. Order P6156.

Current Probe – 935 Hz to 120 MHz. Order P6022.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

Spectrum Analyzers

New FSEA20 • New FSEA30 • New FSEB20 • New FSEB30

Features

FSEA20/A30

- 20 Hz to 3.5 GHz (9 kHz to 3.5 GHz, FSEA20)
- 10 Hz to 10 MHz Resolution Bandwidth (1 Hz, FSEA30), Adjustable in 1-2-3-5-10 Steps
- –145 dBm Displayed Noise Floor (10 Hz Resolution)
- –120 dBc/Hz Phase Noise at 10 kHz from Carrier
- <1 dB Total Measurement Error up to 1 GHz
- 5 ms Full-span Sweep Time with Fully Synchronized Sweep
- 1 µs Zero-span Sweep Time
- Pretrigger and Trigger Delay
- Gated Sweep
- Eight Marker Functions for Direct Measurement (Four Absolute, Four Delta Marker)
- Measurement of Adjacent Channel Power and Occupied Bandwidth
- Color TFT LCD Display (Standard FSEA30; Option 01 FSEA20)

FSEB20/B30 Above features plus:

- 20 Hz to 7 GHz (9 kHz to 7 GHz, FSEB20)
- –142 dBm Displayed Noise Floor (10 Hz Resolution)
- –117 dBc/Hz Phase Noise at 10 kHz from Carrier

Applications

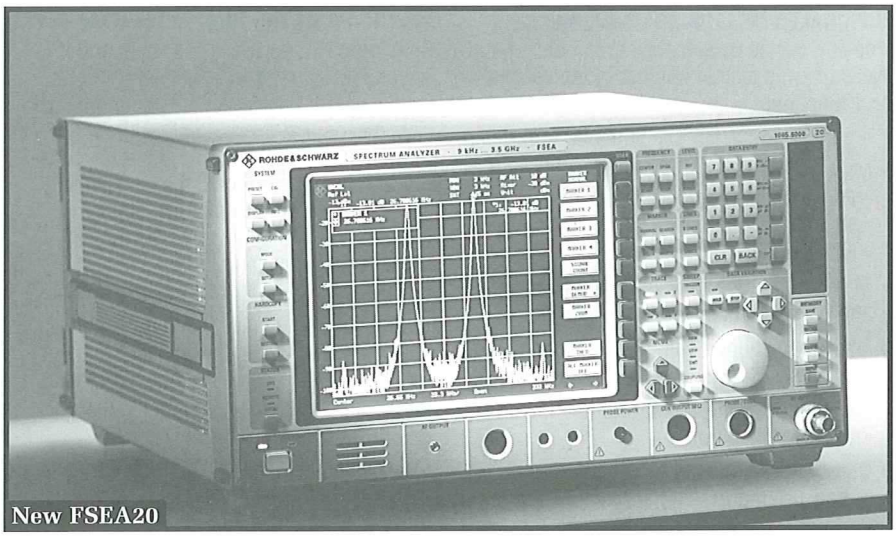
- Digital Mobile Radio – Spectrum, Burst, and Modulation Measurements
- Digital and Analog Mobile Radio Adjacent Channel and Occupied Bandwidth Measurements
- Spread Spectrum Channel Power Measurements
- High Dynamic Range Intermodulation Measurements

GPIB IEEE-488

Product(s) complies with IEEE Standard 488.2-1987 with SCPI 1994.0.

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



New FSEA20

FSEA20/A30, FSEB20/B30 Spectrum Analyzers

The FSE-Series spectrum analyzers have been optimized for general-purpose measurements and to meet the stringent requirements of testing advanced digital communication systems. Extremely high measurement speed, future-proof modular design, and excellent performance characteristics put these analyzers right at the top of today's market – at a medium-range price.

VECTOR ANALYSIS FOR DIGITAL MODULATION

When equipped with Option 07, the FSE-Series analyzers combine the capabilities of a true RF spectrum analysis with those of universal digital-signal demodulation and analysis. The spectrum analyzer function offers the wide dynamic range necessary for many measurements on digitally modulated signals (e.g., burst measurements). The vector signal analyzer option adds demodulation capability for:

- BPSK
- QPSK/DQPSK/π/4DQPSK/Offset QPSK
- 8PSK
- FSK (2 and 4 level)
- MSK
- GMSK
- 16QAM

Standard set-ups are included for GSM, DCS1800, DCS1900, NADC, PHS, PDC, DECLT, TETRA, and ERMES.

These functions are backed up by a variety of display types:

- Eye diagrams
- Vector and constellation diagrams
- Frequency and phase error
- Vector error
- Demodulated data bits

MODULARITY SAFEGUARDS INVESTMENTS

FSE-Series analyzers use a modular design throughout. A wide variety of options is available to allow you to choose the exact features you need for your particular application (see the list of options in the Ordering Information for additional information).

As a result, you can tailor an instrument to your specific requirements and pay only for the performance and features you need. At the same time, you're guaranteed the capability to meet future measurement needs, because most options can be retrofitted at a later time.

TOP DYNAMIC RANGE

FSE-Series analyzers are outstanding for their extremely low noise floor without any impairment to the dynamic range at large signal levels. This can be seen, for example, from the 1 dB compression point of +10 dBm, which yields a dynamic range of 105 dB, even at a resolution bandwidth of 1 MHz, allowing GSM and DECT power ramps to be determined.

The extremely wide intermodulation-free dynamic range of typically 116 dB (FSEA30, FSEB30) and 105 dB (FSEB20, FSEB30) not only ensures reliable measurements on highly linear amplifiers, it also enables detailed analysis of complex broadband signals.

Spectrum Analyzers

New FSEA20 • New FSEA30 • New FSEB20 • New FSEB30

UNEQUALED MEASURING CONVENIENCE

The FSE Series makes measurements easy, offering a large number of convenient test functions:

- Eight markers (four absolute and four delta)
- Marker functions for direct measurement of
  - Phase noise and noise power density (/Hz)
  - NEXT MIN/PEAK, NEXT MIN/PEAK RIGHT, NEXT MIN/PEAK LEFT
- Measurement of adjacent channel power and occupied bandwidth
- Frequency counter with selectable resolution
- LOW NOISE, NORMAL, and LOW DISTORTION modes for low-intermodulation and low-noise operation
- One-button hardcopy on printer or plotter in background mode
- Simultaneous display of four active traces
- Selectable color setup – standard, Model 30; with Option 01, Model 20
- Numerous level and frequency lines
- Split screen with independent windows
- Quasi-analog display

TO-THE-POINT FREQUENCY ACCURACY

Tuning an FSE-series spectrum analyzer is absolutely synchronous to the reference frequency for each span including full span. This means that every point on the frequency axis is determined with the accuracy of the internal reference frequency. Thus, when reducing the span for detailed signal analysis, the tiresome readjustment of the center frequency is no longer needed.

In its basic configuration, the FSE includes an AM/FM demodulator. Unknown signals can easily be identified via headphones or the built-in loudspeaker. Modulation measurements are possible using the optional Vector Signal Analyzer (Option 07).

Limit lines make it easy to check if results are within predefined tolerances. Virtually any number of limit lines can be defined with high accuracy, by means of 50 points, to meet even the most exacting requirements.

EASY OPERATION

FSE Series analyzers feature a combination of hardkeys (fixed functions) and softkeys (menu functions). Upon pressing a hardkey, the associated menu is displayed and an input field is opened. This means very fast, hardkey-oriented handling of the main functions, such as frequency (center, start, and stop), span, sweep time, reference level, etc., without the need to operate any softkey.

The full operating convenience based on a wide variety of evaluation routines and marker functions can be accessed via the menus. Complicated tree structures are a thing of the past with the FSE. Instead, the menus are lateral in structure and use fixed control keys (left, right, up).

The FSEA30 and FSEB30 are equipped with a large 9.5-inch TFT color display with VGA resolution at 640 x 480 pixels (color display available for FSEA20, FSEB20 with Option 01). All essential parameters and results can be seen at a glance. All test data, scale factors, and setting parameters are logically arranged and thus are easy to find. Setups, traces, and graticules are displayed in color to make for error-free analysis of complex results.

The USER key allows operation to be tailored to your specific requirements. With this key, you can compile the functions needed mainly for your measurement tasks, doing away with frequent menu changes and speeding up measurements on the whole by generation of macro sequences.

Spectrum Analyzers

New FSEA20 • New FSEA30 • New FSEB20 • New FSEB30

DOCUMENT TEST RESULTS
The FSE Series provides uncomplicated logging of results. A wide variety of printers and plotters are supported. The printer/plotter interface allows printers to be addressed via the Centronics interface or via the IEC/IEEE bus. Files can also be output to a diskette or stored on the internal hard disk in PCX, WMF, or HPGL format. This allows you to easily export waveform information to standard word processing or graphics packages.

OPERATION WITHOUT A COMPUTER
With the optional Computer Function (Option 15), the FSE Series can operate without an external PC. Option 15 provides an additional VGA card, 16 MB memory extension, mouse, and keyboard. This option opens up the world of Windows applications such as statistics programs, spreadsheet analysis, and programming languages.

Operating software is stored on the internal hard disk. Updates can be made and functions reloaded conveniently via diskette. Complete setups, traces, limit lines, and macros can be stored on the internal hard disk or on the removable diskette.

IDEAL FOR AUTOMATIC TEST SYSTEMS
The FSE Series is ideal for use in automatic test systems, providing both fast processing of results and an IEC/IEEE-bus command set conforming to SCPI. With the optional Computer Function (Option 15) and a second IEC/IEEE-bus card (Option 17), the FSE can be used as the controller for the test system, thus eliminating the need for an additional unit. This saves space in the system cabinet and saves system cost.

LOW OVERALL COST OF OWNERSHIP
In designing the FSE Series, special emphasis was placed on keeping cost of ownership to a minimum:

- Designed for maximum reliability
- Temperature-controlled fans
- Calibration interval up to two years
- Built-in calibration routines
- Elaborate self-test routines
- Modular design

BUILT-IN DIAGNOSTIC SYSTEM FOR SELF-TEST
The built-in self-test routines rapidly locate any faults down to the module level. In conjunction with the quick availability of replacement parts, this minimizes down time due to repair.

The self-test not only provides information on the defective module, it also enables service personnel to quickly check internal test points and make adjustments (e.g., the reference frequency) without opening the unit.

BUILT-IN CALIBRATION ROUTINES
Built-in calibration routines ensure that the FSE remains within defined tolerances and thus maintains its accuracy of measurement. The routines are not performed automatically by the instrument but can be started when desired by the user. This prevents ongoing measurements from being inadvertently interrupted or slowed.

The results of the calibration routines are output by the FSE in the form of comprehensive correction tables. Comparing these tables over an extended period of time, the user can detect changes early and take corrective action. This enhances reliability and measurement accuracy.

MODULAR DESIGN ALLOWS EASY UPGRADING
The modular design of the FSE allows easy installation of most of the options. This allows you to upgrade your instrument to meet current measurement requirements with a minimum of lost time or installation cost.

Spectrum Analyzers

New FSEA20 • New FSEA30 • New FSEB20 • New FSEB30

Characteristics

The following characteristics apply after five minutes warmup at ambient temperature.

Frequency-related	**FSEA20**	**FSEA30**	**FSEB20**	**FSEB30**
Frequency range	9 kHz to 3.5 GHz	20 Hz to 3.5 GHz	9 kHz to 7 GHz	20 Hz to 7 GHz
Frequency resolution	0.01 Hz			
Frequency axis	Linear or logarithmic			
Reference Frequency				
Internal (nominal)				
Aging, after 30 days operation	1 x 10^{-6}/year	1 x 10^{-9}/day, 2 x 10^{-7}/year	1 x 10^{-6}/year	1 x 10^{-9}/day, 2 x 10^{-7}/year
Temperature drift (0 to 50°C)	1 x 10^{-6}	5 x 10^{-8}	1 x 10^{-6}	5 x 10^{-8}
Total error	2.5 x 10^{-6}/year	2.5 x 10^{-7}/year	2.5 x 10^{-6}/year	2.5 x 10^{-7}/year
With Option 04				
Aging, after 30 days operation	1 x 10^{-9}/day, 2 x 10^{-7}/year	–	1 x 10^{-9}/day, 2 x 10^{-7}/year	–
Temperature drift (0 to 50°C)	5 x 10^{-8}	–	5 x 10^{-8}	–
Total error	2.5 x 10^{-7}/year	–	2.5 x 10^{-7}/year	–
External	10 MHz or n x 1 MHz (where n = 1 to 16)			
Frequency Display (with marker)				
Resolution	0.1 Hz to 10 kHz (dependent on span)			
Error	±(marker frequency x reference error + 0.25% span + 10% x resolution bandwidth + 10 Hz + 1/2 last digit)			
Frequency Counter (measures marker frequency)				
Resolution	0.1 Hz to 10 kHz (selectable)			
Count accuracy (S/N >25 dB)	±(frequency x reference error + 10 Hz + 1/2 last digit)			
Display Range for Frequency Axis (0 Hz, 10 Hz to full span)				
Resolution	0.1 Hz			
Error of display range	1%			
Spectral Purity (SSB phase noise, RF frequency ≤500 MHz, carrier offset)				
Standard				
100 Hz	–	–85 dBc/Hz*1	–	–79 dBc/Hz*1
1 kHz	–88 dBc/Hz*2	–110 dBc/Hz*1	–84 dBc/Hz*1	–104 dBc/Hz*1
10 kHz	–102 dBc/Hz*2	<–120 dBc/Hz*2, <–125 dBc/Hz*2 (typical)	–95 dBc/Hz*2 –	<–117 dBc/Hz*2, <–119 dBc/Hz*2 (typical)
100 kHz	–120 dBc/Hz*2	–120 dBc/Hz*2	–114 dBc/Hz*2	–114 dBc/Hz*2
1 MHz	–135 dBc/Hz*2	–140 dBc/Hz*2	–129 dBc/Hz*2	–134 dBc/Hz*2
With Option 04				
100 Hz	–85 dBc/Hz*1	–	–79 dBc/Hz*1	–
1 kHz	–110 dBc/Hz*1	–	–104 dBc/Hz*1	–
10 kHz	<–120 dBc/Hz*2, <–125 dBc / Hz*2 (typical)	– –	<–117 dBc/Hz*2, <–119 dBc/Hz*2 (typical)	– –
1 MHz	–135 dBc/Hz*2	–	–129 dBc/Hz*2	–
Resolution Bandwidths				
3 dB bandwidths	10 Hz to 10 MHz in 1/2/3/5 steps	1 Hz to 10 MHz in 1/2/3/5 steps	10 Hz to 10 MHz in 1/2/3/5 steps	1 Hz to 10 MHz in 1/2/3/5 steps
Bandwidth error	≤3 MHz: <10%; 5 MHz: <15%; 10 MHz: +25%, –10%			
Shape factor 60/3 dB				
<1 kHz	<6	<6	<6	<6
1 kHz to 2 MHz	<15	<12	<15	<12
>2 MHz	<7	<7	<7	<7
Video bandwidths:	1 Hz to 10 MHz in 1/2/3/5 steps			

**1 For RF frequencies >500 MHz: Add 20 x log (f/GHz + 0.5).*

**2 For RF frequencies >500 MHz: Add 1.5 x (f/GHz – 0.5).*

FREQUENCY-RELATED (CONT.)

Sweep Time –
Display range 0 Hz: 1 µs to 1,000 s in 5% steps.
Display range ≥10 Hz: 5 ms to 1,000 s in 5% steps.
Error: 1%.
Picture refresh rate: >20 updates/s with 1 trace, >15 update/s with 2 traces.
Sampling rate: 50 ns (20 MHz A/D converter).
Number of pixels: 500.
Time measurement: With marker and cursor lines.
Resolution: 50 ns.
Sweep trigger: Free run, single, line, video, gated, delayed, external.
Zero span: Additionally pre-trigger, post-trigger, trigger delay.

LEVEL-RELATED

Display Range – Noise floor displayed to 30 dBm.

Maximum Input Level –
RF attenuation 0 dB: DC voltage: 0 V; CW RF power: 20 dBm (= 0.1 W); Pulse spectral density: 97 dBµV / MHz.
RF attenuation ≥10 dB: DC voltage: 0 V; CW RF power: 30 dBm (=1 W); Maximum pulse voltage: 150 V; Maximum pulse energy (10 µs): 1 mWs.

Level Display –
Screen: 10 x 10 subdivisions.
Trace: 500 x 400 pixels (with one diagram displayed).
Log level axis: 10 to 200 dB, in steps of 10 dB.
Linear level axis: 10% of reference level per level division, 10 divisions.

Setting Range of Reference Level –
Log level display: –130 to 30 dBm, in steps of 0.1 dB.
Linear level display: 7.0 nV to 7.07 V in steps of 1%.
Units of level axis: Log level display: dBm, dBµV, dBµA, dBpW; Linear level display: mV, µV, mA, µA, pW, nW.

Level Measurement Error –
Absolute error at 120 MHz: <0.3 dB.
Frequency response (10 dB RF attenuation): <0.5 dB (f <1 GHz), <1 dB (f >1 GHz).
Attenuator error: <0.3 dB.
IF gain error: <0.2 dB, 0.1 dB typical.

Spectrum Analyzers

New FSEA20 • New FSEA30 • New FSEB20 • New FSEB30

Level-related	FSEA20	FSEA30	FSEB20	FSEB30
1 dB compression of input mixer		+10 dBm (0 dB RF attenuation)		
Displayed Noise Floor		At 10 Hz Bandwidth (0 dB RF attenuation, VBW = 1 Hz, no signal at RF input)		
20 Hz	–	<–80 dBm	–	<–50 dBm
1 kHz	–	<–110 dBm	–	<–100 dBm
10 kHz	<–90 dBm	<–125 dBm	<–84 dBm	<–124 dBm
100 kHz	<–110 dBm	<–135 dBm	<–104 dBm	<–124 dBm
1 MHz	<–130 dBm, –135 dBm typical	<–145 dBm, –150 dBm typical	<–125 dBm, –130 dBm typical	<–142 dBm, –147 dBm typical
10 MHz to 3.5/7 GHz	<–145 dBm, –150 dBm typical	<–145 dBm, –150 dBm typical	<–142 dBm, –147 dBm typical	<–142 dBm, –147 dBm typical
Maximum Dynamic Range	@ 10 Hz Bandwidth	@ 1 Hz Bandwidth	@ 10 Hz Bandwidth	@ 1 Hz Bandwidth
Displayed noise floor (at 1 dB compression)	155 dB	165 dB	152 dB	162 dB
Maximum Harmonics Suppression (f >50 MHz)		90 dB		
Maximum Intermodulation-free Range (50 MHz to 3.5/7 GHz)	105 dB	115 dB	105 dB	115 dB
Intermodulation				
3rd-order intercept point (TOI)		12 dBm, 15 dBm typical for f >50 MHz) Δf >5 x resolution BW or >10 kHz		
Intermodulation-free range at –40 dBm mixer level		105 dB		
Intercept point k2		30 dBm for f >45 <50 MHz, >50 dBm typical for f >50 MHz		
Immunity to Interference				
Image frequency	80 dB	>80 dB, 90 dB typical	80 dB	>80 dB, 90 dB typical
Intermediate frequency	80 dB	>90 dB	80 dB	>90 dB
Spurious response (f >1 MHz, without input signal, 0 dB attenuation)	<–100 dBm		<–100 dBm	
Span <30 MHz		<–110 dBm		<–110 dBm
Span ≥30 MHz		<–100 dBm		<–100 dBm
f_{in} = 25.175 MHz		<–100 dBm		<–100 dBm
Linearity error				
Log level display				
0 to –50 dB		<0.3 dB		
–50 to –70 dB		<0.5 dB		
–70 to –80 dB	<1 dB	–	<1 dB	–
–70 to –95 dB	–	<1 dB	–	<1 dB
Linear level display		5% of reference level		
GENERAL				
Display				
Standard	24 cm (9.5 inch) LC display	24 cm (9.5 inch) LC color display	24 cm (9.5 inch) LC display	24 cm (9.5 inch) LC color display
With Option 01	24 cm (9.5 inch) LC color display	–	24 cm (9.5 inch) LC color display	–
Resolution		640 x 480 pixels (VGA resolution)		

Bandwidth Switching Display – <0.2 dB.

Total Measurement Error (0 to –50 dB) – <1 dB (f <1 GHz), <1.5 dB (f >1 GHz).

Pulse Amplitude Error (single pulses) –
Bandwidth <1 MHz: <0.5 dB, nominal.
Bandwidth >1 MHz: <2 dB, nominal.

TRIGGER-RELATED

Trigger Source – Free run, line, video, RF, external.

Delayed Sweep –
Trigger source: Free run, line, video, RF, external.
Delay time: 100 ns to 10 s, resolution 1 µs minimum (or 1% of delay time).
Error of delay time: ±(1 µs + (0.1% x delay time)).
Delayed sweep time: 2 µs to 1,000 s.

Gated Sweep –
Trigger source: External, RF.
Gate delay: 1 µs to 100 s.
Gate length: 1 µs to 100 s, resolution 1 µs or 1%.
Error of gate length: ±(1 µs + (0.05% x gate length)).

Gap Sweep (Span = 0 Hz) –
Trigger source: Free run, line, video, RF, external.
Pretrigger: 1 µs to 100 s, 500 ns resolution, dependent on sweep time.
Trigger-to-gap time: 1 µs to 100 s, 500 ns resolution, dependent on sweep time.
Gap length: 1 µs to 100 s, 500 ns resolution.

DEMODULATION-RELATED

Modulation Modes – AM and FM.
Audio output: Loudspeaker and headphones output.
Marker stop time: 100 ms to 60 s.
Squelch: Adjustable by means of level line.

INPUTS AND OUTPUTS

Front Panel –
RF input: N female, 50 Ω.
VSWR (RF attenuation >0 dB):
f <3.5 GHz: <1.5:1; f <7 GHz (PSEA 20/30); <2.0 (FSEB20/30).
Attenuator: 0 to 70 dB, selectable in 10 dB steps.
Probe power supply: +15 V DC, –12.6 V DC, and ground, maximum 150 mA.
Power supply and coding connector for antennas, etc. (antenna code): 12-contact Tuchel connector; Supply voltages: ±10 V, maximum 100 mA, ground.
AF output: Z_{out} = 10 Ω, jack plug; Open-circuit voltage: Adjustable up to 1.5 V.

Spectrum Analyzers

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Rear Panel –
IF 21.4 MHz: Z_{out} = 50 Ω, BNC female, bandwidth >1 kHz or resolution bandwidth; Level: 0 dBm at reference level, mixer level >–60 dBm; Video output: Z_{out} = 50 Ω, BNC female; Voltage (BW ≥1 kHz, log scaling): 0 to 1 V, full scale (open-circuit voltage).

Reference Frequency –
Output (usable as input): BNC female; Output frequency: 10 MHz; Level: 10 dBm nominal. Input: 1 to 16 MHz, integer MHz; Required level: >0 dBm from 50 Ω.

Sweep Output – BNC female, 0 to 10 V, proportional to displayed frequency.

Noise Source –
Power supply connector for noise source: BNC female, 0 and 28 V, switch-selected.

External Trigger/Gate Input – BNC female, >10 kΩ. Voltage: TTL level.

IEC/IEEE bus Control – Interface to IEC-625-2 (IEEE 488.2). Instruction set: SCPI 1994.0. Connector: 24-contact Amphenol female. Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C11.

Serial Interface – RS-232C (COM 1 and COM 2), 9-contact female connectors.

Mouse Interface – PS/2 compatible.

Plotter – Via IEC/IEEE bus or RS-232C. Plotter language: HPGL.

Printer Interface – Parallel (Centronics compatible) or serial (RS-232C).

Keyboard Connector – 5-contact DIN female for MF-2 keyboard.

User Interface – 25-contact Cannon female.

Connector for External Monitor (VGA) – 15-contact female.

GENERAL

Mass Memory – 1.44 MB 3.5 in. diskette (built-in), hard disk.

Calibration Interval – 1 year (2 years for operation with external reference).

RFI Suppression – To EMC directive of EU (89/336/EEC) and German EMC law.

ENVIRONMENTAL CHARACTERISTICS

Operating Temperature Range – Nominal temperature range: +5 to +40°C. Limit temperature range: 0 to +50°C. Storage temperature range: –40° to +70°C.

Climatic Loading – +40°C at 95% relative humidity (IEC 68-2-3).

Mechanical Stress –
Sinusoidal vibration: 5 to 150 Hz, maximum 2 g at 55 Hz; 0.5 g from 55 to 150 Hz; to IEC 68-2-6, IEC 68-2-3, IEC 1010-1, MIL-T-28800D, class 5.
Random vibration: 10 to 300 Hz, acceleration 1.2 g_{rms}.
Shock: 40 g shock spectrum, to MIL-STD 810C and MIL-T-28800D, classes 3 and 5.

POWER REQUIREMENTS

AC Supply – 100/120/230/240 V ±10%, 47 to 440 Hz, class of protection 1 to VDE 411.

Power Consumption – 170 VA (FSEA20), 180 VA (FSEA30), 185 VA (FSEB20), 195 VA (FSEB 30).

Safety – To EN 61010-1.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	427	17.1
Height	236	9.4
Depth	460	18.4
Weight	**kg**	**lb.**
FSEA20	21.5	47.3
FSEA30	22.7	49.9
FSEB20	21.8	48.0
FSEB30	23 kg	50.6

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

FSEA20
9 kHz to 3.5 GHz Spectrum Analyzer.
Includes: Power Cable, Operating Manual, Spare Fuses.

FSEA30
20 Hz to 3.5 GHz Spectrum Analyzer.
Includes: Power Cable, Operating Manual, Spare Fuses.

FSEB20
9 kHz to 7 GHz Spectrum Analyzer.
Includes: Power Cable, Operating Manual, Spare Fuses.

FSEB30
20 Hz to 7 GHz Spectrum Analyzer.
Includes: Power Cable, Operating Manual, Spare Fuses.

Opt. 01/FSE-B1 – FSEA20, FSEB20 Color Display, Factory-installed Only (Standard on FSEA30, FSEB30).

Opt. 02/FSE-B2 – FSEA20, FSEA30 7-GHz Frequency Extension.

Opt. 04/FSE-B4 – FSEA20, FSEB20 Low Phase Noise and OCXO (Standard on FSEA30, FSEB30).

Opt. 05/FSE-B5 – FSEA20, FSEB20 FFT Bandwidths 1 Hz to 1 kHz (Standard on FSEA30, FSEB30).

Opt. 07/FSE-B7 – Vector Signal Analyzer.

Opt. 15/FSE-B15 – Computer Function (English).

Opt. 16/FSE-B16 – Ethernet Interface (AUI).

Opt. 17/FSE-B17 – Second IEC/IEEE bus Interface (enables Opt. 15 to control FSEA/FSEB Plus External Instruments).

Opt. 49/FSE-B6 – Ethernet Interface (BNC).

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES

Noise Figure Measurement Software – Order FSE-K3.

GSM Test Software – Order FSE-K0.

Service Kit – Extender Boards and Coaxial Cables. Order FSE-Z1.

Keyboard – American. Order PSA-Z1.

GPIB Cable – 0.5 m. Order 012-1282-00.

GPIB Cable – 1 m. Order 012-0991-01.

GPIB Cable – 2 m. Order 012-0991-00.

GPIB Cable – 4 m. Order 012-0991-02.

19-inch Rack Adapter –
With front handles. Order ZZA-95.

19-inch Rack Adapter –
Without front handles. Order ZZA-951.

Set of Front Handles – Order ZZG-95.

Transit Case – Order ZZK-954.

Trolley – Order ZZK-1.

Matching Pad – 75 Ω, L Section. Order RAM.

Matching Pad – 25 Ω, Series Resistor. Order RAZ.

Preamplifier – 9 kHz to 30 MHz. Order ESH3-Z3.

Preamplifier – 20 Hz to 1 GHz. Order ESV-Z3.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987 with SCPI 1994.0.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Spectrum Analyzers
New R3465

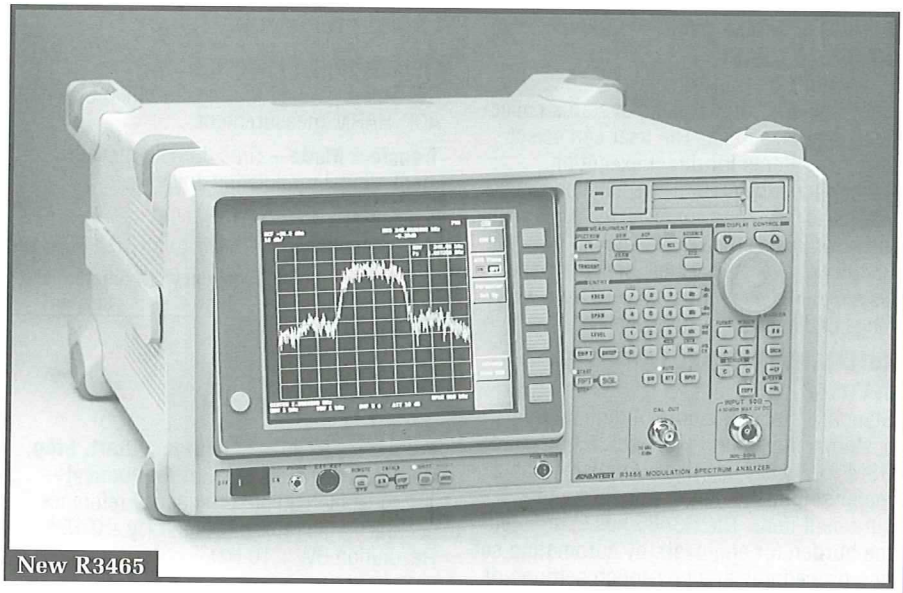
Features

NEW R3465

- 8 GHz Frequency Response for Full Range of Digital Mobile Radio Frequencies
- Built-in Standard Digital Radio Measurements Including PHS, PDC, NADC, and GSM (optional)
- 6.5-Inch Color LCD Display
- Lightweight Portable – 16 kg (35.2 lbs.)
- Two IC Memory Card Slots

Applications

- Digital Mobile Radio Transmitter Measurements
- Phase and Frequency Error
- Spectrum, Time, and Modulation Measurements
- NADC, PDC, PHS Mobile and Base Station Measurements



New R3465

R3465 8 GHz Modulation Spectrum Analyzer

The R3465 is a modulation spectrum analyzer that goes beyond traditional spectrum analysis. The 8 GHz frequency range provides coverage for a full range of digital radio frequencies. The 6.5-inch TFT color LCD display provides powerful support for multi-window operations. It incorporates a 15-degree adjustable tilt mechanism for easy viewing.

The R3465 is a high-performance spectrum analyzer armed with capabilities sufficient to support detailed waveform analysis. The newly developed high-speed settling synthesizer significantly reduces blanking time for narrow-band sweep (span of 5 MHz or less), thus enabling truly high-speed measurement. A high-frequency sweep accuracy of 1% or less, frequency stability of 2×10^{-8}/day, and a built-in preselector starting from 1.7 GHz permit harmonic measurements with a dynamic range of 100 dBc.

TRANSIENT MODE FOR DIGITAL ANALYSIS

In addition to the CW mode for conventional spectrum analysis, a TRANSIENT mode adds digital analysis capabilities, including modulation accuracy and measurement of transmission speed. Measurement power is further enhanced by a FAST measurement algorithmic function, which enables significantly reduced measurement time.

ONE-KEY SOLUTION

The R3465 allows direct operation when measuring occupied bandwidth, adjacent channel leakage power, and harmonic levels. Assigning frequently used measurement functions to special function keys frees the user from repetitive panel operations. Measurements can be started by a simple one-key operation. The SINGL key advances the measurement incrementally by each key stroke. The REPEAT key provides continuous, repetitive measurements.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2.*

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

Spectrum Analyzers
New R3465

ENHANCED DIRECT MENU OPERATION FOR COMPLETE TESTS
The ADVANCE mode displays all measurement items for digital radio systems collectively on one screen. The user can select necessary items for direct execution. Furthermore, the AUTO TEST function enables automatic measurement on all the items on the menu, or just on the selected items. The R3465 can execute a variety of performance tests required on production lines for a wide range of digital radio equipment.

AUTOMATIC STANDARD PARAMETER SETTINGS
Standard measurements of digital radio systems, including PHS, PDC, NADC, and GSM (optional), involve complicated parameter settings for each standard and measurement item. The R3465 has eliminated the burden for engineers by automating setting procedures and one-touch settings of user-defined standards.

TWO IC MEMORY CARD SLOTS
Two IC memory card slots are provided to enable save/recall of system conditions, as well as measurement results.

EASY-TO-VIEW COLOR DISPLAY
A large, high-resolution, full-color 6.5-inch TFT display provides powerful support for multi-window operations. Enhanced operability is provided by a 15-degree adjustable tilt mechanism.

Characteristics

MEASUREMENT FUNCTION
CW Mode – Spectrum measurement, OBW, ACP, HARM measurement.

Transient Mode – Time domain measurement, digital modulation analysis.

FREQUENCY-RELATED
Frequency Range – 9 kHz to 8 GHz.

	Frequency Band	N (LO harmonic number)
9 kHz to 3.1 GHz	0	1
1.7 GHz to 7.0 GHz	1	1
6.9 GHz to 8.0 GHz	2	1

Frequency Readout Accuracy (Start, Stop, Center Frequency, Marker Frequency) –
±(frequency reading x frequency reference accuracy + span x span accuracy + 0.15 x Resolution BW + 10 Hz).

Marker Frequency Counter –
Resolution: 1 Hz to 1 kHz in decade steps.
Accuracy (S/N ≥25 dB): ±(marker frequency x frequency reference accuracy + 5 Hz x N +1 LSD).

Frequency Reference Accuracy –
$\pm 2 \times 10^{-8}$/ day; $\pm 1 \times 10^{-7}$/year.

Frequency Stability –
Residual FM (zero span): <3 Hz x $N_{p\text{-}p}$/0.1 s.
Drift after 1 hour warmup (Span≤5 MHz): <20 Hz x (Sweep Time (minutes) x N).

Spectral Purity Noise Side Bands –
10 kHz offset: <–100 dBc/Hz.
100 kHz offset: <–110 dBc/Hz.

Resolution Bandwidth (3 dB) –
Range (1, 3, 10 sequence): 300 Hz to 3 MHz, 5 MHz.
Resolution Bandwidth Accuracy:
1 kHz to 1 MHz: ±20%;
300 kHz, 3 MHz, 5 MHz: ±30%.
Selectivity (300 Hz to 5 MHz): <15:1.

Video Bandwidth Range (1, 3, 10 sequence) –
1 Hz to 3 MHz, 5 MHz.

Frequency Span –
Linear Span (zero span): 2 kHz to 8 GHz.
Accuracy: Span >5 MHz: ±4%;
Span ≤5 MHz: ±1%.

Frequency Sweep –
Sweep Time: 50 ms to 1000 s (CW mode, Spectrum Measurement).
Accuracy: ±5%.
Sweep Trigger: Free run, Line, Single, Video, External, IF signal.

Gated Sweep –
Gate Position: 1 µs to 65 ms in 1 µs steps.
Gate Width: 2 µs to 65 ms in 1 µs steps.
Trigger: Internal IF detection, External.

AMPLITUDE-RELATED
Amplitude Range – +30 dBm to noise level.

Display Range (10 x 10 Divisions) –
Log: 10, 5, 2, 1, 0.5 dB/div.
Linear: 10% of reference level/div.

Reference Level Range –
Log (0.1 dB step): –105 to +60 dBm.
Linear: 1.25 µV to 223 V.

Input Attenuator – 0 to 70 dB in 10 dB steps.

Spectrum Analyzers
New R3465

DYNAMIC RANGE
Displayed Average Noise Level (Resolution Bandwidth 1 kHz, Input Attenuator 0 dB, VIdeo Bandwidth Range 1 Hz) –

Frequency Range	Frequency Band	Displayed Average Noise Level
10 kHz	0	–70 dBm
100 kHz	0	–80 dBm
1 MHz to 3.0 GHz	0	–(115 – 1.55 x f (GHz) dBm)
1.7 GHz to 7.0 GHz	1	–115 dBm
6.9 GHz to 8.0 GHz	2	–115 dBm

Spurious Response –

Second harmonic distortion:

Response	Second Harmonic Distortion	Mixer Level
10 MHz to 3.0 GHz	<–70 dBc	–30 dBm
>1.7 GHz	<90 dBc	–10 dBm

Third harmonic distortion (12.5 kHz Separation, Resolution Bandwidth 300 Hz):

Response	Third Harmonic Distortion	Mixer Level
10 MHz to 3.0 GHz	<–75 dBc	–30 dBm
>1.7 GHz	<–75 dBc	–30 dBm

Amplitude Accuracy –

Frequency response (10 dB input atten.):

Frequency Range	In Band Flatness	Frequency Band
9 kHz to 3.0 GHz	±1.5 dB	0
50 MHz to 3.0 GHz	±1.0 dB	0
1.7 GHz to 7.0 GHz	±1.5 dB	1
6.9 GHz to 8.0 GHz	±1.5 dB	2

CALIBRATOR
Accuracy (30 MHz) – –10 dBm ±0.3 dB.

IF GAIN UNCERTAINTY (AFTER AUTOMATIC CALIBRATION)
0 to –50 dBm – ±0.5 dB.

0 to –80 dBm – ±0.7 dB.

SCALE FIDELITY (AFTER AUTOMATIC CALIBRATION)
Log – 1 dB: ±0.2 dB; 10 dB: ±1 dB: 90 dB: ±1.5 dB.

Linear – ±15% of reference level.

TIME DOMAIN MEASUREMENT
Amplitude Resolution – 10-Bit.

Sweep Time – 20 µs to 30 ms.

Sweep Trigger – Free Run, Single, Video, IF. Trigger delay: 200 ns to 10 s.

ANALOG DEMODULATION
Spectrum Demodulation –
Modulation type: AM, FM.
Audio Output: Speaker and phone jack with volume control.
Marker pause time: 100 ms to 1000 s.

DIGITAL MODULATION ANALYSIS
Type – π/4DQPSK (PHS, PDC, NADC); 0.3 GMSK (GSM) modulation analysis is available as an option.

Frequency Calibration (Burst) –
Measurement Range (fast/CW mode): 10 MHz to 7.5 GHz.
Input Level: –30 dBm to +30 dBm.
Measurement Accuracy (PDC, NADC): Reference Accuracy x Carrier Frequency + 125 Hz.
Measurement Accuracy (PHS): Reference Accuracy x Carrier Frequency + 625 Hz.

Average Power (after calibration) –
Measurement Range: –30 dBm to +30 dBm.
Measurement Accuracy (within PHC, PDC, NADC bands): CW mode: ±0.5 dBm; Transient mode: ±0.8 dB.

OBW –
Points (sweep/CW mode): 500.
Input Level (fast/CW mode): –20 dBm to +30 dBm.

ACP (fast/CW/mode) –
Measurement range:

PHS	PDC	NADC
0 dB to –57 dB (600 kHz offset)	0 dB to –60 dB (50 kHz offset)	0 dB to –55 dB (30 kHz offset)
0 dB to –62 dB (900 kHz offset)	0 dB to –62 dB (100 kHz offset)	0 dB to –60 dB (60 kHz offset)

Spurious –
Measurement Range (sweep/CW mode): 9 kHz to 8 GHz.
Frequency Range (fast/CW mode): 10 MHz to 8 GHz.

Modulation Analysis –

	PHS	PDC/NADC
Frequency Range	±13 kHz	±1.4 kHz
Frequency Accuracy	Reference Accuracy x Carrier Frequency + 5 kHz	Reference Accuracy x Carrier Frequency + 5 kHz
Modulation Range	0 to 30%	0 to 30%
Modulation Accuracy	±1% ±(Readout x 2%)	±1% ±(Readout x 2%)
Transmission Rate Accuracy	±1 ppm	±1 ppm

Spectrum Analyzers
New R3465

INPUTS AND OUTPUTS
Interface – GPIB, RS-232, Centronics.
Video Output – VGA, 15-Pin female, 640 x 480 dots.
Memory Card – Two IC memory card slots.

ENVIRONMENTAL
Operating Temperature – 0 to 50°C.
Humidity – 85% relative humidity or less.

POWER REQUIREMENTS
AC Line – 100 V to 120 V and 220 V to 240 V, auto-switching.
Line Frequency – 48 Hz to 66 Hz.
Power Consumption – ≤300 VA.

PHYSICAL CHARACTERISTICS

Dimensions (without handle, feet, and front cover) –

	mm	in.
Width	350	13.8
Height	178	7.0
Depth	420	16.5
Weight	**kg**	**lb.**
Net	16	35.3

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

R3465
8 GHz Modulation Spectrum Analyzer.
Includes: Power Cord, Manual.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES
Memory Card – Set of five 64 KB cards. Order A09507.

PROBES
FET Probe – DC to 900 MHz (Requires 1101A). Order P6201.
FET Probe – DC to 500 MHz. Order P6202A.
50 Ω Divider Probe – DC to 3.5 GHz, 6 ft. Order P6156.
Current Probe – 935 Hz to 120 MHz. Order P6022.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2.*

ADVANTEST
Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

Digital Radio Transmitter Test

R2465A/B • R2471A/B

Features

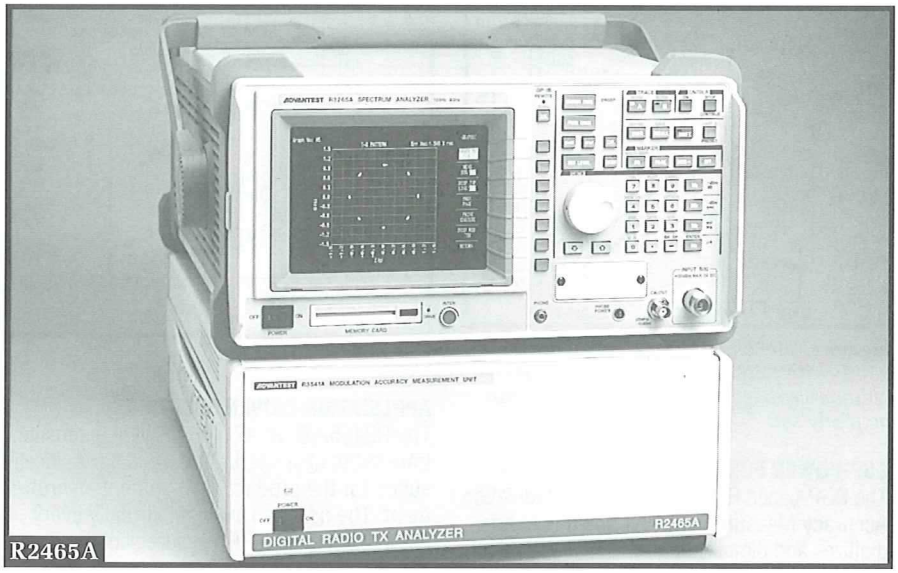
R2465A/B, R2471A/B

- Spectrum Analysis Measurements
  - Frequency Accuracy
  - RF Output Power
  - Harmonic and Spurious Signal Levels
- Time-domain and Time-gated Spectrum Analysis Measurements
  - Burst Rise and Fall Time
  - Average Burst Power
  - Adjacent Channel Power
- Dual Display – Simultaneous Frequency and Time Domain
- Memory Card Interface

Applications

MOBILE RADIO

- NADC
- PHP
- PDC



R2465A

R2465A/B, R2471A/B Digital Radio Transmitter Analyzers

The R2465A consists of the 100 Hz to 8 GHz R3265A Spectrum Analyzer coupled with the R3541C Option 70 Modulation Accuracy Measurement Unit. The R2465B consists of the 100 Hz to 8 GHz R3365A Spectrum Analyzer with built-in tracking generator coupled with the R3541C Option 70 Modulation Accuracy Measurement Unit. The R2471A consists of the 100 Hz to 26.5 GHz R3271A Spectrum Analyzer and the R3541C Option 70 Modulation Accuracy Measurement Unit. The R2471B consists of the 100 Hz to 26.5 GHz R3371A Spectrum Analyzer with tracking generator and the R3541C Option 70 Modulation Accuracy Measurement Unit. The resultant system is capable of a variety of measurements: conventional spectrum analysis, time-domain analysis, time-gated spectrum analysis, and modulation analysis.

These transmitter analyzers are designed to evaluate the digital transmitter characteristics of North American Dual-mode Cellular (NADC) phones. The systems provide simultaneous displays of frequency domain and time domain information in order to simplify analysis. To enable precision modulation measurements, the DSP-based R3541C Option 70 Modulation Accuracy Measurement Unit down converts, digitizes, and digitally demodulates $\pi/4$ DQPSK signals. Tests are performed with the high speed necessary for production line testing, and the detail and accuracy needed for the development environment.

COMPREHENSIVE TEST FUNCTIONALITY

The R2465A/B and R2471A/B systems perform a wide range of spectrum analysis measurements. The R2465A/B analyzers can measure frequency accuracy from 100 Hz to 8 GHz in one sweep; 100 Hz to 26.5 GHz for the R2471A/B.

The spectrum analyzer's time-domain function allows monitoring of transmitter power and time response, meeting critical TDMA system requirements. Combined with a fast sweep function (5 µs/div in zero span), the burst-signal analysis function can be used to monitor the transmission power in any single time slot of the TDMA signal. Burst-signal power is measured by separating it into "on" and "off" power periods. Use time-domain measurement to measure the average power of the selected zone with the marker.

The R2465A/B, R2471A/B analyzers can measure adjacent-channel leakage power of digital radio equipment transmitter characteristics from the measured spectrum data through a simple operation. Two types of leakage power measurements are provided. Adjacent Point measures the leakage power of the upper and lower channels, while Adjacent Graph measures the leakage power of all channels in the bandwidth specified, as shown in Figure 1.

The R2465A/B, R2471A/B can perform time-gated measurements. By setting the instrument to dual-screen mode with both a frequency display and a time display, the gate width can be adjusted so the frequency is only displayed during the gate.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1.*

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

Digital Radio Transmitter Test

R2465A/B • R2471A/B

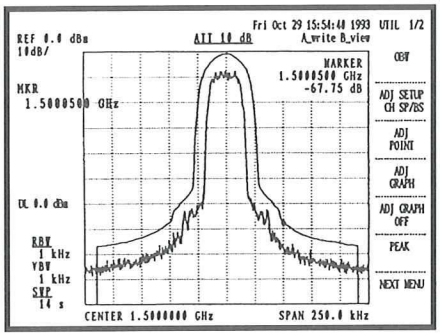


Figure 1. The channel separation and bandwidth parameters of the adjacent channel leakage power measurement can be freely set.

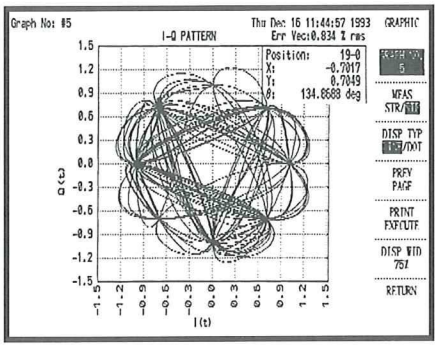


Figure 2. I-Q display.

DSP-POWER FOR ANALYSIS

The DSP-based R3541C Option 70 Modulation Accuracy Measurement Unit down converts, digitizes and digitally demodulates π/4 DQPSK signals, and displays the information. Combined with the R2465A/B or R2471A/B, the resultant system can measure the error vector, magnitude, and phase. In addition, an FFT (Fast Fourier Transform) of each of these measurements allows further analysis.

Eye pattern displays plot I (In-phase) and Q (Quadrature) against time. A key feature of these diagrams is that the greater the error vector, the more the eye closes. I versus Q (see Figure 2) and constellation diagrams are useful for measuring modulation quality. The key feature of this graph is that if the value of the error vector is small, the intersecting point is centered on each symbol point.

APPLICATION-DRIVEN SOLUTIONS

The R2465A/B, R2471A/B provide extensive transmitter characterization capabilities, ideally suited for the product development environment. The user can evaluate virtually every relevant transmitter RF measurement parameter, whether in the time or frequency domains.

These analyzers are equally useful in production environments, having sophisticated firmware measurement routines to facilitate operations. Software can be loaded via the spectrum analyzer's memory card interface, and the instruments can perform automatic measurements to meet the requirements of IS-55. Their GPIB interface enables them to function within a larger ATE system under computer control. Line-limit evaluation with pass/fail results can also be performed, making the analyzers useful in high-speed production testing.

Characteristics

Frequency Range –
When used with R3265A or R3365A – For PDC and NADC: 450 kHz to 8 GHz. For PHP: 10 MHz to 8 GHz.
When used with R3271A or R3371A – For PDC and NADC: 450 kHz to 26.5 GHz. For PHP: 10 MHz to 26.5 GHz.

Modulation System – For PDC and NADC: π/4 DQPSK. For PHP: π/4 DQPSK.

Measurement Input Level – –30 to +30 dBm Modulation (R3265A/R3365A or R3271A/R3371A input).

Modulation Accuracy (RMS) –
Measurement Range: 0 to 30%.
Accuracy: For PDC and NADC, <0.5%±2% of measured value (RBW 3 MHz). For PHP, <1% ±2% of measured value (RBW 3 MHz).

Frequency Error –
Measurement Range: For PDC and NADC, ±1.4 kHz. For PHP, ±13 kHz.
Accuracy: Accuracy of reference frequency source ±5 Hz.

Carrier Leakage –
Measurement Range: For PDC and PHP, –15 dB or lower. For NADC, –20 dB or lower.
Accuracy: ±0.5 dB (down to –35 dB).

Other Measurement Functions – Phase error (RMS). Amplitude error (RMS). Burst amplitude droop. 10-burst measurement (NADC only). Averaging function (displays average, maximum, minimum, and standard deviation of up to 50 measurements). Root Nyquist Filter: 0.5 ON/OFF.

NOTE: For complete specification information on the Advantest R3265A, R3365A, R3271A, or R3371A portable spectrum analyzers, see page 170.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

R2465A
Digital Radio Transmitter Analyzer.
Includes: Power Cord, Front Cover, Instruction Manual.

R2465B
Digital Radio Transmitter Analyzer with Tracking Generator.
Includes: Power Cord, Front Cover, Instruction Manual.

R2471A
Digital Radio Transmitter Analyzer.
Includes: Power Cord, Front Cover, Instruction Manual.

R2471B
Digital Radio Transmitter Analyzer with Tracking Generator.
Includes: Power Cord, Front Cover, Instruction Manual.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.

RECOMMENDED ACCESSORIES
Also see page 434.

Automatic Measurement Software for Digital Mobile Communication:

PDC Software (for Mobile Station) –
Order PR326501-IC.

PDC Software (for Base Station) –
Order PR326511-IC.

PDC Software (for Both Mobile and Base Station) – Order PR326541-IC.

NADC Software (for Mobile Station) –
Order PR326502-IC.

PDC/NADC Software (for Mobile Station) –
Order PR326521-IC.

PHP Software (for Mobile Station) –
Order PR326504-IC.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

Spectrum Analyzers
2712 • 2711

Features

2712

- High Value, Low Cost
- 5 x 10^{-7} Frequency Accuracy
- Sensitivity to –139 dBm (–92 dBmV) with Built-in Preamp
- Internal Frequency Counter
- 4 Trace Digital Plus True Analog Display
- 124 K of RAM
- Easy to Use
- Dedicated Numeric Keypad Plus Logically Grouped Menu Keys
- Powerful Built-in Measurement Routines
- EMC Measurements with Optional Quasi-peak Detector
- Swept Measurements to 1.8 GHz with Optional Internal or External Tracking Generator
- UL Listed 1244, Certified CSA C22.2 No. 231-M89

2711

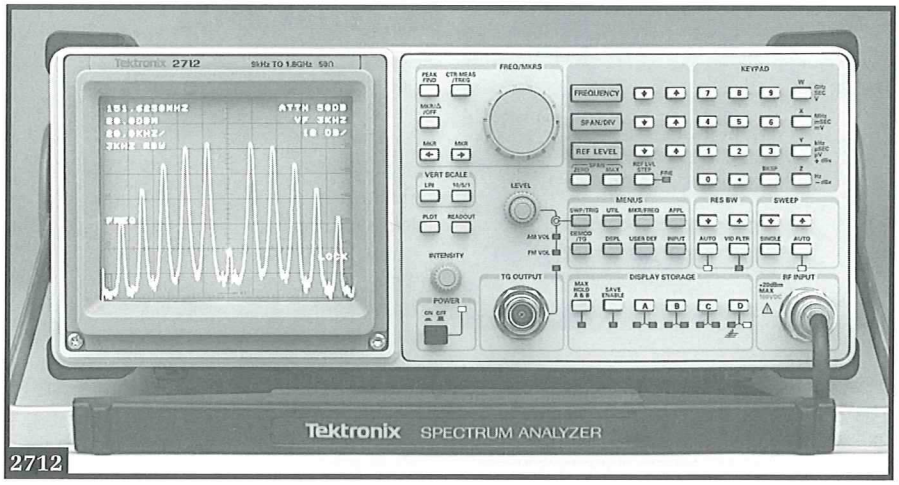
- Economical, Can Be Configured to Meet Most Budgets
- High Portability
- Internal or External Tracking Generator Option
- Internal Frequency Counter (Option 02)
- GPIB or RS-232 Interface Option
- Excellent Frequency Accuracy and Sensitivity
- 3-Control Operation for Most Measurements
- UL Listed 1244, CSA Bulletin 556B

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *2712, 2711 Option 03 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*



2712 Spectrum Analyzer

The Tektronix 2712 Spectrum Analyzer provides excellent RF performance, a built-in frequency counter, full programmability, digital and true analog displays, high portability, enough non-volatile memory for 108 saved displays, and much more.

A straightforward human interface, with conveniently-grouped, dedicated front-panel keys and simple, menu-driven functions makes the 2712 easy to learn and use. You can set frequency, span, and reference level directly from the front panel. A real-time clock provides an on-screen date and time display, plus date/time stamp capability for waveform printouts.

Frequency-corrected tuning and phaselock stabilization enhance the ability to resolve close-in signals and reliably demodulate narrowband signals. Sensitivity up to –127 dBm (–80 dBmV) at 300 Hz resolution bandwidth (RBW) lets you see weak signals. The built-in preamp can improve sensitivity another 12 dB, up to –139 dBm (–92 dBmV). Up to 80 dB on-screen dynamic range ensures visibility of weak signals in the presence of strong ones.

A 300 Hz RBW filter with a shape factor ≤7:1 means you'll see many close-in sidebands and spurious or unexpected signals you might otherwise miss. At the other end of the spectrum the 5 MHz RBW filter is useful when demodulating wideband signals such as actively modulated video carriers.

The built-in signal counter, with 0.5 ppm ±10 Hz accuracy, offers added power for rapidly identifying signals. The capability to choose between digital and true analog displays lets you examine signals for characteristics that are not visible on digital-only displays.

Sweep speeds of 1 µsec/div, TV Line and TV Field triggering, an internal audio amplifier and AM/FM detectors, and the optional Video Monitor Mode all make video communications measurements easier.

Bandwidth, Carrier-to-Noise, Noise Power, Signal Search, and FM Deviation modes provide additional measurement power and convenience. Occupied Bandwidth Mode, with percent settable from 1 to 99%, aids in broadcast and radio measurements.

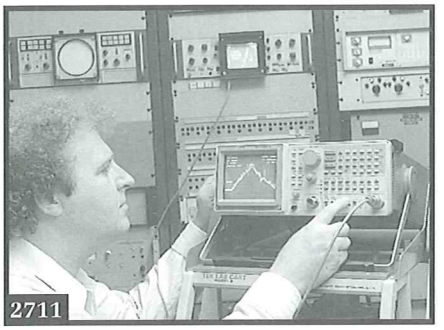
The optional internal or external tracking generator provides high dynamic range swept measurements to 1.8 GHz.

EMC MEASUREMENT

To help simplify your EMC measurements, the 2712 offers an optional quasi-peak detector, EMI resolution bandwidth filters, and fully corrected E-field intensity measurements to assist in pre-certification and troubleshooting. EMC ancillary devices are available to provide a complete measurement solution. See page 222.

Continued on next page.

Spectrum Analyzers
2712 • 2711



2711 Spectrum Analyzer

The 2711 offers a wide range of features at an extremely affordable price. This value leader is well suited for checking broadcast transmitter performance and communications system operations, looking for unwanted RF emissions, testing two-way communications equipment, maintaining industrial security, and teaching frequency domain concepts in the classroom, plus a wide variety of other applications.

The standard 2711 shares many of the 2712's valuable features, such as compact size and light weight (9.5 kg, about 21 lb.). Both instruments can also be quickly converted to rack operation with optional rack-mount adapters.

Frequency accuracy is 1 x 10^{-5} and sensitivity is up to –117 dBm (–70 dBmV) at 3 kHz RBW. The built-in preamp can add another 12 dB, up to –129 dBm (–82 dBmV). Up to 80 dB on-screen dynamic range helps see weak signals, even when strong ones are present.

True analog display capability, along with fast sweep speeds and TV Line and TV Field triggering provide convenient demodulation of video carriers for making depth-of-modulation checks or looking at special baseband data, VITS, and many other signals.

An internal audio amplifier and AM/FM detectors let you hear demodulated signals, using either the built-in speaker or headphone jack, for fast signal identification and trouble-shooting in communications applications.

With the Video Monitor (Option 10) installed, you can view broadcast (AM) TV signals or down-converted satellite (FM) signals.

The 2711 can also be used with a set of near-field probes as a handy EMC diagnostic tool.

SELECTION GUIDE

Capability	2712	2711
Frequency Range	9 kHz to 1.8 GHz	9 kHz to 1.8 GHz
±0.5 ppm Freq. Accuracy	Std.	NA
Signal Counter	Std.	Opt. 02
GPIB Interface	Std.	Opt. 03
Internal Tracking Gen.	Opt. 04	Opt. 04
External Tracking Gen.	Opt. 05	Opt. 05
RS-232C Interface (replaces GPIB)	Opt. 08 (no charge)	Opt. 08
Video Monitor Mode	Opt. 10	Opt. 10
EMC Pre-certification Measurements	Opt. 12	NA
TV Sideband Adapter Interface	Opt. 15	Opt. 15
Non-volatile Memory	124 K	28 K (124 K with Opt. 03 or 08)
High Portability	Yes	Yes
Both Digital and True Analog Displays	Yes	Yes
Dedicated Numeric Keypad	Yes	Yes
Real-Time Clock	Std.	With Opt. 03 or 08

Characteristics

The following characteristics apply to both the 2712 and 2711 after a 15-minute warm-up period, unless otherwise noted.

FREQUENCY RELATED

Frequency Range – 9 kHz to 1800 MHz.

Center Frequency Accuracy – 2712: 5x10^{-7} of CF ±700 Hz; 2711: 1x10^{-5} of CF ±5 kHz.

Frequency Counter Accuracy (Std. 2712, Option 02 2711) – 2712: 5x10^{-7} of CF ±10 Hz, ±1 LSB. 2711: 1x10^{-5} of CF ±10 Hz, ±1 LSB.

Dot Marker Frequency Accuracy*1 – CF Accuracy ±3% of span.

Long-term Drift*1 – 2712: 2 ppm/yr.; 2711: 10 ppm/yr.

Short-term Drift – 2712: ≤400 Hz maximum drift between correction cycles; 2711: ≤20 kHz maximum drift between correction cycles.

Residual FM – 2712: ≤100 Hz p-p/20 msec at ≤20 kHz span/div; ≤2 kHz p-p/20 msec at >20 kHz span/div; 2711: ≤2 kHz p-p/20 msec.

Resolution Bandwidth (–6 dB) – 2712: 5 MHz, 300 kHz, 30 kHz, 3 kHz, 300 Hz; 2711: 5 MHz, 300 kHz, 30 kHz, 3 kHz; 2712 with Option 14: Add 1 MHz, 100 kHz, 10 kHz, and 1 kHz; 2712 with Option 12: add 1 MHz, 120 kHz, 9 kHz, 1 kHz – 200 Hz replaces 300 Hz filter.

Resolution Bandwidth Shape Factor (60 dB/6 dB) – ≤7:1 for RBW ≤1 MHz.

Noise Sidebands – ≤70 dBc at 30xRBW.

Video Filter – Approx. 1/100 (Auto) of RBW. Manual Selection: 3 Hz to 300 kHz in 1-3 sequence.

Freq. Span/Div Range – 2712: 180 MHz to 1 kHz. 2711: 180 MHz to 10 kHz selected in 1-2-5 sequence or within two significant digits via menu.

Span Accuracy – ±3% over the center eight divisions.

AMPLITUDE RELATED

Flatness – ±1.5 dB measured with 10 dB internal RF attenuation (preamp off).

Vertical Display Modes – 10, 5, 1 dB/div, Linear.

Measurement Range – 2712: –139 (preamp on) to +20 dBm (–92 to +67 dBmV); 2711: –129 (preamp on) to +20 dBm (–82 to +67 dBmV).

Display Dynamic Range – 80 dB max (limited to 40 dB in optional 2712 Quasi-peak Detector mode).

Reference Level Range – LOG Mode: –70 to +20 dBm (–23 to +67 dBmV), or to –90 dBm with preamp on. LINEAR Mode: 8.8 µV to 280 mV.

Reference Level Steps – LOG Mode: 1 dB or 10 dB. LINEAR Mode: 1-2-5 sequence.

Mixer Input Level – Automatically controlled by instrument for on-screen signals. Level selectable between –20 to –50 dBm (+27 to –3 dBmV).

Display Amplitude Accuracy – 10 dB/div: ±1.0 dB/10 dB to max. cum. error of ±2 dB over 70 dB range; ±2.0 dB/10 dB over 70-80 dB range. 5 dB/div: ±1.0 dB/10 dB to max. cum. error of ±2 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 to 50 dB, 2 dB steps.

Sensitivity – 2712: –127 dBm (–80 dBmV) at 300 Hz RBW, –139 dBm (–92 dBmV) at 300 Hz RBW with preamp on (to 600 MHz); 2711: –117 dBm (–70 dBmV) at 3 kHz RBW, –129 dBm (–82 dBmV) at 3 kHz RBW with preamp on (to 600 MHz).

**1 Typical but nonwarranted performance parameters.*

Spectrum Analyzers
2712 • 2711

SPURIOUS RESPONSE (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 measured with 1st mixer input level of ≤–30 dBm (+17 dBmV).

2nd Harmonic Distortion – ≤–66 dBc measured with 1st mixer input level of ≤–40 dBm (+7 dBmV).

INPUT RELATED

LO Emission – ≤–70 dBm with 0 dB RF attenuation.

RF Input – Type N connector, 50 Ω.

VSWR with 10 dB or More RF Attenuation – 1.5:1 max.

Maximum Safe Input – +20 dBm (+67 dBmV) (0.1 W) continuous peak with 0 dB RF attenuation; 100 V DC (initially applied with full attenuation).

1 dB Compression Point – ≥–15 dBm (+32 dBmV) 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 eight 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: Min. 1.0 V peak, (15 Hz to 1 MHz).

INPUT/OUTPUT CHARACTERISTICS

External Trigger*1 – BNC connector, 10 kΩ impedance, DC coupled 0.1 µs min. pulse width. 35 V max.

External Video Input*1 – DC coupled. 0-50 kHz, 0-1.4 V (175 mV/div typical) signal input for vertical deflection of CRT beam.

Sweep Gate Out – TTL level, HI while CRT beam sweeps.

Sweep Output – +1.3 to –1.3 V, negative-going ramp, proportional to the horizontal sweep. Source impedance ≤50 Ω.

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 SPECIFICATIONS

Temperature – Operating: 0° to 50°C (MIL-T-28800D). Nonoperating: –55° to +75°C.

Humidity – Nonoperating: Five cycles (120 hours) per MIL-T-28800D, Class 5.

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.

Electromagnetic Compatibility – EC92 EMC Directive 89/336/EEC:

Emissions: EN50081-I.
Radiated Emissions, 30 MHz to 1 GHz, EN55022 Class B (CISPR 22 B).
Conducted Emissions, 150 kHz to 30 MHz, EN55022 Class B (CISPR 22 B).
Conducted Emissions, power line harmonics. 0 to 2 kHz, IEC 555-213.

Immunity: EN50082-1.
Electrostatic Discharge, 8 kV, IEC 801-2.
Radiated Immunity, 27 MHz to 500 MHz, IEC 801-3. No response above –90 dBm in a 3 V/meter field.
Fast Transients, capacitive clamp, 1 kV power leads, 500 V control leads, IEC 801-4.
Power Line Surge, 1 kV differential mode, 2 kV Common mode, IEC 801-5.

Vibration – Meets MIL-T-28800E, Paragraph 4.5.5.3.1 (modified).

GENERAL CHARACTERISTICS

Power Requirements – 105 W max. (1.4 A) at 115 V, 60 Hz. Operates 48 Hz to 440 Hz, 90 to 132 V AC, or 48 Hz to 63 Hz to 250 V AC. Battery power (Option 07) available.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	137*1	5.4*1
Width	361*1	14.2*1
Depth	445*1	17.5*1
Weight	**kg**	**lb.**
Net	9.5*2	<21*2

*1 *With feet, handle, and front panel cover.*

*2 *Nominal for basic configuration.*

OTHER CAPABILITIES

Markers – Single marker/delta marker; next right, next left peaks; next lower, next higher peaks; (highest) peak find; marker to center frequency and reference level.

Non-volatile Memory – Lithium battery backup. 2712: 124 kB available; up to 108 displays saved; 36 front-panel setups, large user-definable key routines, and antenna tables (exact number and size depends on NV RAM utilization). 2711: 28 kB available; up to 18*2 displays saved and 9*2 front-panel setups, user-definable key routines, and antenna tables.

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, C; B, C MINUS A; WATERFALL display mode; digital storage off provides analog sweep.

Ensemble Averaging – Provides weighted continuous or discrete averaging of display resulting in reduction of random noise.

Internal Preamp – Preamp can be switched in/out of circuit (flatness degrades above 600 MHz, provides approximately 12 dB sensitivity improvement).

Alternative Reference Level Units – dBm, dBmV, dBV, dBµV, dBµW, dBµV/m.

User-Definable Power-on Status – Instrument powers up to user-definable state or factory default condition.

Center Measure – Signal is centered with frequency and peak amplitude automatically read out (not a marker mode). The signal is counted in the 2712 or 2711 with Option 02.

Signal Track – Drifting signal is kept at display center with correct frequency and peak amplitude displayed.

Graticule Illumination – For CRT photography in analog display mode.

Direct Plot/Print – Supports Epson FX and LQ Series Printers and Tektronix HC100 Printer/Plotter via built-in GPIB interface (std. 2712, 2711 Option 03), RS-232C interface (Option 08, 2712 and 2711).

*1 *Typical but non-warranted performance parameters.*

*2 *Up to 108 saved displays, 36 front-panel setups available with Option 03 or 08.*

Spectrum Analyzers
2712 • 2711

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

2712
Spectrum Analyzer.
Includes: Power Cord (U.S. 115 V/60 Hz), User's Manual, Pocket Reference Guide, Programmers Manual, Front Cover, and N-to-BNC Adapter.

2711
Spectrum Analyzer.
Includes: Power Cord (U.S.115 V/60 Hz), User's Manual, Pocket Reference Guide, Front Cover, and N-to-BNC Adapter.

Opt. 02 – (2711 only) Add Internal Frequency Counter with Selectable 1 kHz/1 Hz Readout Resolution.

Opt. 03 – (2711 only) GPIB Interface. Full Programmability, Direct Print, additional NV RAM, and Real-time Clock. Cannot combine with Opt. 08.

Opt. 04 – Add Internal Tracking Generator, 100 kHz to 1800 MHz, 0 dBm to –48 dBm in 0.1 dB steps. (Not compatible with 2712 Opt. 12 or 14 – order External Tracking Generator Opt. 05 instead.)

Opt. 05 – External Tracking Generator with Active Probe Power Jack. Not compatible with Opt. 04.

Opt. 07 – Add 2704 Inverter/2705 Battery Pack.

Opt. 08 – (2712 only) Replace GPIB with RS-232C Interface.

Opt. 08 – (2711 only, not compatible with Opt. 03.) RS-232 Interface, Full Programmability, Direct Print, additional NV RAM, and Real-time Clock.

Opt. 10 – Video Monitor Mode.

Opt. 12 – (2712 only) Add Quasi-peak Detector (built-in). Including 200 Hz, 9 kHz, and 120 kHz EMC Filters; 1 kHz and 1 MHz RBW Filters. Not compatible with Opt. 04 or 14. Note: 200 Hz EMC Filter replaces standard 300 Hz RBW Filter.

Opt. 14 – (2712 only) Add 1 kHz, 10 kHz, 100 kHz, and 1 MHz RBW Filters.
Not compatible with Opt. 04 or 12.

Opt. 15 – 1st LO output for use with Tektronix 1405 TV Sideband Adapter Interface or 2707 Internal Tracking Generator.

Opt. 20 – EMC Antenna Set plus Tripod and Coax suitable for tests to 1 GHz (contact Tektronix sales engineer for more information).

Opt. 21 – Add 2706 Stepping RF Preselector.

Opt. 30 – Rackmount for 19 in. rack width, 5.25 in. height.

Opt. 33 – Travel Line Package. Including Accessory Pouch, Carrying Strap, Vinyl Rain Cover.

Opt. 34 – Portable-to-Rackmount Adapter for 19 in. rack width, 7 in. height.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – United Kingdom 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.
See Customer Information Section for additional description.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

SOFTWARE
See page 220 for additional information.

271x PC Utility Software – Order S26UT10.

EMI Commercial Test Software – Order S26EMI2.

EMI Ancillary Devices – See page 225.

ADDITIONAL ACCESSORIES
Also see page 434.

PROBES

Active – All require 1103 Power Supply. 4 GHz, 0.4 pF/100 kΩ, 1 m. Order P6217. 750 MHz, 2 pF/1 MΩ, 1.5 m. Order P6205.
TEKPROBE® Power Supply. Order 1103.

CAMERAS/PLOTTERS/PRINTERS

Camera – Low Cost. Order C-9 Opt. 1A and 20.

Plotter – Four Color. (GPIB). Order HC100 Opt. 01. (RS-232). Order HC100 Opt. 03.

CART – K212 Instrument Cart.

Power Splitter – 75 Ω/50 Ω BNC Output, 50 Ω BNC Input. Order 067-1232-00.

CABLES, PADS, AND ADAPTERS

50 Ω Coaxial Cable –
BNC to BNC, 5.5 in. Order 012-0214-00.
BNC to BNC, 18 in. Order 012-0076-00.
BNC to BNC, 42 in. Order 012-0057-01.

75 Ω Coaxial Cable – BNC to BNC, 42 in. Order 012-0074-00.

GPIB Cables –
0.5 m. Order 012-1282-00.
1 m. Order 012-0991-01.
2 m. Order 012-0991-00.
4 m. Order 012-0991-02.

RS-232 Modem Cables –
9-Pin Female to 25-Pin Male. Order 012-1241-00.
9-Pin Female to 9-Pin Female. Order 012-1379-00.
9-Pin Female to 25-Pin Female. Order 012-1380-00.

75 Ω to 50 Ω Minimum Loss Adapter –
With DC block, 5.7 dB loss. Order 011-0112-00.

75 Ω BNC to 50 Ω Type N Minimum Loss Attenuator – Order 131-4199-00.

75 Ω to 50 Ω Matching Attenuator –
With 11.25 dB conversion factor from dBm to dBV with DC block. Order 011-0118-00.

"F" Female to BNC Male Adapter –
Order 013-0126-00.

BNC Female to "F" Male Adapter –
Order 103-0158-00.

"N" Female to BNC Male Adapter –
Order 103-0058-00.

75 Ω to 50 Ω Matching Transformer –
0.5 dB loss. 50 kHz to 300 MHz. Order 120-1883-00.
5 MHz to 1 GHz. Order 120-1884-00.

GPIB CARDS
PC-GPIB Card – IBM PC, AT, and compatibles. Order S3FG210.

AT-GPIB Card – IBM AT Bus (High-speed Card). Order S3FG220.

MC-GPIB Card – IBM PS/2 with Microchannel Bus. Order S3FG230.

User's Manual –
2712. Order 070-8137-00.
2711. Order 070-5800-00.

Service Manual –
2712. Order 070-8130-01.
2711. Order 070-8130-01.

Front Panel Cover – Order 200-2520-00.

Transit Case – Order 016-0792-02.

Soft Side Case – Order 016-1158-00.

Rain Cover – Order 200-2500-00.

Accessory Pouch – Mounts on top. Order 016-0677-03.

Carrying Strap – Order 346-0199-00.

Viewing Hoods –
Collapsible. Order 016-0592-00.
Binocular. Order 016-0566-00.
Polarized. Order 016-0180-00.

CRT Filter – Smoke Gray. Order 337-2775-02.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *2712, 2711 Option 03 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*

Spectrum Analyzers
2714 • 2715

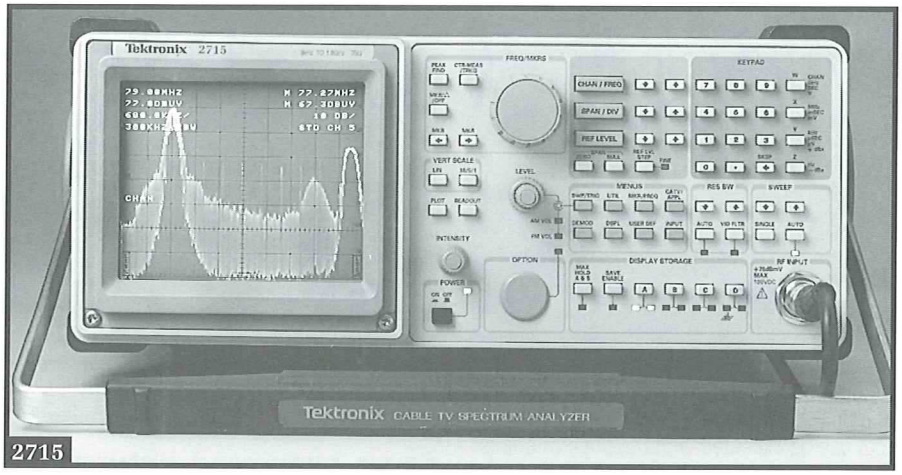
Features

2715

- In-service Measurements for In-channel C/N and Frequency Response, and CSO

2714/2715

- Built-in Automatic Cable TV Measurements Enhance Measurement Repeatability and Reduce Technician Training Time
- Addresses All Field FCC Proof-of-Performance Requirements
- Key Cable TV Measurements Execute Automatically from Simple, On-screen Menu Selections
- Unattended and Remote Measurement Modes Reduce Personnel Requirements in the Field
- Full Programmability over RS-232 or IEEE-488 (GPIB) Interface
- Quick-change 75 Ω F and BNC Input Connectors
- Built-in Preamp and Audio, and AM/Wideband FM Video Demodulation
- UL Listed 1244, Certified to CSA C22.2 No. 231-M89



The 2714 and 2715 simplify cable TV and broadband LAN measurements.

2714 Cable TV Spectrum Analyzer

QUICK, REPEATABLE, PUSH-BUTTON MEASUREMENTS

The Tektronix 2714 Cable TV Spectrum Analyzer provides the ultimate in ease and economy for cable TV and broadband LAN measurements. It's cable ready with a 75 Ω BNC input that can be quickly changed to a 75 Ω F-connector input. All of the common cable system spectral measurements are built in and menu selectable, including those needed to address field proof-of-performance requirements. Plus the accompanying PC software package adds measurement configuration, data collection, and automatic report generation capabilities.

What used to be complicated measurement procedures, even for engineering, are now push-button simple. Technicians can easily perform extensive cable system analysis and data collection in the field, all automatically.

Measurements and data collection can also be done remotely under computer control. Or the 2714 can be left unattended to run automatic measurements and data collection initiated by the built-in real-time clock.

Data collected in the field can be transferred from the 2714's memory via an RS-232 or GPIB interface to an MS-DOS personal computer (PC). The 2714's accompanying PC software package includes data archiving facilities, as well as automatic report generation for proof-of-performance records.

2715 Cable TV Spectrum Analyzer

DEPENDABLE, IN-SERVICE RF MEASUREMENTS AT AN AFFORDABLE PRICE

The Tektronix 2715 Cable TV Spectrum Analyzer includes all the capabilities of the 2714 Cable TV Spectrum Analyzer and more! Now you can make proof of performance and other cable system measurements without disruption of service to subscribers. And you can minimize the inconvenience of making measurements at the output of set-top converters. The 2715 provides accurate and automated measurement of in-channel carrier-to-noise, in-channel response, and coherent distortion signals, as well as carrier levels, frequencies, and more… without removal of carriers or modulation. In-service measurement of CTB requires an empty, adjacent channel or spectrum space.

You get all this capability in a 23-lb., compact, easy-to-carry package… at an attractive price. Similar to the Tektronix 2714, the 2715 includes the capabilities that will help you with system maintenance and toward speedy resolution of cable system problems: built-in preamplifier, audio and video demod, selectable TV line and field triggering and true, full gray-scale analog display for finding spurious signals and beats among noise and for checking modulation characteristics. Analog display is also used in the depth of modulation adjustment mode that is included with the 2715.

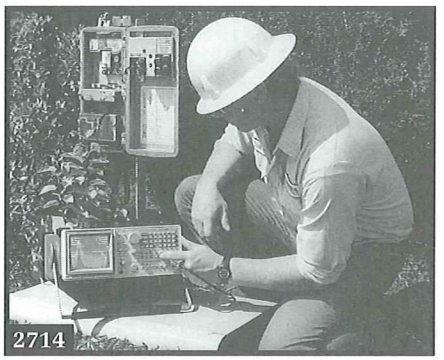
For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

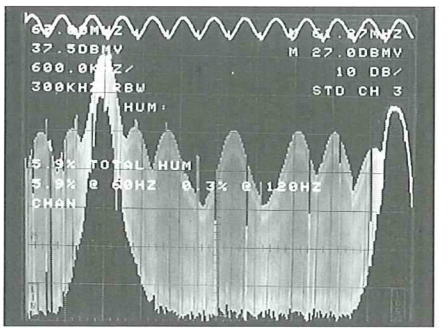
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Spectrum Analyzers
2714 • 2715



A complete set of in-service measurements can be configured into a system test program that can be executed with the push of one or two front-panel keys. Results from the field can be readily transferred from the 2715's non-volatile memory to your PC via the RS-232 or GPIB communications interface. The Tektronix Spectrum Analyzer RF Measurements software package, which is included in the price of the 2715, provides a data base for your measurements and can generate reports. Data is compatible with most popular spreadsheet packages. This software also provides remote operation capability for the 2715.

The 2715 includes a convenient, field-replaceable input connector that can easily be converted from type F to BNC.



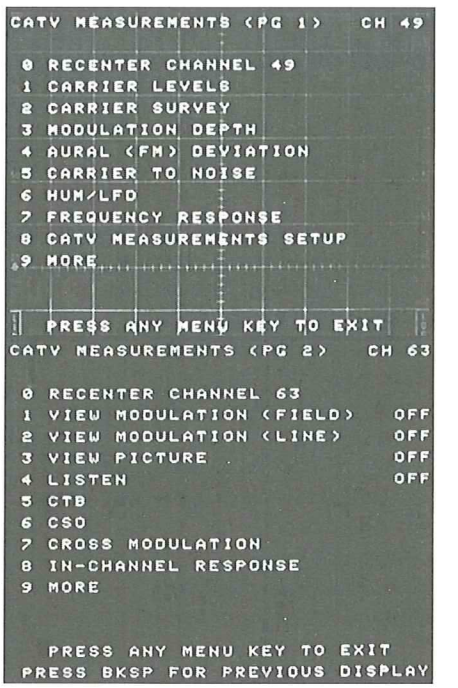
Measurement conditions and results are clearly displayed on-screen. Text can even be added, to describe measurement location, for example.

BUILT-IN, AUTOMATIC MEASUREMENTS

The 2714/2715 contains the following measurements and capabilities in its CATV Application menu:

- Automatic positioning of visual and aural carriers
- Visual and aural carrier levels and frequencies for selected channels
- Visual-to-aural carrier amplitude and frequency difference measurements for selected channels
- Dual-carrier audio level and frequencies
- Survey of system visual and aural carrier levels and frequencies
- Depth-of-modulation measurement
- Depth-of-modulation adjustment
- Aural carrier deviation measurement
- Aural carrier deviation adjustment
- Visual carrier-to-noise measurement
- In-channel response measurement
- Hum/low-frequency disturbance measurement
- System frequency response
- View baseband modulation (field and line) and demodulated video
- Aural carrier demodulation (listen mode)
- Distortion measurement – CTB and CSO
- Cross-modulation measurement

Measurements selected from the menu are automatically executed, and the results are displayed on the CRT screen. Not only are complex measurements reduced to push-button simplicity for less-experienced spectrum analyzer users, but measurement repeatability is high.



Pressing the CATV/APPL front-panel button provides easy access to the CATV Measurement Mode menu display.

Measurement results can be output to a printer or plotter connected directly to the interface port. Results can also be automatically stored in the non-volatile memory for later transfer to a PC. This, along with high portability, makes these analyzers ideal as automatic data collection tools in the field for engineers and technicians alike.

THE 2714/2715 CAPITALIZE ON PC POWER

The PC-based software package that accompanies the 2714/2715 runs automated cable TV measurements via an RS-232 or GPIB interface and provides a perpetual database for tracking system performance.

The software package provides the following capabilities:

Channel Table Generator – Create your own custom channel tuning tables in addition to the standard tables provided. Result: Data will be consistently taken on all of your system carriers, including scrambled channels, aeronautical offsets, and non-standard frequencies.

High-level Test Sequences – You can configure automatic test sequences from the built-in measurements. Creating a test sequence is a simple matter of indicating the desired tests in an on-screen setup matrix.

Spectrum Analyzers
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Report Generator – You can generate test and measurement reports that can be in any of several forms. These reports are directly usable for presentation of proof-of-performance data.

GENERAL PURPOSE CAPABILITIES
In addition to their special cable TV features, the 2714/2715 also double as highly capable, general-purpose spectrum analyzers. You get excellent RF performance, a built-in frequency counter, full programmability, enough non-volatile memory for up to 108 saved displays and 36 front-panel setups, digital and true analog displays, high portability, and numerous other features, including field-changeable F and BNC connectors.

The 2714/2715 can also be used to characterize filters, cable trunk amplifiers, line extenders, and other 2-port devices when used with the Option 05 External Tracking Generator.

Characteristics (Cable TV)

CABLE TV MEASUREMENTS
The following specifications and features apply after a 15 minute warmup period and after all normalizations, including reference normalizations, have been performed. CATV characteristics represent typical performance and are dependent on general spectrum analyzer specifications. CATV characteristics need not be verified independently providing that all spectrum analyzer specifications are verified.

Channel Selection – Visual and aural carriers displayed when channel number is entered or front-panel selected.
Tune Configuration: STD., HRC, IRC, and custom; configured using PC software.
Channel Number Range: 0 to 999; configured using PC software.
Frequency Range: 1 MHz to 1.8 GHz; dependent on selected Channel Table.

Visual Carrier Frequency – Measured with internal counter to 1 Hz resolution with accuracy of $5x10^{-7}$ x Carrier Frequency ±10 Hz ±1 Least Significant Digit.

Visual-to-Aural Carrier Frequency – Aural carrier measured with internal counter relative to visual carrier.
Difference Range: 1 MHz to 10 MHz (depending on selected channel table) for an amplitude difference of ≤30 dB and aural carrier to noise ≥15 dB (300 kHz RBW).
Resolution: 1 Hz.
Accuracy: ±15 Hz for visual-to-aural carrier difference ≤8 MHz.

Visual Carrier Peak Level – Absolute peak amplitude measured with preamp off.
Amplitude Range: –18 dBmV to +58.8 dBmV for visual carrier to noise ≥30 dB (300 kHz RBW) and total input power ≤+70 dBmV.
Frequency Range: 15 MHz to 1015 MHz.
Resolution: 0.1 dB.
Absolute Accuracy: ±2.5 dB for visual carrier to noise ≥30 dB (300 kHz RBW); for FM signals, carrier to noise ≥33 dB (100 kHz RBW).
Relative Accuracy: ±0.5 dB relative to adjacent channel, ±1.2 dB relative to all others.
Note: This test may not be valid on some scrambled channels.

Visual-to-Aural Carrier Level Difference –
Difference Range: 0 to 30 dB for aural carrier to noise ≥15 dB (300 kHz RBW).
Resolution: 0.1 dB.
Accuracy: ±0.75 dB for aural carrier-to-noise ≥15 dB (300 kHz RBW).
Note: This test may not be valid on some scrambled channels.

Modulation Depth – % AM measured from sync tip to lowest white level in 10 sweeps (VITS line used if defined in channel table).
AM Range: 50% to 95%.
Resolution: 0.1%.
Accuracy: ±2% for visual carrier-to-noise ≥40 dB (300 kHz RBW).

Hum/Low-Frequency Disturbance – Power line frequency measured on an unmodulated visual carrier and low frequency disturbance measured on the modulated carrier.
AM Range: 1% to 10% peak-to-peak.
Resolution: 0.1%.
Accuracy: ±1% for hum ≤5% and visual carrier-to-noise ≥25 dB (300 kHz RBW); ±2% for hum, <10% and visual carrier-to-noise ≥25 dB (300 kHz RBW).

Carrier-to-Noise – Default noise floor is a normalized 4 MHz bandwidth measured relative to the visual carrier peak.
Normalized bandwidth is user-selectable.
Resolution: 0.3 dB.
In-service, in-channel measurement with 2715.

CTB/CSO – Measured relative to visual carrier peak according to NCTA recommendations.
Resolution: 0.3 dB.
In-service CSO measurement with 2715.

Frequency Response – For fixed-amplitude scrambling or no scrambling, system amplitude variations (flatness) are displayed relative to a reference trace stored during frequency-response reference setup.
Range: 5 dB/div.
Resolution: 0.2 dB.
Flatness Accuracy: ±0.75 dB.

In-channel Response – Expresses maximum variance in amplitude within some specified frequency range within a particular channel, given a "flat" input over that same specified range. The variance is referenced to the average of the highest and lowest amplitude within the frequency range.
In-service measurement with 2715.
Range: ±3 dB.
Resolution: 0.1 dB.
Accuracy: ±0.5 dB.

Carrier Survey – Absolute peak amplitude of each visual carrier is measured and each associated aural carrier level is measured relative to the visual carrier for the selected channel. Frequency counted only when ACCUR AMPL AND FREQ is enabled.
Note: This test may not be valid on some scrambled channels.

Aural (FM) Deviation – Peak FM deviation is measured for the selected channel.
Range: 10 kHz to 50 kHz; usable to 80 kHz.
Accuracy: ±4 kHz.

Cross Modulation – Peak of fundamental component of 3rd order distortion at horizontal sync frequency (AM) measured on the unmodulated visual carrier.
Range: 48 dB.
Resolution: 0.1 dB.
Accuracy: ±2 dB for cross modulation <36 dB; ±3 dB for cross modulation <48 dB.

Listen Mode – Selected channel's aural carrier is FM demodulated and output fed to speaker or headphone jacks; instantaneous peak FM deviation is displayed.

View Picture Mode – Visual carrier is demodulated and displayed.

View Modulation (Field) – One video field of the selected channel's video is displayed.

Spectrum Analyzers
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View Modulation (Line) – VITS line displayed; if VITS line isn't specified in channel table, line 17 displayed.
TV Line Selection: Via FREQ/MKRS knob.
Line Format: NTSC, PAL, SECAM.
Line Range: 1-525 (NTSC); 1-625 (PAL).
Sweep Time: 10 µsec/div.

Characteristics (Spectrum Analyzer)

FREQUENCY RELATED

Frequency Range – 9 kHz to 1800 MHz.

Center Frequency Accuracy – 5 x 10^{-7} of center frequency ±700 Hz.

Frequency Counter Accuracy – 5 x 10^{-7} of center frequency ±10 Hz ±1 LSD (least significant digit).

Residual FM – ≤100 Hz p-p/20 msec at ≤20 kHz span/div; ≤2 kHz p-p/20 msec at >20 kHz span/div.

Resolution Bandwidth (–6 dB) – 5 MHz, 1 MHz, 300 kHz, 100 kHz, 30 kHz, 10 kHz, 3 kHz, 1 kHz, and 300 Hz.

RBW Shape Factor (60 dB/6 dB) – ≤7:1 for RBW ≤1 MHz.

Noise Sidebands – ≤–70 dBc at 30 x RBW for RBW ≤100 kHz.

Frequency Span/Div Range – 100 MHz to 1 kHz selected in 1-2-5 sequence or any value from 100 MHz to 1 kHz via the keypad or UTIL menu, plus 180 MHz and 0 Hz.

Span Accuracy – ±3% measured over the center eight divisions.

AMPLITUDE RELATED

Flatness – ±2 dB (relative to reference level at 100 MHz) measured with 10 dB internal RF attenuation (preamp off).

Vertical Display Modes – 10, 5, 1 dB/div, Linear.

Display Dynamic Range – 80 dB max. (Log Mode); 8 divisions maximum (Linear Mode).

RF Attenuation Range – 0 to 50 dB in 2 dB steps.

Maximum Sensitivity (at 300 Hz RBW) – –78 dBmV (–127 dBm); –90 dBmV (–139 dBm) with preamp on.

SPURIOUS RESPONSE (PREAMP OFF)

3rd Order IM Distortion – ≤–70 dBc from any two on-screen signals with any frequency span.

2nd Harmonic Distortion – ≤–66 dBc measured with 1st mixer input level of ≤+9 dBmV.

INPUT RELATED

RF Input – 75 Ω BNC with quick change to 75 Ω type F connector.

VSWR – With RF Attenuation ≥10 dB: 1.5:1 maximum to 1 GHz. With 0 dB RF Attenuation: 2:1 maximum to 1 GHz.

Maximum Safe Input – +70 dBmV (0.1 W or 2.2 V) continuous peak with 100 V DC blocking capacitor.

1 dB Compression Point – ≥+34 dBmV (–15 dBm) with 0 RF attenuation and 1st mixer at +19 dBmV (–30 dBm).

ENVIRONMENTAL

Temperature – Operating: 0° to +50°C (MIL T-28800E). Nonoperating: –55° to +75°C.

Humidity – Nonoperating: Five cycles (120 hours) in accordance with MIL-STD 28800E, Class 5.

Vibration – Meets MIL-T-28800E, Paragraph 4.5.5.3.1 (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.

Altitude – Operating: 15,000 ft. Nonoperating: 50,000 ft.

Electromagnetic Compatibility –
EC92 EMC Directive 89/336/EEC:
Emissions: EN50081-I.
Radiated Emissions, 30 MHz to 1 GHz, EN55022 Class B (CISPR 22 B).
Conducted Emissions, 150 kHz to 30 MHz, EN55022 Class B (CISPR 22 B).
Conducted Emissions, power line harmonics. 0 to 2 kHz, IEC 555-213.
Immunity: EN50082-1.
Electrostatic Discharge, 8 kV, IEC 801-2.
Radiated Immunity, 27 MHz to 500 MHz, IEC 801-3. No response above –90 dBm in a 3 V/meter field.
Fast Transients, capacitive clamp, 1 kV power leads, 500 V control leads, IEC 801-4. Power Line Surge, 1 kV differential mode, 2 kV Common mode, IEC 801-5.

GENERAL CHARACTERISTICS

Power Requirements – 105 W maximum (1.4 A) at 115 V, 60 Hz: Operates 48 Hz to 440 Hz, 90 to 132 V AC, or 48 Hz to 63 Hz, 90 V AC to 250 V AC.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	137*1	5.4*1
Width	361*1	14.2*1
Depth	445*1	17.5*1
Weight	**kg**	**lb.**
Net	<10.2*2	22.5*2

*1 *With feet, handle, and front-panel cover.*

*2 *Nominal for basic configuration.*

Note: Full specifications are available in the 2714 and 2715 Cable TV Spectrum Analyzer Data Sheets.

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Accessories

K212 INSTRUMENT CART
- Low Cost Portability
- Tiltable Top Tray
- Durable Aluminum and Thermoset Polyester Construction



ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

2714
Cable TV Spectrum Analyzer.
Includes: PC Software, Power Cord (U.S. 115 V/60 Hz), User's Manual, Programmer Manual, Software Reference Manual, Front Cover, 75 Ω BNC Connector, 75 Ω F Connector, and Choice of GPIB or RS-232 Interface (Opt. 03 or Opt. 08).

2715
Cable TV Spectrum Analyzer.
Includes: PC Software, Power Cord (U.S. 115 V/60 Hz), User's Manual, Programmer Manual, Software Reference Manual, Front Cover, 75 Ω BNC Connector, 75 Ω F Connector, and Choice of GPIB or RS-232 Interface (Opt. 03 or Opt. 08).

Opt. 03 – Provides an IEEE-488 General Purpose Interface Bus (GPIB) as a no-cost option (not compatible with Opt. 08).

Opt. 05 – 100 kHz to 1.8 GHz External Tracking Generator with Mechanical Mating Kit (includes Opt. 15).

Opt. 07 – Add 2704 Inverter/2705 Battery Pack.

Opt. 08 – Provides an RS-232 Port as a no-cost option (not compatible with Opt. 03).

Opt. 15 – Add 1st Local Oscillator Output for a 1405 TV Sideband Analyzer or External Tracking Generator.

Opt. 30 – Rackmount Adapter for 19 x 5.25 in.

Opt. 33 – Travel Line Package includes: Rain Cover, Accessory Pouch, Gray CRT Filter, and Carrying Strap.

Opt. 34 – Portable-to-rackmount Adapter for 19 x 7 in.

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Opt. A5. See Customer Information Section for additional description.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

SOFTWARE
See page 220 for additional information.

271x PC Utility Software – Order S26UT10.

ADDITIONAL ACCESSORIES
Also see pages 434.

CAMERAS/PLOTTERS/PRINTERS
Camera – Low cost. Order C-9 Opt. 1A and Opt. 20.

Plotter – Four Color. Order HC100 Opt. 01.

CART – K212 Instrument Cart.

CABLES, PADS, AND ADAPTERS
75 Ω Coaxial Cable –
BNC to BNC 42 in. Order 012-0074-00.
BNC to BNC 24 in. Order 012-1339-00.

F Series Input Adapter/Connector Replacement – Order 103-0301-00.

BNC Input Adapter/Connector Replacement – Order 103-0310-00.

GPIB Cables – 0.5 m. Order 012-1282-00.
1 m. Order 012-0991-01.
2 m. Order 012-0991-00.
4 m. Order 012-0991-02.

RS-232 Modem Cables –
9-Pin Female to 25-Pin Male. Order 012-1241-00.
9-Pin Female to 9-Pin Female. Order 012-1379-00.
9-Pin Female to 25-Pin Female. Order 012-1380-00.
25-Pin Male to 36-Pin Male. Order 012-1250-00.

"F" Female to BNC Male Adapter – Order 013-0126-00.

BNC Female to "F" Male Adapter – Order 103-0158-00.

"N" Female to BNC Male Adapter – Order 103-0058-00.

GPIB CARDS
PC-GPIB Card – IBM PC, AT, and Compatibles. Order S3FG210.

AT-GPIB Card – IBM AT Bus (High-speed Card). Order S3FG220.

MC-GPIB Card – IBM PS/2 with Microchannel Bus. Order S3FG230.

User's Manual
2714. Order 070-8532-02.
2715. Order 070-9115-00.

Service Manual – Order 070-8534-00.

Front Panel Cover – Order 200-2520-00.

Transit Case – Order 016-0792-02.

Soft Side Case – Order 016-1158-00.

Rain Cover – Order 200-2500-00.

Accessory Pouch – Mounts on top. Order 016-0677-03.

Carrying Strap – Order 346-0199-00.

Viewing Hoods – Collapsible. Order 016-0592-00.
Binocular. Order 016-0566-00.
Polarized. Order 016-0180-00.

CRT Filter – Smoke Gray. Order 337-2775-02.

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GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

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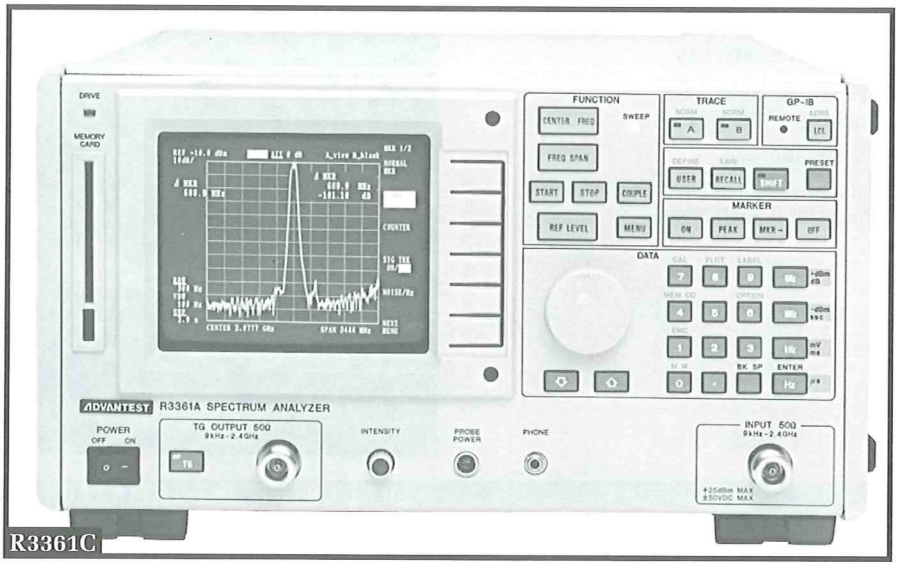
Spectrum Analyzers

R3361C • R3361CN • R3361D • R3261C • R3261CN • R3261D

Features

R3261C, R3261CN, R3261D, R3361C, R3361CN, R3361D

- Total Level Accuracy of 1 dB (Typical)
- User-defined Functions
- Measuring Window Function
- 120 dB Display Range
- Built-in Tracking Generator (R3361C, R3361CN, R3361D)
- CDMA Power Measurements (with Option 1K)



R3361C

R3261/R3361 Series Spectrum Analyzers

The R3261/R3361 Series spectrum analyzers use a synthesized technique to cover wide frequency bands: 9 kHz to 2.6 GHz (R3261C, R3361C) or 9 kHz to 3.6 GHz (R3261D, R3361D). These compact analyzers also offer high-performance functions, such as the 1 Hz resolution frequency setting function and 1 Hz resolution frequency counter function.

The R3261/R3361 Series spectrum analyzers are easy to operate because they incorporate unique features such as the user-defined functions and measuring window function. Weighing only 15 kg (33 lb.) the analyzers are small and useful for measurement and analysis of all kinds, from maintenance to research and development. The EMC measuring function, field strength measuring function, and audio-visual equipment analysis function for VCRs and 8-mm video equipment are also available.

The analyzers have an internal controller function (Option 15), parallel I/0, and GPIB interface for line connection and automatic measurement, so the user can create the ideal system configuration.

CHOOSE FROM SIX MODELS, DEPENDING UPON YOUR APPLICATION

The R3261/R3361 Series consists of six models. All models feature high performance and a set of features and functions for various applications.

	R3261C	R3261CN	R3261D	R3361C	R3361CN	R3361D
Frequency Range	9 kHz to 2.6 GHz	9 kHz to 2.6 GHz	9 kHz to 3.6 GHz	9 kHz to 2.6 GHz	9 kHz to 2.6 GHz	9 kHz to 3.6 GHz
Input Impedance	50 Ω	75 Ω	50 Ω	50 Ω	75 Ω	50 Ω
Internal Tracking Generator	Not available	Not available	Not available	Standard	Standard	Standard
Memory Card	Standard	Standard	Standard	Standard	Standard	Standard
Controller Function	Opt. 15	Opt. 15	Opt. 15	Opt. 15	Opt. 15	Opt. 15
Occupied Bandwidth Measurement, Adjacent-channel Leakage, Power Measurement	Standard	Standard	Standard	Standard	Standard	Standard
Burst Signal Analysis	Opt. 12	Opt. 12	Opt. 12	Opt. 12	Opt. 12	Opt. 12
CDMA Power Measurement	Opt. 1K	N/A	Opt. 1K	Opt. 1K	N/A	Opt. 1K

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987.*

ADVANTEST *Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.*

Spectrum Analyzers

R3361C • R3361CN • R3361D • R3261C • R3261CN • R3261D

1 HZ RESOLUTION SYNTHESIZER

The R3261/R3361 Series portable spectrum analyzers are based upon a synthesized system, so the center and start/stop frequencies can be set with a resolution of 1 Hz. Accurate and quick setting of the measuring frequencies is extremely useful when the frequency of a radio system already known is measured, or the start/stop frequency must be set correctly. The synthesizer, featuring 1 Hz resolution, is a powerful tool ideal for waiting, receiving, or spot measurement in the zero-span mode.

1 HZ RESOLUTION FREQUENCY COUNTER

The frequency counter built into the R3261/R3361 Series features 1 Hz resolution. One of the advantages of these analyzers is that they can measure the modulated frequency or spurious frequency of a radio system that cannot be measured with an ordinary frequency counter simply by setting a marker. The R3261/R3361 Series can measure a frequency very accurately in the counter mode even when the marker point is slightly off the peak point. In addition, the ability to measure weaker signals than a frequency counter can extend the application range from broadband panoramic measurement to weak signal measurement.

MANUAL SWEEP FUNCTION FOR SPOT MEASUREMENT

EMC measurements using the quasi-peak (QP) detector require an extended sweep time. However, the time required to measure the peak value can be shortened using the manual sweep function.

CREATE YOUR OWN UNIQUE MENU

The R3261/R3361 Series spectrum analyzers are very functional and very easy to use because of the user-defined functions and define functions. The built-in microprocessor (in some instruments) improves the measurement accuracy and functions but, at the same time, may make the systems very difficult to use. As a solution to this problem, the software menu method was developed. However, this method was still not satisfactory. The new concept employed in the R3261/R3361 solves these problems:

- **User-defined function.** The user can define a necessary function on the USER key in the same way as on the function keys of a personal computer. A unique menu can be created.
- **Define function.** The define function enables the user to change the software key menu manually. With this function, you can create a unique system by changing the key functions that were defined before the system was shipped from the factory.

FAST MEASUREMENT WITH MEASURING WINDOW FUNCTION

The R3261/R3361 Series has a measuring window function. In conventional analysis, the user picks up only necessary portions from all the display data with a marker. However, you may need to specify a certain range of data for the analysis. This is accomplished by the measuring window function. The window specification may include not only a frequency but a level. The frequency and level are not fixed but can be specified to arbitrary values for flexible analysis. In addition, since marker and sweep operations are possible in a range set by the frequency and level, the measuring time can be reduced greatly.

Characteristics

FREQUENCY RELATED

Measuring Frequency Range –
R3261C, R3261CN, R3361C, R3361CN: 9 kHz to 2.6 GHz.
R3261D, R3361D: 9 kHz to 3.6 GHz.

Central Frequency Setting Resolution – 1 Hz.

Central Frequency Display Accuracy –
Span ≤2 MHz: ±(3% of span + central frequency x reference oscillator accuracy + 20 Hz).
Span >2 MHz: +(2% of span + central frequency x reference oscillator accuracy + 20 kHz).

Reference Oscillator – Switching by internal or external input (10 MHz).

Internal Reference Oscillator Stability –
$+2 \times 10^{-8}$/day, $\pm 2 \times 10^{-7}$/year.

Frequency Span –
Linear mode: R3261C/CN, R3361C/CN, 1 kHz to 2.6 GHz and zero. R3261D/R3361D, 1 kHz to 3.6 GHz and zero.
Log mode: 1, 2, or 3 decades selected between 10 kHz and 1000 MHz.

Frequency Span Accuracy –
Span <2 MHz: ≤±3% of span.
Span >2 MHz: ≤±5% of span.

Frequency Stability – Residual FM:
10 MHz ≤ span < 2 MHz, 50 kHz p-p or less.
Span >2 MHz, 2 kHz p-p or less.
Span ≤2 MHz, 20 Hz p-p or less.
Frequency drift: Span ≤2 MHz, 300 Hz/min. or less.

Sideband Noise – At 20 kHz offset
f ≤ 3.0 GHz, –105 dBc/Hz;
f ≤ 3.6 GHz, –101 dBc/Hz.

Resolution –
3 dB bandwidth: 30 Hz to 1 MHz; switchable in 1 to 3 steps.
6 dB bandwidth: 200 Hz, 9 kHz, 120 kHz.
Selectivity: ≤15:1 (60 dB: 3 dB).
Bandwidth accuracy: ≤20%.

Marker Accuracy –
Normal mode: Central frequency display accuracy + span accuracy.
Counter mode: Display frequency x reference oscillator accuracy ±1 count.

AMPLITUDE RELATED

Amplitude Measuring Range –
R3261C, R3261D, R3361C, R3361D:
–130 dBm to +25 dBm.
R3261CN, R3361CN: –19 dBμV to +132 dBμV.

Screen Display Range –
Log mode: 10 dB/div, 120 dB. 10 dB/div, 80 dB. 5 dB/div, 50 dB. 2 dB/div, 20 dB. 1 dB/div: 10 dB.
Linear mode: 10 div.
QP mode: 80 dB (10 dB/div) when measuring range is 70 dB.

Display Linearity –
Log mode: ±2.0 dB/110 dB, ±1.5 dB/70 dB, ±1.0 dB/10 dB, ±0.2 dB/1 dB.
Linear mode: ±5% of full scale.
QP mode: ±2.0 dB/70 dB, ±1.0 dB/40 dB.

Reference Level Display Range –
R3261C, R3261D, R3361C, R3361D:
–109.9 dBm to +40.0 dBm, 0.715 μV to 22.4 V.
R3261CN, R3361CN: +0.1 dBμV to +150 dBμV, 1.01 μV to 31.6 V.

Reference Level Accuracy (after automatic calibration) –

	R3261C/R3261D R3361C/R3361D	R3261CN R3361CN
<±0.3 dB	0 dBm to –50 dBm	+110 dBμV to +60 dBμV
<±0.7 dB	+20 dBm to –70 dBm	+130 dBμV to +40 dBμV

Dynamic Range

Average Noise Level – (resolution bandwidth – 300 Hz, Video bandwidth 1 Hz, Input attenuator 0 dB, Frequency range 10 MHz or more):
R3261C, R3261D, R3361C, R3361D:
–120 dBm + 1.55 f (GHz) dB. R3261CN, R3361CN: –10 dBμV +1.55 f (GHz) dB.

Secondary and Tertiary Distortion –
≤–70 dB at –30 dBm input, Input attenuator 0 dB, Frequency 10 MHz or more.

Spectrum Analyzers

R3361C • R3361CN • R3361D • R3261C • R3261CN • R3261D

Frequency Response –

	R3261C/R3261D R3361C/R3361D	R3261CN R3361CN
100 Hz to 2 GHz	≤+0.5 dB	≤+0.5 dB
9 kHz to 2.6 GHz	≤+1.0 dB	–
9 kHz to 3.6 GHz	–	≤+1.5 dB

Residual Response –
R3261C, R3261D, R3361C, R3361D: ≤–100 dB (Termination: 50 Ω). R3261CN, R3361CN: ≤–11 dBµV (Termination 75 Ω).

Resolution Bandwidth Switching Accuracy – ≤±0.3 dB after automatic calibration.

Video Filter – 1 Hz to 1 MHz; switchable in 1 or 10 steps.

SWEEP RELATED

Sweep Time – 50 ms to 1000 s and manual sweep.

Sweep Time Accuracy – ≤3%.

Trigger Modes – FREE RUN, LINE, VIDEO, EXT, TV-V, and SINGLE.

TRACKING GENERATOR SPECIFICATIONS (R3361C, R3361CN, R3361D)

Frequency Range –
R3361C/R3361CN: 9 kHz to 2.6 GHz.
R3361D: 9 kHz to 3.6 GHz.

Output Level Range –
R3361C, R3361D: 0 dBm to –50 dBm.
R3361CN: +105 dBµV to 55 dBµV setting in 1 dB steps.

Output Level Accuracy – ≤±0.5 dB (30 MHz, –10 dBm, 20°C to 30°C).

Output Level Flatness –

	R3361C/R3361D (at –10 dBm output)	R3361CN (at +95 dBµV output)
100 kHz to 1.0 GHz	≤0.7 dB	≤0.7 dB
9 kHz to 2.6 GHz	≤1.5 dB	≤1.5 dB
9 kHz to 3.6 GHz	≤2.0 dB	≤2.0 dB

Output Level Switching Accuracy (at 0 dBm/+95 dBµV output) –
100 kHz to 1.0 GHz: ≤±1.0 dB.
9 kHz to 2.6 GHz: ≤±2.0 dB.
9 kHz to 3.6 GHz: ≤±3.0 dB.

Output Spurious (at 0 dBm/+105 dBµV output) –
Harmonic spurious: ≤–20 dB.
Non-harmonic spurious: ≤30 dB.

Tracking Generator Leakage –
R3361C/R3361D: Frequency ≤3.0 GHz, ≤–110 dBm. Frequency ≤3.6 GHz, ≤–100 dBm.
R3361CN: ≤+1 dBµV.

Output Impedance –
R3361C, R3361D: Approximately 50 Ω.
R3361CN: Approximately 75 Ω.

Output VSWR (at ≤–10 dBm/+95 dBµV output) – 100 Hz to 2 GHz: ≤1.5. 9 kHz to 3.6 GHz: ≤2.0.

Output Connector – N type.

INPUT RELATED

Input Impedance –
R3261C, R3261D, R3361C, R3361D: 50 Ω.
R3261CN, R3361CN: 75 Ω.

VSWR (at input attenuator ≥10 dB) –
100 kHz to 2 GHz: ≤1.5.
9 kHz to 3.6 GHz: ≤2.0.

Input Connector – N type.

Maximum Input Level –
R3261C, R3261D, R3361C, R3361D: +25 dBm (attenuator ≥30 dB), 50 V DC max.
R3261CN, R3361CN: +132 dBuV (attenuator ≥30 dB), ±50 V DC max.

Input Attenuator – 0 to 50 dB in 10 dB steps.

Input Attenuator Switching Accuracy – ≤1.0 dB (≤2.0 GHz), ≤1.5 dB (≤3.6 GHz) at input attenuator 10 dB.

Detection Modes – NORMAL, POSI, NEGA, and SAMPLE.

INPUTS/OUTPUTS

External Memory Function – IC memory card.

GPIB Data Output/Remote Control – Data output and remote control through internal GPIB interface.

Direct Plotting – Hardcopy output of all display data to Tektronix HC100 Option 01, or other HPGL plotters through internal GPIB interface.

Voice Monitor Output – AM and FM with approximately 8 Ω earphone.

Probe Power Source: – ±15 V, 4-Pin connector.

ENVIRONMENTAL

Ambient Temperature – 0°C to +50°C.
Relative Humidity: 85% or less.

Storage Temperature – –20°C to +60°C.

Safety – This product has been safety tested by Advantest to IEC 348 specifications.

POWER REQUIREMENTS

Operating Voltage –
Standard: 90 to 132 V.
Option 40: 198 to 250 V.

Power Consumption – Less than 220 VA.

Frequency – 48 to 66 Hz.

CRT – 5.5 in.

PHYSICAL CHARACTERISTICS

Dimensions (approx.)	mm	in.
Height	177	7.0
Width	330	13.0
Depth	450	17.7
Weight	**kg**	**lb.**
R3261C/CN/D	15	33
R3361C/CN/D	17	37.5

Spectrum Analyzers

R3361C • R3361CN • R3361D • R3261C • R3261CN • R3261D

Accessories

HC100

- Compatible with TDS Series, 11000 Series, and Most PC Systems
- Direct Plots from Most Tektronix Digitally-based Instruments Without Using a Controller
- Four Color
- Standard Interfaces
  – Centronics Parallel
  – GPIB
- A4 and US Letter Sizes
- Four Plotting Modes, Including HPGL

K475

- Stable/Mobile Platform
- Tiltable Shelf for Optimum Viewing
- Work-bench Height
- Heavy-duty Nylon Instrument Straps
- Surge and Noise Suppression
- Surge-protected Four Outlet Power Strip Accessory
- Shipped Ready to Assemble


K475

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

R3261C
2.6 GHz, 50 Ω Spectrum Analyzer.
Includes: Power Cord, BNC-to-BNC Cable, N-to-BNC Adapter, Memory Card, Instruction Manual.

R3261CN
2.6 GHz, 75 Ω Spectrum Analyzer.
Includes: Power Cord, BNC-to-BNC Cable, N-to-BNC Adapter, Memory Card, Instruction Manual.

R3261D
3.6 GHz, 50 Ω Spectrum Analyzer.
Includes: Power Cord, BNC-to-BNC Cable, N-to-BNC Adapter, Memory Card, Instruction Manual.

R3361C
2.6 GHz, 50 Ω Spectrum Analyzer with Tracking Generator.
Includes: Power Cord, BNC-to-BNC Cable(2), N-to-BNC Adapter (2), Memory Card, Instruction Manual.

R3361CN
2.6 GHz, 75 Ω Spectrum Analyzer with Tracking Generator.
Includes: Power Cord, BNC-to-BNC Cable(2), N-to-BNC Adapter (2), Memory Card, Instruction Manual.

R3361D
3.6 GHz, 50 Ω Spectrum Analyzer with Tracking Generator.
Includes: Power Cord, BNC-to-BNC Cable(2), N-to-BNC Adapter (2), Memory Card, Instruction Manual.

Opt. 12 – Gated Sweep Plus RS-232.

Opt. 15 – Gated Sweep Plus Controller Function (including Parallel I/O and Serial I/O).

Opt. 40 – 198 to 250 V AC operation.

Opt. 1K – CDMA Power Measurements.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES

PROBES

FET Probe – DC to 900 MHz (Requires 1101A). Order P6201.

FET Probe – DC to 500 MHz. Order P6202A.

50 Ω Divider Probe – DC to 3.5 GHz, 6 ft. Order P6156.

Current Probe – 935 Hz to 120 MHz. Order P6022.

Plotter – Order Tektronix HC100 Opt. 01.

Carrying Case – Order R16211A.

Front Cover – Order A02804.

Transit Case – Order R16056A.

Memory Card – Set of Five 32 KB Cards. Order A09505.

Memory Card – Set of Five 128 KB Cards. Order A09506.

Preamplifier – 9 kHz to 1 GHz, ≥ 25 dB. Order R14601.

Rackmount Set – Conforms to EIA Standards. Order A02455.

ADDITIONAL ACCESSORIES

Also see page 434.

Cart – Order K475.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987.*

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

Spectrum Analyzers
R4131D

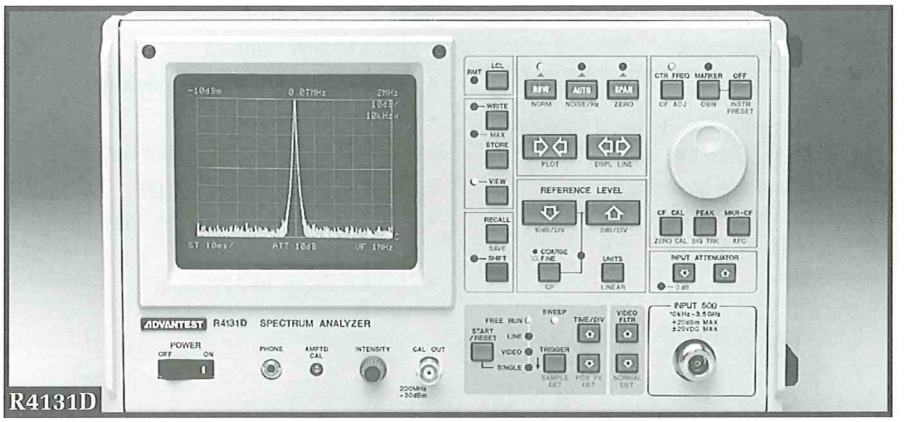
Features

R4131D

- 10 kHz to 3.5 GHz Coverage
- Excellent Phase Noise Sideband Characteristics:
  –80 dBc @ 20X Resolution Offset
- Small and Light, Weighing Only 10 kg (22 lb.)
- Save/Recall Measurement Conditions, Including Waveforms
- Low Price

Applications

- EMC Diagnostic Measurement
- Spectrum Monitoring



R4131D Spectrum Analyzer

The R4131D Spectrum Analyzer is small, light, and affordable. Its wide frequency range accommodates measurement of PCN MDS, and other 2 GHz band signals, plus harmonic distortion of RF signals. Maximum input sensitivity of –116 dBm, dynamic range of 70 dB, and –80 dBc phase noise characteristic enhance the range of signals that can be measured with the R4131D. AFC tuning enhances the stability of this economical spectrum analyzer.

Built-in quasi-peak detector and EMC resolution bandwidth filters enable diagnostic EMC measurement. Automated measurements and data logging are complimented by a GPIB communication interface.

SAVE/RECALL FUNCTION FOR CONDITIONS AND WAVEFORMS

The R4131D has a save/recall function which operates not only for measurement condition settings but for waveforms as well. Three sets of conditions and waveforms are stored and recalled. This enables a stored waveform to be used as a reference in comparison measurements at different locations. Independent from this function is an auto-recall function that automatically sets the desired measurement conditions when power is switched on – a great convenience in making on-site measurements.

WIDE DYNAMIC RANGE FOR FREQUENCY CHARACTERISTIC MEASUREMENTS

The R4131D can be combined with the TR4153B or TR4154 Tracking Generators to enable frequency characteristic measurements with wide dynamic range.

AUTOMATIC MEASUREMENT OF OCCUPIED BANDWIDTH

The R4131D has an optional automatic occupied-bandwidth measurement function. This function automatically determines the bandwidth within which 99% of the radiated power is contained, indicating the bandwidth markers and displaying values digitally.

Characteristics

FREQUENCY RELATED

Frequency Range – 10 kHz to 3.5 GHz.

Center Frequency Display – Displayed on the CRT with a maximum resolution of 1 kHz.

Center Frequency Display Accuracy (after zero calibration at local feed through) – ±100 kHz ±3% of span, <2.5 GHz at a sweep time of 5 ms/div to 0.5 s/div); ±10 MHz, ≥2.5 GHz.

Frequency Span – 50 kHz to 4 GHz in 10 divisions on the horizontal scale on the CRT, selectable in 1-2-5 sequence. With zero span, operates as a fixed tuned receiver.

Frequency Span Accuracy – ±5%.

Stability – Frequency stability (at fixed frequency, after 30-minute warm-up): 10 kHz max/10 minutes ≤2.5 GHz at sweep time of 5 ms/div to 0.5 s/div. Residual FM: 2 kHz p-p max/100 ms.

Noise Sideband – –80 dBc max at resolution bandwidth of 1 kHz (at 20 kHz from the carrier, with a 10 Hz video filter).

Resolution –
Resolution bandwidth (3 dB points): 1 kHz to 1 MHz in 1, 3, 10 sequence.
Resolution bandwidth (6 dB points): 9 kHz, 120 kHz, when QP mode is selected.
Selectivity (ratio of 60 dB:3 dB resolution bandwidths): 15:1 max.
Resolution bandwidth accuracy: ±20%, CISPR standard or better in QP mode.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1.*

ADVANTEST
Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

Spectrum Analyzers
R4131D

Marker Display –
Resolution: Maximum 1 kHz (depends on span).
Measurement accuracy: Center frequency display accuracy + frequency span accuracy.

AMPLITUDE RELATED
Screen Display Range –
LOG mode: With respect to reference level 80 dB for a 10 dB/div display and 20 dB for a 2 dB/div display, or 40 dB for a 5 dB/div display in QP mode.
LIN mode: 10 div.

Linearity –
LOG mode: ±0.15 dB/1 dB, ±1 dB/10 dB, ±1.5 dB/70 dB.
LIN mode: ±5% of full scale.

Reference Level –
LOG mode: –69 dBm to +40 dBm (for 10 dB/div, 10 dB and 1 dB steps, and for 1 dB/div and 5 dB/div, 1 dB and 0.25 dB steps).
LIN mode: 72.77 µV to 22.36 V.

Reference Level Accuracy – ±1 dB in LOG mode (in the reference level range of 0 to –59 dBm at 200 MHz, with attenuation at 10 dB after level calibration).

Reference Level Units – Selectable as dBm, dBµV, dBmV, or dBµV/m. When dBµV/m is selected, an automatic correction is made for the antenna calibration factor.

Marker Display –
Resolution: 0.2 dB (for 10 dB/div) or 0.05 dB (for 2 dB/div).
dBm/Hz: RMS noise level is displayed normalized with respect to the 1 Hz bandwidth noise at the marker position.

Dynamic Range –
Average noise level: –116 dBm + 1.55 f (GHz) dB or less.
2nd and 3rd order distortion: 70 dB down or greater (when input level is –30 dBm, at 10 MHz or above).
Frequency response (with 10 dB attenuation):
±1 dB or less (100 kHz ≤ F ≤ 2 GHz);
±2 dB or less (10 kHz ≤ F ≤ 3.5 GHz).
Residual response (with attenuation 0 dB, input termination 50 Ω, frequency >100 kHz): –100 dBm or less.

Video Filter – 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, 300 kHz, 1 MHz.

Resolution Bandwidth Switching Accuracy – ±1 dB (+20°C to 30°C).

Gain Compression – 1 dB max for –10 dBm input.

SWEEP RELATED
Sweep Time – 5 ms/div to 100 s/div selectable in 1-2-5 sequence.

Sweep Time Accuracy – ±15%.

Trigger Modes – Free-run, line, video, and single (reset, start).

INPUT RELATED
RF Input – Approx. 50 Ω, N connector.

Maximum Input Level – +20 dBm, ±25 V DC max (with 20 dB or greater input attenuation).

Input Attenuator – 0 to 50 dB in 10 dB steps.

Input Attenuator Switching Accuracy – ±1 dB (10 kHz ≤ F ≤ 2 GHz) or ±1.5 dB (2 GHz ≤ F ≤ 3.5 GHz) with respect to 10 dB attenuation.

Input VSWR (at 10 dB input attenuation or greater) – 1.5 max (100 kHz ≤ F ≤ 2 GHz); 2.0 max (2 GHz ≤ F ≤ 3.5 GHz).

DISPLAY RELATED
Display – Waveform, setting conditions, grid.

CRT – 5.5 inch, phosphor, amber display.

Trace – WRITE waveform and VIEW waveform (up to 2 waveforms displayed on the CRT).

WRITE – Posi-peak, sample, and posi-neg display.

MAX HOLD – For every repetition from the beginning of the function, the maximum signal level along the horizontal axis is displayed.

MARKER – Frequency and level at the marker point are measured and displayed.

PEAK SEARCH – The marker is moved to the point of maximum level on the displayed waveform.

MRK CF – The center frequency is changed to the marker frequency.

ZERO CAL – Improves the center frequency accuracy for local feed through.

PLOT – Direct plotting via GPIB.

NORMALIZE – Display of values relative to an internally stored reference response.

SAMPLE – Display of instantaneous time-signal levels at each analysis position for each sweep.

OUTPUT RELATED
Calibration Output Signal – 200 MHz ±30 kHz, –30 dBm ±0.5 dB.

Monitor Output – Approx. 8 Ω, enables monitoring using an earphone.

Recorder Outputs (analog output of WRITE waveform only) – X axis: Approx. –5 V to +5 V (approx. 10 kΩ). Y axis: Approx. 0 V to +4 V (approx. 220 Ω).

IF Output – 3.58 MHz IF output, approx. 50 Ω.

Video Output – Approx. 1 V p-p, approx. 75 Ω (composite signal for external CRT).

Probe Power Output – ±15 V, 4-Pin connector.

GPIB – Fully controllable over the GPIB for automatic testing as well as direct plotting without an external controller.

POWER REQUIREMENTS
Line Voltage – 90 to 132 V.

Line Frequency – 50/60 Hz.

Power Consumption – 120 VA max.

GENERAL SPECIFICATIONS
Save/Recall – Up to three sets of measurement conditions, including waveforms, can be stored in memory and auto-recall can be used to automatically recall stored conditions when power is applied.

Temperature – Operating: 0°C to +50°C. Storage: –20°C to +70°C.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	300	11.8
Height	177	7.0
Depth	460	18.1
Weight	**kg**	**lb.**
Net	10	22

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

R4131D
Spectrum Analyzer.
Includes: Power Cable, Input Cable, N-to-BNC Adaptor.
Opt. 14 – Occupied Bandwidth Measurement and 3 dB Down Measurement.

ADDITIONAL ACCESSORIES
Also see page 434.
Preamplifier – 9 kHz to 1 GHz, ≥25 dB. Order R14601.

ADVANTEST
Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

Spectrum Analyzers
U4941 • U4941N

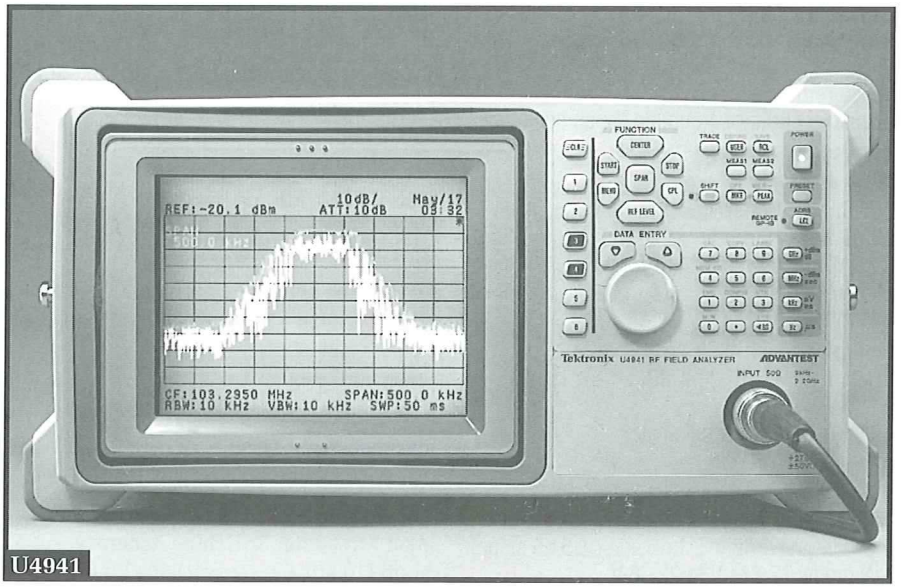
Features

U4941/U4941N

- 9 kHz to 2.2 GHz Frequency Range
- High Mobility – Very Light and Compact
- Operate from Attach-on Optional Battery, Standard AC Adapter, or Direct 12-V DC
- Enhanced Spectral Display Comparison using 6-inch Color TFT LCD Display
- Accurate Frequency Measurement with Built-in Counter
- 10 MHz External Frequency Reference Input Providing Added Accuracy
- Diverse Signal Measurement Using 90 dB Display Dynamic Range
- EMI Measurement with Built-in Quasi-peak Detector and EMC Filters

Applications

- EMC Field Measurement
- Broadband LAN Installation
- Field-strength Measurement
- Two-way and Wireless Communications Troubleshooting



U4941

U4941/U4941N RF Field Analyzers

These 9 kHz to 2.2 GHz analyzers introduce a new level of portability and convenience to RF measurements. The 5.8 x 11.5 x 13 inch, 14.3 pound package is easily carried to hard-to-reach places. And if your measurement site lacks AC mains, the U4941/U4941N are ready to run directly from an external 12 V DC supply or from their own optional attach-on battery.

These analyzers feature a mechanical package that is designed to MIL-T-28800D environmental standards for shock, vibration, and drop – adding to your confidence to carry the U4941/U4941N into the field.

SEE YOUR RESULTS IN COLOR!
An easy-on-the-eyes, six-inch TFT LCD color display not only reduces instrument weight, size, and power requirements, but also lessens user-fatigue when extended display viewing time is required. The display screen may be tilted for optimum viewing angle.

PERFORMANCE FOR TODAY'S APPLICATIONS... AND TOMORROW'S
Wide, 90 dB display dynamic range and high sensitivity ensure that you see weak signals, even in the presence of much stronger signals. Sensitivity is enhanced by a built-in 20 dB preamp. And signals can be readily identified by a built-in frequency counter.

EASY TO USE, EASY TO STORE MEASUREMENT RESULTS
Soft-key menus and three modes of data input adapt operation of the U4941/U4941N to differing user preferences. A full complement of marker functions improve speed and repeatability on a variety of measurements. Included is a window function, which delimits a portion of the displayed sweep, resulting in a significantly faster update of the spectrum of interest when sweep time must be increased due to change of resolution bandwidth, video bandwidth, or span.

Measurement set-ups, limit lines, measurement results, and other data can be stored on memory cards that plug into either of two PCMCIA slots conforming to JEIDA-Ver 4.1/PCMCIA Rel 2.0. Or, two cards may be used simultaneously for redundant storage of measurement data.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1.*

Tektronix

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

Spectrum Analyzers
U4941 • U4941N

COMPLEMENT YOUR APPLICATION WITH THESE ADDITIONAL CAPABILITIES

- AM/FM detector and built-in speaker/headphone jack for signal demodulation
- Faster measurements using built-in routines for:
  - Occupied bandwidth
  - Adjacent channel leakage
  - Noise power
  - 2nd and 3rd order distortion
  - Percent AM
- 10 MHz external reference input for additional frequency accuracy
- Composite video output to display spectrum on a large screen monitor or hard copy on a video printer
- 75 Ω input for broadband network applications (U4941N)

Characteristics

FREQUENCY RELATED

Frequency Range – 9 kHz to 2.2 GHz.

Frequency Readout Accuracy (Start, Stop, CF, Marker) – ±(span x span accuracy + 0.15 x RBW + 50 kHz).

Count Frequency Marker (S/N ≥ 25 dB, 50 kHz ≤ 1 GHz span, RBW ≥ 100 kHz) –
Resolution: 1 Hz to 10 kHz.
Count accuracy: ±(marker freq. x freq. reference accuracy +1 LSD ±5 Hz).

Frequency Reference Accuracy –
±2 x 10^{-6}/year. ±1 x 10^{-5} (at 0°C to 50°C).

Frequency Span –
Range: 50 kHz to 2.4 GHz, ZERO.
Accuracy: ≤±5% (SPAN ≥ 100 kHz).

Frequency Stability –
Residual FM: ≤3 kHz p-p/100 ms.
Frequency drift (50 ms to 5 s sweep time): ≤10 kHz after 30 minute warm-up.

Noise Sidebands – ≤100 dBc/Hz at 20 kHz offset.

Resolution Bandwidth (3 dB) –
Range: 1 kHz to 3 MHz, 1, 3 sequence.
Bandwidth accuracy: ≤±20% 1 kHz to 1 MHz; ≤±25% at 3 MHz.
Selectivity: ≤15:1 60 dB to 3 dB.
Bandwidth (6 dB): 9 kHz, 120 kHz (conforming to CISPR standard).

Video Bandwidth – 10 Hz to 3 MHz.

AMPLITUDE RELATED

Amplitude Range – +20 dBm to displayed average noise level; +130 dBµV to displayed average noise level.

Maximum Input Level –
Preamplifier OFF: +27 dBm, +134 dBµV (input atten. ≥ 10 dB), ±50 V DC max.
Preamplifier ON: +13 dBm, +120 dBµV, ±50 V DC max.

Display Range –
Log: 10 x 10 divisions; 10, 5, 2, 1 dB/div.
Linear: 10% of reference level/div.
QP Log: 40 dB (5 dB/div).

Reference Level Range –
Preamplifier OFF: Log, –64 dBm to +40 dBm (0.1 dB step); +46 dBµV to +150 dBµV.
Linear, 141.1 µV to 22.36 V.
Preamplifier ON: Log, –84 dBm to +10 dBm (0.1 dB step); +26 dBµV to + 120 dBµV.
Linear, 14.11 µV to 707.1 mV, 19.95 µV to 1 V.

Input Attenuator Range – 0 to 50 dB (10 dB step).

DYNAMIC RANGE

Displayed Average Noise Level –
Preamplifier OFF: –117 dBm + 2.7 f (GHz) dB; –8 dBµV + 2.7 f (GHz) dB.
Preamplifier ON: –132 dBm + 3.3 f (GHz) dB; –23 dBµV + 3.3 f (GHz) dB. (RBW 1 kHz, VBW 10 Hz, Input atten. 0 dB, f ≥ 1 MHz).

Gain Compression (1 dB) –
Preamplifier OFF: >–10 dBm (mixer input level, f ≥ 10 MHz); >+100 dBµV.
Preamplifier ON: >–40 dBm (RF input level, f ≥ 10 MHz); >+70 dBµV.

Spurious Response, Preamplifier OFF (–30 dBm input, input atten. 0 dB, f ≥ 10 MHz) –
Second harmonic distortion, ≤–70 dB.
Third order intermodulation distortion, ≤–70 dB.

Residual Responses (input atten. 0 dB, f ≥ 1 MHz) –
Preamplifier OFF: ≤–100 dBm; ≤+10 dBµV.
Preamplifier ON: ≤–115 dBm; ≤–5 dBµV.

AMPLITUDE ACCURACY

Frequency Response –
Preamplifier OFF (input atten. 10 dB, 20°C to 30°C after calibration): ≤±1 dB (100 kHz to 2 GHz); ≤±2 dB (9 kHz to 2.2 GHz).
Preamplifier ON (input atten. 10 dB): ≤±1 dB (100 kHz to 2 GHz); ≤±2 dB (9 kHz to 2.2 GHz).

Calibration Signal Accuracy –
–20 dBm ±0.3 dB; +78 dBµV ±0.3 dB.

IF Gain Uncertainty (after automatic calibration) – <±0.5 dB.

Scale Fidelity (after automatic calibration) –
Log: ≤±1.5 dB/90 dB; ≤±1.0 dB/10 dB; ≤±0.2 dB/1 dB.
Linear: ±5% of reference level.

Input Attenuator Switching Accuracy (20 to 70 dB settings referenced to 10 dB) –
<±1.0 dB (100 kHz to 2 GHz);
<±1.5 dB (9 kHz to 2.2 GHz).

Resolution Bandwidth Switching Uncertainty (after automatic calibration) –
<±1.0 dB relative to 3 MHz RBW.

SWEEP RELATED

Sweep Time Accuracy – 50 ms to 1000 s and manual sweep ≤±5%.

Trigger Mode – FREE RUN, SINGLE, VIDEO, EXT, TV.

DEMODULATION

Spectrum Demodulation –
Modulation type: AM and FM.
Audio output: Speaker and phone jack with volume control.

Spectrum Analyzers
U4941 • U4941N

INPUTS AND OUTPUTS

RF Input – Connector type: N type.
Impedance: U4941, 50 Ω nominal; U4941N, 75 Ω nominal.
VSWR, Preamplifier OFF: ≤1.5 (100 kHz to 2.0 GHz, input atten. 10 dB); ≤2.0 (9 kHz to 2.2 GHz).
VSWR, Preamplifier ON: ≤2.1 (10 MHz to 2 GHz, input atten. 0 dB).

10 MHz Reference Input –
Connector: BNC female, rear panel.
Impedance: 50 Ω nominal.
Input range: +8 dBm to +16 dBm.

Video Output –
Connector: BNC female, rear panel.
Impedance: 75 Ω nominal, AC coupled.
Amplitude: Approx. 1 V p-p into 75 Ω (composite video signal).

External Trigger Input –
Connector: BNC female, rear panel.
Impedance: 10 kΩ nominal, DC coupled.
Trigger level: TTL level.

Gate Input –
Connector: BNC female, rear panel.
Impedance: 10 kΩ nominal.
Sweep step: During TTL low level.
Sweep continue: During TTL high level.

Phone Output – Connector: Subminiature monophonic jack, front panel.
Power output: 0.2 W into 8 Ω nominal.

GPIB Interface – IEEE-488 bus connector.

Plotter – R9833, HP7470A, HP7475A, HP7440A, HP7550A, HP2225A.

RS-232C – D-SUB 9-Pin, rear panel.

External Memory Card – Slots: 2.
Connector: JEIDA-Ver. 4.1/PCMCIA Rel. 2.0.

POWER REQUIREMENTS

AC input (use AC/DC adaptor A08180) –
Line voltage range: Automatically selects between 100 V AC and 200 V AC.
100 V AC operation: 90 to 120 V.
220 V AC operation: 220 to 240 V.
Line frequency: 48 to 66 Hz. Power consumption: 100 V AC, 300 VA maximum.
220 V AC, 110 VA maximum.
Maximum peak power consumption of AC/DC adapter: ≥300 VA.

External DC input – Connector: XLR 4-Pin.
Voltage range: +10 to +15 V.
Power Consumption: 50 W maximum.

GENERAL SPECIFICATIONS

Environmental – Operating temperature: 0°C to 50°C, humidity 85% or less.
Nonoperating temperature: –20°C to +60°C.

PHYSICAL CHARACTERISTICS

Dimensions*1	mm	in.
Height	148	5.75
Width	291	11.375
Depth	330	13.25
Weight	**kg**	**lb.**
Net	6.2	13.6

*1 Without feet or connector.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

U4941
RF Field Analyzer, 50 Ω Input.

U4941N
RF Field Analyzer, 75 Ω Input.
Includes: Front-panel Cover, Carrying Handle, N-to-BNC Adapter, AC/DC Adapter, AC/DC Converter/Mains Cable, Carrying Belt, Instruction Manual, Quick Guide.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES
Also see page 434.
Battery – Order 146-0111-00.
Battery Charger – Order 119-4901-00.
Display Hood – Order R16601.
External DC Power Cable – Order A01434.
Memory Card, 64K IC – Order A09507.
Soft Carrying Case – Order R16216.
Transit Case – Order R16072.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

Tektronix

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

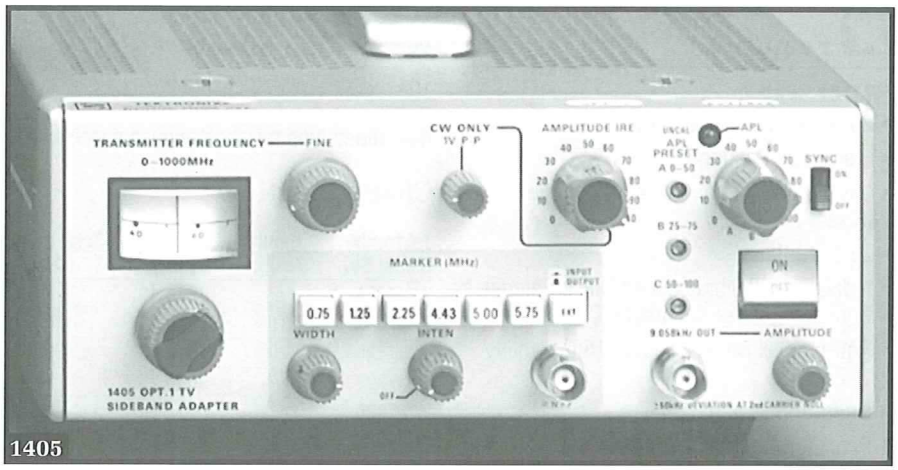
TV Sideband Adapter

1405

Features

1405

- Facilitates In-service or Out-of-Service Testing of Transmitter
- Measure Transmitter Frequency Response to Within ±0.2 dB
- Video Circuits Can Be Swept
- Check Aural FM Deviation with Built-in Bessel Null Technique
- Flexible Marker System Will Accept Standard Crystals
- UL Listed 1244, CSA Bulletin in 556B
- Frequency Range to 1 GHz
- Output Amplitude 0 to 100 IRE
- APL 0 to 100 in 10 IRE Steps
- Compatible with 525/60 or 625/50 Systems



1405

1405 TV Sideband Adapter

The 1405 Sideband Adapter works with 271X Series Spectrum Analyzers to analyze the sideband and in-band response of a television transmitter. It generates a composite video signal, the "picture" portion of which is a constant amplitude sinusoidal signal that sweeps continuously and periodically between 0 and 15 MHz. This signal is applied as modulation to a modulator or transmitter. The output is displayed on the spectrum analyzer and appears as a response curve, typically to within ±0.2 dB, of the transmitter being tested.

The 1405/Spectrum Analyzer combination displays frequency characteristics of RF and IF circuits with frequencies to 1 GHz. Video circuits can also be analyzed.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

1405
TV Sideband Adapter 525/60 Markers.
Includes: Instruction Manual (070-2078-00).

Opt. 01 – TV Sideband Adapter (625/50 Markers).

Opt. 03 – Dial Readout for 271X Series Spectrum Analyzers.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – United Kingdom 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.

See Customer Information Section for additional description.

Rackmount Conversion Kit – Standard 19 in. Rack. Order 016-0489-00.

Waveguide Mixers
WM782 series

Features

WM782 SERIES

- 26 to 325 GHz Frequency Range
- Frequency Response Is ±3 dB*2
- Lowest Conversion Loss Waveguide Mixers Available
- Zero DC Bias
- Individually Calibrated with Quick Reference Conversion Loss Calibration Chart
- Anti-parallel Diodes Reduce Vulnerability to ESD
- Uniform Size and Shape
- Precision Gold-plated Brass Core
- Tough Protective Outer Shell of LEXAN Plastic

Applications

- Spectrum Analysis for Millimeter Wave Frequencies
- Swept Frequency Response Measurements
- Power Level Measurements for Millimeter Wave Frequencies
- Harmonic Generator/Frequency up/down Conversion

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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WM782 Series Waveguide Mixers

The Tektronix WM782 Series are high-performance, broadband, zero DC bias, anti-parallel dual-diode type mixers designed specifically for use with the Tektronix 2784. The mixer series covers the standard waveguide bands from 26 GHz to 325 GHz. Each mixer has its own conversion loss chart on the back for easy reference.

Characteristics

Tektronix Model No.	Band Desig.	Freq. Range (GHz)	Sensitivity*1 (dBm)	Freq. Response*2 (dB)	Conv. Loss (dB)	1 dB Compression	Low-pass Cut-off Freq.*4
WM782A	A	26 to 40	–115	–	20	0 dBm	16 GHz
WM782Q	Q	33 to 50	–115	±3	20	0 dBm	20 GHz
WM782U	U	40 to 60	–115	±3	20	0 dBm	20 GHz
WM782V	V	50 to 75	–110	±3	25	0 dBm	28 GHz
WM782E	E	60 to 90	–105	±3*3	35	0 dBm	28 GHz
WM782W	W	75 to 110	–105	±3*3	35	0 dBm	28 GHz
WM782F	F	90 to 140	–95	±3*3	40	0 dBm	32 GHz
WM782D	D	110 to 170	–90	±3*3	45	0 dBm	40 GHz
WM782G	G	140 to 220	–85	±3*3	60	0 dBm	40 GHz
WM782J	J	220 to 325	–75	±3*3	70	0 dBm	40 GHz

**1 Equivalent average noise level using 2784 Spectrum Analyzer in 1 kHz resolution bandwidth.*
**2 Maximum amplitude variation across each waveguide mixer band using a 2784 Spectrum Analyzer.*
**3 Over any 5 GHz bandwidth for millimeter wave mixers above 60 GHz.*
**4 Low-pass filters in LO/IF path.*

Tektronix Product	Waveguide (EIA)	(JAN)	Dimensions Flange LxWxH	Weight (g)
WM782A 26 to 40 GHz	WR-28	UG-599/U	9.525x2.54x4.32 in. 3.75x1.00x1.70 cm	113.4 4.0
WM782Q 33 to 50 GHz	WR-22	UG-383/U	8.89x2.54x4.32 in. 3.50x1.00x1.70 cm	113.4 4.0
WM782U 40 to 60 GHz	WR-19	UG-383/U-M	8.89x2.54x4.32 in. 3.50x1.00x1.70 cm	113.4 4.0
WM782V 50 to 75 GHz	WR-15	UG-385/U	8.89x2.54x4.32 in. 3.50x1.00x1.70 cm	113.4 4.0
WM782E 60 to 90 GHz	WR-12	UG-387/U	8.89x2.54x4.32 in. 3.50x1.00x1.70 cm	113.4 4.0
WM782W 75 to 110 GHz	WR-10	UG-387/U-M	8.89x2.54x4.32 in. 3.50x1.00x1.70 cm	113.4 4.0
WM782F *1 90 to 140 GHz	WR-08	UG-387/U-M	8.89x2.54x4.32 in. 3.50x1.00x1.70 cm	113.4 4.0
WM782D *1 110 to 170 GHz	WR-06	UG-387/U-M	8.89x2.54x4.32 in. 3.50x1.00x1.70 cm	113.4 4.0
WM782G *1 140 to 220 GHz	WR-05	UG-387/U-M	8.89x2.54x4.32 in. 3.50x1.00x1.70 cm	113.4 4.0
WM782J 220 to 325 GHz	WR-03	–	–	–

**1 All mixers have standard UG-xxx/U-type flanges. MIL-F-3022-type flanges available in F, D, & G bands.*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

WM782 WAVEGUIDE MIXERS AND SETS

26 to 40 GHz – Order WM782A.
33 to 50 GHz – Order WM782Q.
40 to 60 GHz – Order WM782U.
50 to 75 GHz – Order WM782V.
60 to 90 GHz – Order WM782E.
75 to 110 GHz – Order WM782W.
90 to 140 GHz – Order WM782F.
110 to 170 GHz – Order WM782D.
140 to 220 GHz – Order WM782G.
220 to 325 GHz – Order WM782J.
26 to 60 GHz Set – Includes WM782A and WM782U. Order WM7826.
26 to 90 GHz Set – Includes WM7826 plus WM782E. Order WM7827.
26 to 140 GHz Set – Includes WM7827 plus WM782F. Order WM7828.
26 to 220 GHz Set – Includes WM7828 plus WM782G. Order WM7829.
33 to 75 GHz Set – Includes WM782Q and WM782V. Order WM78210.
33 to 110 GHz Set – Includes WM78210 plus WM782W. Order WM78211.
33 to 170 GHz Set – Includes WM78211 plus WM782D. Order WM78212.
Cable – Required for use. Order 012-1346-00.

Waveguide Mixers
WM780 Series

Features

WM780 SERIES

- 18 to 325 GHz Frequency Range
- Frequency Response Is ±2 dB
- Individual Frequency Characterization Curves Attached to Housing
- Custom Characterization Available
- Precision Gold-plated Brass Body

Applications

- Radar
- Millimeter Wave R&D
- Communications

WM780 Series Waveguide Mixers

The Tektronix WM780 Series Waveguide Mixers cover a frequency range of 18 to 325 GHz with optimum flatness. They can serve a wide variety of general-purpose uses, such as down-conversion for noise figure and network analysis measurements.

WM780 Series Waveguide Mixers feature individual frequency characterization curves attached to the housing for improved measurement accuracy.

All mixers are gold-plated brass, conforming to MIL-G-45204 Class I, Type 1 specifications, and will withstand harsh environments.

ELECTRICAL CHARACTERISTICS

Tektronix Model No.	Band Desig.	Frequency Range (GHz)	Sensitivity Typical (dBm)	Frequency Response Typical (dB)	Conversion Loss Typical (dB)	Low-pass*1 Cut-off Frequency
WM780K	K	18-26.5	–100	±2	30	12 GHz
WM780A	A	26.5-40	–95	±2	30	16 GHz
WM780Q	Q	33-50	–90	±2	35	21 GHz
WM780U	U	40-60	–90	±2.5	35	16 GHz
WM780V	V	50-75	–90 @ 50 GHz –85 @ 75 GHz typ	±3 typical	35 @ 50 GHz 40 @ 75 GHz	28 GHz
WM780E	E	60-90	–80 @ 60 GHz –80 @ 90 GHz typ	±3 typical	35 @ 60 GHz 45 @ 90 GHz	28 GHz
WM780W	W	75-110	–80 @ 75 GHz –70 @ 110 GHz typ	±3 typical	45 @ 75 GHz 55 @ 110 GHz	30 GHz
WM780F	F	90-140	–75 @ 90 GHz –65 @ 140 GHz typ	±3 typical	50 @ 90 GHz 60 @ 140 GHz	32 GHz
WM780D	D	110-170	–70 @ 110 GHz –60 @ 170 GHz typ	±3 typical	50 @ 110 GHz 60 @ 170 GHz	40 GHz
WM780G	G	140-220	–65 @ 140 GHz –55 @ 220 GHz typ	±3 typical	55 @ 140 GHz 65 @ 220 GHz	40 GHz
WM780J	J	220-325	–55 @ 220 GHz, –45 @ 325 GHz typ	±3 typical	65 @ 220 GHz 75 @ 325 GHz	40 GHz

**1 These low-pass filters are in the LO/IF connector.*

Note: Above characteristics are for information and are not warranted. User can enter frequency data into the Advantest R3271A and R3272 Spectrum Analyzers.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

WM780 WAVEGUIDE MIXERS AND SETS

18 to 26.5 GHz – Order WM780K.
26.5 to 40 GHz – Order WM780A.
33 to 50 GHz – Order WM780Q.
40 to 60 GHz – Order WM780U.
50 to 75 GHz – Order WM780V.
60 to 90 GHz – Order WM780E.
75 to 110 GHz – Order WM780W.
90 to 140 GHz – Order WM780F.
110 to 170 GHz – Order WM780D.
140 to 220 GHz – Order WM780G.
220 to 325 GHz – Order WM780J.
18 to 40 GHz Set – Includes WM780K, WM780A. Order WM7802.
18 to 60 GHz Set – Includes WM780K, WM780A, WM780U. Order WM7803.
33 to 170 GHz Set – Includes WM780Q, WM780V, WM780W, WM780D. Order WM78012.

ACCESSORIES

Case – Order 006-7340-00.

Tracking Generators

2707 • 2711/2712 Opt. 04 • 2711/2712/2714 Opt. 05

Features

2707, 2711/2712 OPT. 04 AND 2711/2712/ 2714 OPT. 05

- 2707 External Tracking Generator (271X Opt. 05) for 2711 and 2712 (Must be Used for Tracking Generator Capability with 2712 Opt. 12 or 14) and 2714/2715
- Internal Tracking Generator for 2711 and 2712 (Opt. 04)
- Swept Measurements 100 kHz to 1.8 GHz
- Output from –48 dBm to 0 dBm (–1.2 dBmV to 46.8 dBmV) in 0.1 dB Steps
- Easy to Operate
- Frequency Offset Capability

Applications

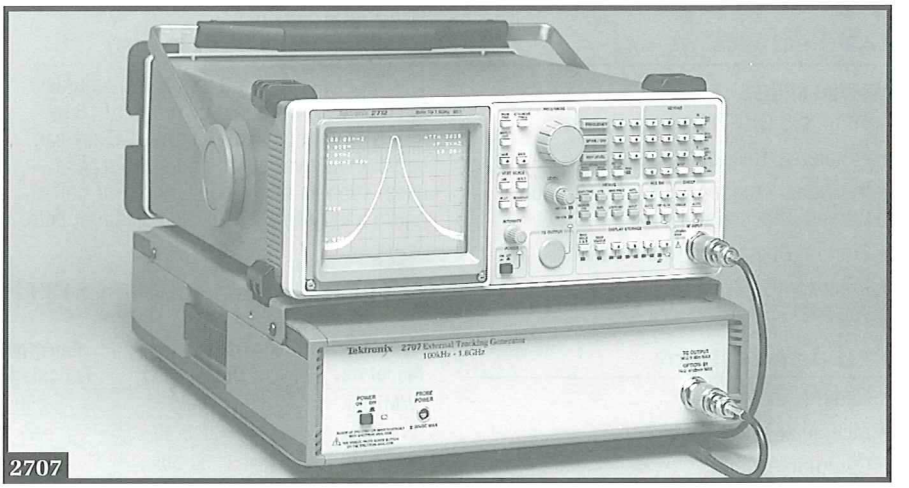
- CATV – Check Filters, Amplifiers and Cables
- EMI – Site Attenuation Tests, Filter Design, and Isolation Checks
- Broadcast – Check Traps and Filters
- Communications Radio Maintenance – Tune Duplexers, Check Antennas

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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Internal and External Tracking Generators

Characterize filters, check duplexers or cables, make frequency response, SWR measurements (with a return-loss bridge), EMI site attenuation tests – all this and much more. The 2707, 2711/2712 Option 04 (internal) and 2711/2712/2714 Option 5 (external) tracking generator systems provide swept measurements from 100 Hz to 1.8 GHz and at least 100 dB dynamic range to see filter, ultimate rejection, or circuit isolation characteristics.

Characteristics (with 271X Series)

2711/2712 Option 04 Internal Tracking Generator. 2707 External Tracking Generator (271X Option 05*[1]).

Frequency Range – 100 kHz to 1.8 GHz.

Tracking Adjust – Accommodates delay devices (long coaxial cables, etc.).

Output Range – 0 dBm to –48 dBm; Option 01: –1.2 dBmV to 46.8 dBmV.

Output Setting Resolution – 0.1 dB.

Manual Level Adjust – Continuous between attenuator steps.

VSWR – ≤2:1 or better with Output Level ≤–8 dBm.

Tracking Generator Flatness – ±1 dB from 100 kHz to 1.0 GHz and ±1.5 dB to 1.8 GHz.

User Corrected Flatness (B, C minus A) – Typically ±0.2 dB.

Dynamic Range (System) – ≥100 dB typical.

Spurious Responses (harmonically related) – ≤–20 dBc at ≥100 kHz.

Spurious Responses (non-harmonically related) – ≤–30 dBc at ≥100 kHz.

Request External Tracking Generator Data Sheet or Internal Tracking Generator Data Sheet for full characteristics.

**[1] Option 15, 1st LO output, must be installed in 271X Spectrum Analyzers to be used with the 2707. See compatibility kits below.*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

2707
External Tracking Generator.

2711/2712/2714 OPTION 05
External Tracking Generator.
Includes: Power Cord, 50 Ω SMA Cable, Type N Male-to-BNC Female Adapter, 15-Pin Male-to-15-Pin Male High Density D-sub Cable Assembly. Mounting Bracket with Mounting Hardware, Trim Strips, Instruction Manual.

Opt. 01 – 75 Ω output.

2711/2712 OPTION 04
Internal Tracking Generator.
See page 198 for more information.

2707 COMPATIBILITY KITS
2711, 2712, and 2714 with Opt. 15 (1st LO output) Installed. Order 040-1406-00.

2711, 2712, and 2714 without Opt. 15 Installed. Order 040-1407-00.

2711, 2712 and 2714 1st LO Output. Order 040-1408-00.

Tracking Generators

TR4153B • TR4154

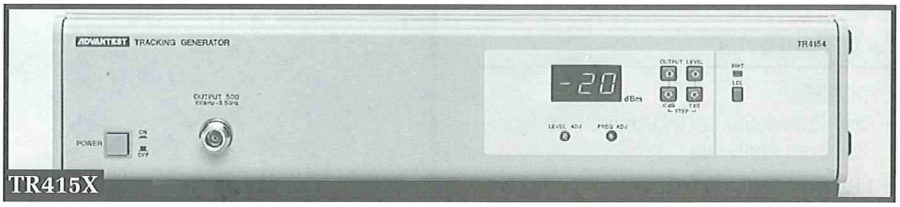
Features

TR4153B/TR4154

- 100 kHz to 2 GHz (3.5 GHz, TR4154)
- 0 dBm to –59 dBm (Switchable in 1 dB Steps)
- Wide Dynamic Range Scalar Analysis Measurement

Application

- CATV – Check Filters and Amplifiers
- EMI – Site Attenuation Tests, Filter Design, and Isolation Checks
- Broadcast – Check Traps and Filters
- Communications Radio Maintenance – Tune Duplexers, Check Antennas



TR4153B/TR4154

The TR4153B/TR4154 Tracking Generators provide swept frequency operation for the R4131D Spectrum Analyzer.

TR4153B Characteristics

Frequency Range – 100 kHz to 2 GHz.

Output Impedance – Approximately 50 Ω.

Output VSWR – 100 kHz to 1.5 GHz: 1.5 maximum.
1.5 GHz to 2.0 GHz: 2.0 maximum.

Output Level Flatness – ±0.7 dB maximum (with respect to 200 MHz output, over an output level range of 0 to –10 dBm and frequency range of 100 kHz to 2 GHz).

Output Level Variable Range – 0 to –10 dBm or greater, continuously variable.

Spurious Output Components –
Harmonics: ≤20 dBc.
Nonharmonics: ≤30 dBc (at 0 dBm output).

Tracking Generator Leakage – –110 dBm.

Output Connector – Type N.

Environmental – Operating temperature: 0°C to 40°C.
Humidity: 85% maximum.

Power Requirements –
Line voltage: 90 to 110 V.
Line frequency: 50 to 60 Hz.
Power consumption: 50 VA maximum.

TR4154 Characteristics

Frequency Range – 100 kHz to 3.5 GHz.

Output Impedance – Approximately 50 Ω.

Output VSWR – 100 kHz to 2 GHz: 1.5 maximum.
2 GHz to 3.5 GHz: 2.0 maximum (at output level of –10 dBm or lower).

Output Level Accuracy – ±0.5 dB (at 200 MHz, –10 dB output, +20°C to +30°C).

Output Level Flatness – 100 kHz to 2 GHz, –10 dBm output: 2 dB p-p. 100 kHz to 3.5 GHz, –10 dBm output: 4 dB p-p.

Output Level Switching Accuracy (with respect to –10 dBm output, over an output level range of 0 to –59 dBm) – 100 kHz to 2 GHz, ±2 dB. 100 kHz to 3.5 GHz, ±2.5 dB.

Spurious Output Components (at 0 dBm output) – Harmonics: ≤20 dB.
Nonharmonics: ≤30 dB.

Tracking Generator Leakage – –110 dBm or less.

Output Connector – Type N.

Environmental – Operating temperature: 0°C to 40°C.
Humidity: 85% maximum.

Power Requirements –
Line voltage: 90 to 110 V.
Line frequency: 50 to 60 Hz.
Power consumption: 50 VA maximum.

PHYSICAL CHARACTERISTICS

	TR4153B		TR4154	
Dimensions	**mm**	**in.**	**mm**	**in.**
Height	90	3.5	88	3.5
Width	300	11.8	424	16.7
Depth	440	17.3	440	17.3
Weight	**kg**	**lb.**	**kg**	**lb.**
Net	10	22	10	22

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TR4153B
Tracking Generator.
Includes: Power Cable, Output Cable, SMA Connecting Cable, BNC Connecting Cable.

TR4154
Tracking Generator.
Includes: Power Cable, Output Cable, SMA Connecting Cable, BNC Connecting Cable.

ADDITIONAL ACCESSORIES
Also see page 434.

Inverter/Battery Pack

2704 • 2705

Features

2704/2705

- Easy Connection to Tektronix 271X Family Spectrum Analyzers
- 115 W of AC Power
- Continuous Power Using Sequential Battery Packs
- Lightweight Single Package for Easy One-handed Carrying
- Automatic Charging of Two Battery Packs Simultaneously
- Auxiliary 18 V DC LNB Power
- Low Battery Warning



2704 Inverter/ 2705 Battery Pack

The 2704 Inverter and 2705 Battery Pack can provide for operation of 271X spectrum analyzers in locations where AC power is not available. These units mount directly on the spectrum analyzer to form a portable package.

Several 2705s can be used to provide an uninterruptible power source for the spectrum analyzer or other equipment. The 2704 includes a battery charger, and provides an auxiliary 18 volt output. The 2704 also accepts 12 volt input from other sources, such as car batteries. These units are described in more detail in the Inverter/Battery Pack Data Sheet.

Characteristics

2704 INVERTER

DC Input (main and auxiliary) – 11.25 V DC to 15 V DC.

Output Voltage – 115 V AC RMS ±10%.

Output Frequency – 60 Hz ±5%.

Output Waveform – Quasi-sinusoid.

Output Power – 115 W maximum continuous.

Battery Charger – AC input voltage (90 V AC to 250 V AC, 50/60 Hz). AC power consumption 70 W typical.

Auxiliary Output for LNB Voltage – 18 V DC ±10%. Ripple, 200 mV typical. Maximum output current 1 A (current limited).

2705 BATTERY PACK

Type – Sealed lead-acid.

Minimum Operating Time – 50 min at 10°C to 40°C, 45 minutes at 0°C to 10°C.

Charging Time (using 2704) – Eight hours typical for one battery pack, 12 hours for two battery packs, fully discharged state, 0°C to 40°C.

Cycle Life – ≥125 charge/discharge cycles to 100%.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

2704
Inverter.
Includes: Power Cord (U.S. 115 V, 60 Hz), Operator's Manual, Analyzer Mounting Plate.

2705
Battery Pack.

1.5 Meter DC Power Cord –
2704 Inverter-to-Automotive Cigarette Lighter Plug. Order 118-8549-00.

1.5 Meter DC Power Cord –
2704 Inverter-to-Alligator Clips. Order 118-8550-00.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – United Kingdom 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.

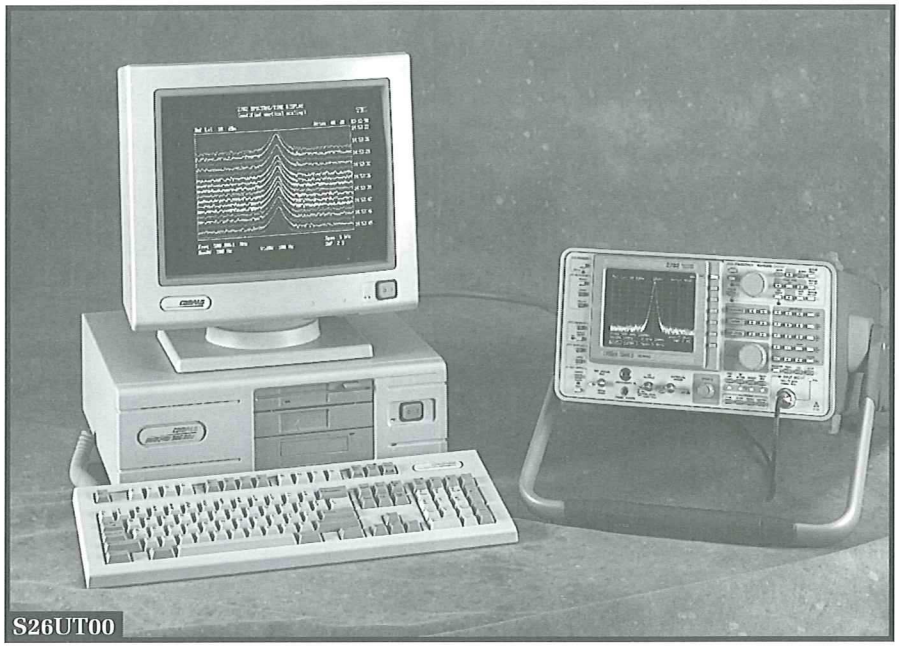
See Customer Information Section for additional description.

Spectrum Analyzer Software
S26UT00

Features

S26UT00

- Performs Automated Spectrum Analysis on PC-compatible Controllers
- Select Applications Routines Through Pop-up Menus
- Provides Data Logging to Color Copier, Printer, or Magnetic Media



S26UT00 2784/PC Utility Software

The Tektronix 2784/PC Utility Software is designed to capitalize on the power of the Tektronix 2784 Spectrum Analyzers and PC-compatible controllers.

This software package offers applications/utility routines that are selected through pop-up menu operation. Even a non-technical operator has immediate access to operations such as waveform graphing, waveform storage and recall, harmonic distortion measurements, and performing a fast or precise signal search over a selected frequency band.

A Talk/Listen routine is also included for explicitly setting or querying any front-panel function. This is very useful for programmers who want to test certain programmable features in an interactive environment.

A particularly unique capability of this software is the waterfall routine. It continually acquires and graphs traces on screen, using a pattern of changing colors. This allows you to detect changes in spectral content that occur over specified time intervals.

All 278x tests are based on user-defined defaults. The results of the tests can then be displayed on screen, or stored to disk for later recall. Graphics drivers are included for both CGA (Color Graphics Adapter) and EGA (Enhanced Graphics Adapter) displays, and the colors of the graphs are user selectable.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

S26UT00
2784 Utility Software.

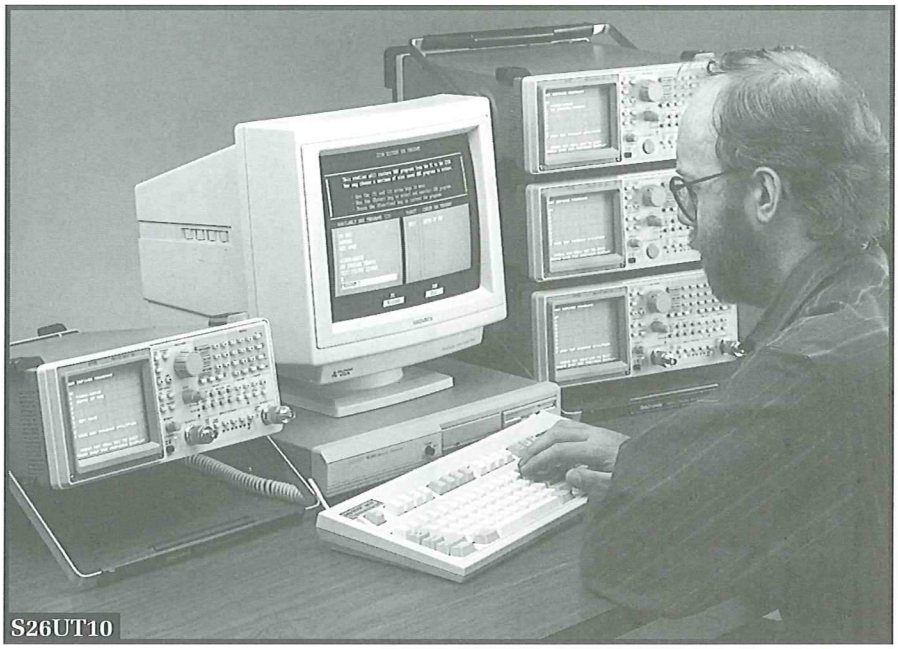
Includes: Software on 5.25 in. DS/DD Diskettes, License Agreement, and User's Manual.

Spectrum Analyzer Software
S26UT10

Features

S26UT10

- Performs Automated Spectrum Analysis on PC-compatible Controllers
- Measurement Data May Be Stored to Disk, or Included As Part of a Report or Document



S26UT10 271X/PC Utility Software

Tektronix' 271X/PC Utility Software is designed to extend the storage capabilities as well as automate some of the more common functions of the 271X Spectrum Analyzers. These include waveform acquisition, graphing, documentation, storing to disk, comparing, subtracting, recalling from disk, and sending to the analyzer. Both single traces and groups of related traces can be manipulated.

The software provides utility routines for operations such as TALK/LISTEN (sending commands and receiving responses), selecting the color of waveform graphs and annotation, and specifying the drive or path under which waveforms and other files will be stored.

The software includes an application category which can be supplemented with user-specific applications. This category contains a waterfall application, an occupied bandwidth measurement application, and an application to save, recall, and transfer User-defined Programs to other 271X analyzers equipped with a communications port.

The measurement category contains a program to measure harmonic distortion and a program to check swept frequency response. The latter uses the optional, fully programmable 271X tracking generator to measure peak-to-valley response within a specified frequency range.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

S26UT10
2710 Series PC Utility Software.
Includes: Software on 5.25 in. and 3.5 in. Diskettes.

Opt. 09 – Source Code.

EMI/RFI Solutions

EMI/RFI Solutions – An Introduction

Electrical and electronic devices may emit signals which interfere with other devices, or even with themselves. These signals are known as electromagnetic interference (EMI) or sometimes as radio frequency interference (RFI). Conversely, the ability of a device to withstand emissions from other devices or from itself is called immunity. The inverse of immunity is electromagnetic susceptibility (EMS).

As the number of electronic devices in use increases, so does the potential for these devices to interfere with each other. Electromagnetic compatibility (EMC) is a measure of how well they share their electromagnetic environment without adverse affects from EMI.

The goal of EMC is to construct electrical equipment with sufficiently low emissions and sufficiently high immunity to guarantee electromagnetic compatibility. The definition and enforcement of "sufficiently high" and "sufficiently low" becomes a matter of standards and regulations. In fact, when we refer to EMC compliance, we generally mean the ability of a system or device to meet standards regulating the amount of EMI that it can emit and its immunity to EMI.

EMC/EMI is a vital concern to manufacturers of electrical equipment subject to compliance. Their products must meet the applicable standards before they can be marketed. To ensure electromagnetic compatibility, the necessary measures should, therefore, be considered as early in the design phase as possible so they can be implemented in product development.

EMI

Electromagnetic interference or emissions from an electrical or electronic device may significantly impair radio and TV reception in the vicinity. While this is clearly an annoyance, an even greater concern is interference to navigation and communications equipment on board aircraft.

To prevent such a critical situation and to allow a wide variety of devices to operate next to and with each other, it's important to define interference limits ensuring a sufficient safety margin between EMI emissions and EMS limit values. Depending upon the standard being applied and the limit class required, different test conditions have to be observed in interference measurements. Test measurements are made either in shielded rooms or at an open-area test site as required. It is important that the measuring instruments themselves should not influence the result.

EMS

EMS measurements are made to test the function of a module, instrument, or system under the influence of conducted or radiated interference. These measurements must be carried out in shielded rooms or anechoic chambers. RF absorbers in the test chamber prevent erroneous results and simulate open-site conditions at high frequencies.

FIELD-STRENGTH AND RADIO MONITORING MEASUREMENTS

Radiocommunications services (PTT, broadcasting corporations, military, traffic and security authorities, as well as civil services) use field-strength meters for propagation measurements in the planning stage and for coverage measurements during operation of communication networks.

Field-strength measurements – in particular, propagation and coverage measurements – are usually made in mobile mode (vehicle or aircraft). Therefore, portability and DC or battery operation are important criteria in the choice of a test receiver.

Radio monitoring services use test receivers to check emissions for compliance with the specifications. Test parameters include field-strength, wave propagation, spurious responses, frequency, occupied bandwidth, frequency deviation, and amplitude modulation depth, as well as channel and band occupancy.

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EMI/RFI SOLUTIONS

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EMI/RADIO MONITORING SOLUTIONS

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EMI/RFI Solutions

27120

Features

DIAGNOSTIC AND PRE-/POST-CERTIFICATION MEASUREMENTS

- Detect Potential Problems Early in the Design Phase
- Diagnose and Correct "Hot Spots" Prior to Building Production Prototypes
- Verify Performance Before Purchasing Expensive and Difficult-to-Schedule Certification Testing

COMPLIANCE MAINTENANCE

- Establish Ongoing EMC Compliance Program
- Create Benchmarks and Detect Deviations
- Make Relative and Absolute Measurements to Ensure Product Continues to Meet EMC Standards

OPTIONAL 2707 TRACKING GENERATOR

- Site Attenuation Measurements
- Filter Evaluation

27120 SYSTEM INCLUDES

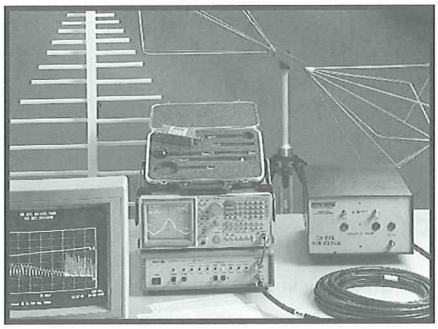
- 2712 Option 12 Spectrum Analyzer
- 2706 Stepping RF Preselector
- S26EM12 Test Software
- Biconical and Log-perodic Antennas
- RF Probe Set, LISN, Transient Limiter, Tripod, 10 m Cable

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*



Tektronix EMC Measurement Solutions Are Affordable and Effective

The time to address Electromagnetic Compliance (EMC) is before it becomes an expanding problem. Proper attention to EMC from the design stage through pre-certification testing can reduce your product development cost and decrease your time to market.

Tektronix wants to share its EMC experience and expertise with you. For over 40 years Tektronix has been a world leader in the design and production of spectrum analyzers, oscilloscopes, logic analyzers, and a wide variety of other high-technology electronic devices. In support of these products, we have established and maintained an FCC approved, in-house EMC testing facility and evolved effective measurement systems and methodologies. The knowledge gained has had an important influence on the EMC measurement tools and solutions described in this section.

One result is the 27120 EMC Pre-/Post-Certification Measurement System. It can maximize the probability that your product will be certified the first time through the EMC testing lab, lowering the cost of delays from scheduling and re-testing your products. It can also ensure continued compliance in the months and years after certification.

By combining the economical 2712 Spectrum Analyzer with a variety of supporting devices and our versatile S26EM12 EMI Test Software, Tektronix has created a pre- and post-certification system that will help you achieve these and other goals in the years ahead.

The S26EM12 PC-based EMC software package provides a straightforward means of controlling the 27120 system and managing measurement results. The software facilitates FCC, EC, VDE, VCCI, and other EMI testing. The easy-to-use 9 kHz to 1.8 GHz 2712 Spectrum Analyzer includes many features helpful in identifying and measuring EMC signals: built-in pre-amp, frequency counter, AM/FM demodulator, true analog or 4-trace digital display, peak, quasi-peak, and average detection, and 200 Hz, 9 kHz, and 120 kHz EMI filters.

Overload capability is enhanced and ambient signal interference is minimized by the 2706 Stepping RF Preselector. Biconical and log-periodic antennas, a tripod and feedline, and a LISN (Line Impedance Stabilization Network) with transient limiter enable you to make radiated measurements from 30 MHz to 1 GHz and conducted measurements from 9 kHz to 30 MHz. Magnetic and electric near-field RF probes for EMC troubleshooting round out the system. All together, this is a complete but very economical package for addressing all of your EMI diagnostic and pre- and post-certification needs. More details on the 2712 Spectrum Analyzer are available on page 195. Components of the 27120 Measurement System are also available separately.

For additional information on EMC measurements using Tektronix Spectrum Analyzers, software, and associated equipment, contact your local Tektronix Sales Office.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

27120
EMC Pre-/Post-Certification Measurement System.
Includes: 2712 Opt. 12 Spectrum Analyzer, 2706 Stepping RF Preselector, S26EM12 Test Software, Biconical and Log-periodic Antennas, RF Probe Set, LISN, Transient Limiter, Tripod, 10 m Cable.

Opt. 05 – Add External Tracking Generator.

Opt. 10 – Add Television Demodulator.

Opt. 11 – Delete Antennas, Tripod, Cable.

Opt. 16 – Delete LISN and Transient Limiter.

Opt. 17 – Delete 2706 RF Preselector.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

ADDITIONAL ACCESSORIES

Rain Cover – Order 200-2500-00.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-5

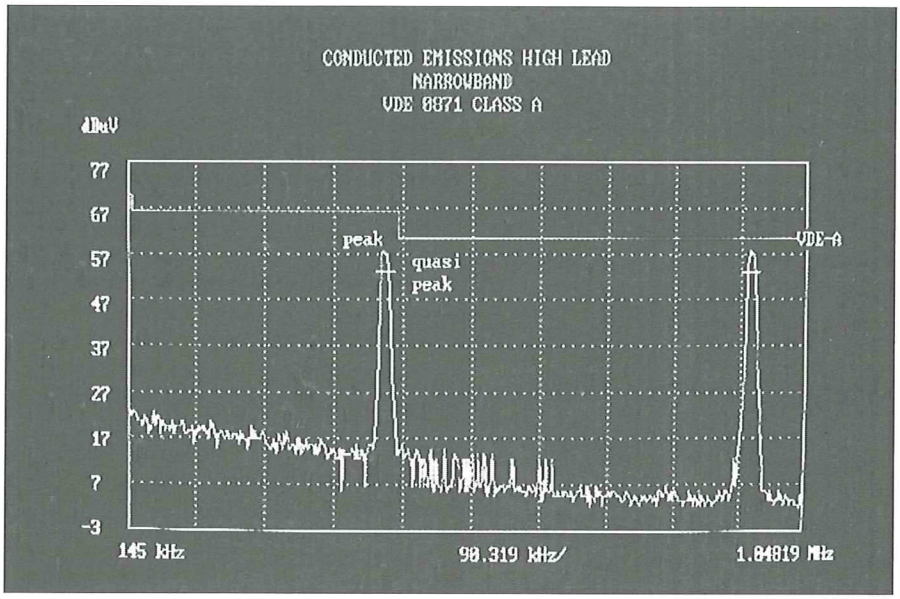
EMI/RFI Solutions

S26EM12

Features

S26EM12 EMI TEST SOFTWARE

- Cost-effective Approach to Automated EMI Testing
- Runs on IBM-compatible PC
- Easy, Menu-driven Operation
- Configure and Save Test Set-ups with User-defined Steps and Frequency Ranges
- Define and Save User-specified Test Limits
- Perform Tests to User-defined or Standardized Limits
- Define and Save User-specified Correction Factors
- Graphically Display Multiple Test Results
- Automate Spectrum Analyzer Compression Tests



Graphic display of peak and quasi-peak measurements.

S26EM12 Commercial EMI Test Software

Tektronix' Commercial EMI Test Software provides a powerful engineering tool for integrating EMI testing into product design cycles.

The EMI software automates the testing and data recording procedures required to analyze the Equipment Under Test (EUT) against U.S. or international test requirements, over a frequency range of 1 kHz to 1.8 GHz. Routines and provisions are included for compliance to FCC, VDE, and CISPR standards. This comprehensive software package runs radiated emissions, magnetic emissions, conducted emissions, and radiated power tests. Measurements can also be made against user-defined limits. The software supports peak, quasi-peak, and average detection methods and controls most Tektronix spectrum analyzers and the 2706 Stepping RF Preselector.

The software works with your IBM PC or compatible computer. Hardware requirements are modest: a GPIB interface, 512 KB of RAM, a hard disk, and any size floppy disk drive. Color graphics take better advantage of the software's features (EGA or VGA is recommended), but monochrome is supported too. A run-time function library module (for Microsoft QuickBASIC) is included, as well as sample test setups and results.

Tektronix S26EM12 EMI Software allows test systems to be set up in shielded rooms, at open field sites, or at the engineering bench. All acquired test data are stored to disk and can be viewed immediately in graphic or text formats, or archived for later review and report generation. Test results are stored as ASCII characters so they can be used by other analysis software.

Testing is completely menu-driven from the computer keyboard and display. Test results can be automatically graphed on the monitor screen, or plotted on HP-GL or Epson-compatible plotters. They can also be printed on Epson FX-compatible or HP LaserJet-compatible printers. In addition, tabular test results can be printed on an Epson-FX or compatible line printer.

FREE DEMO –
A free demo disk is available by calling the Tektronix TeleBusiness Center at 1-800-426-2200.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

Free S26EM12 demo disk available. Call the number above.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

S26EM12
Commercial EMI Test Software.
Includes: 5.25 in., 3.5 in. Media and Documentation.

EMI Ancillary Devices – See page 225.

EMI/RFI Solutions

2706

Features

2706

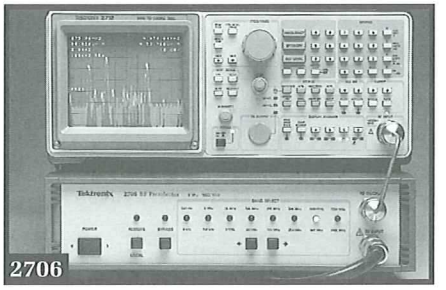
- Low Investment
- Easy to Use
- Part of Automated Measurement System Using Tektronix S26EM12 EMI Software
- Bypass Mode Facilitates Measurement Without Preselection
- Can Be Easily Taken to Remote Measurement Sites
- Can Be Used As a Standalone Filter in Many Other Applications
- 9 kHz to 1800 MHz Overall Range (Bypass Mode)
- Continuous Bandpass Filtering from 9 kHz to 1800 MHz in Eight Selectable Bands
- Compact, Lightweight Design
- Attaches to the Tektronix 271X Spectrum Analyzers to Form Integrated Unit
- UL Listed 1244, Certified CSA C22.2 No. 231-M89

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2.*

See Tektronix on the World Wide Web: http://www.tek.com

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2706 Preselector

The 2706 Stepping RF Preselector facilitates distortion-free measurements in the presence of large signals at the spectrum analyzer input. If total signal power at the first mixer stage of the spectrum analyzer exceeds the 1 dB compression point, inaccurate amplitude measurements and spurious intermodulation products can result. The 2706 Preselector enables the spectrum analyzer user to make accurate measurements over a wider range of signal environments by:

- Significantly attenuating undesired out-of-band signals
- Reducing energy from high amplitude, short duration pulses
- Minimizing the total number of individual signals present at the analyzer input

Use of commercial RF preselectors has been limited because of high costs. Now Tektronix offers an affordable and cost-effective solution for pre-certification testing.

The Tektronix 2706 Stepping RF Preselector is designed to be used with spectrum analyzers for EMI measurements and other applications. The 2706 can be attached to the bottom of 271X Spectrum Analyzers to form a single compact unit. Signals present at the 2706 input connector are routed directly to the spectrum analyzer when preselection is not desired. When preselection is desired, one of eight bandpass filters is switched into the circuit to limit the range of frequencies passed to the analyzer.

The 2706 is a stepping RF preselector using band switching to select the desired range of frequencies. Manual operation is possible from the front panel, and remote operation is provided via a GPIB interface which is supported by Tektronix S26EM12 EMI Software. While not equivalent to a narrow-band tracking preselector, the 2706 does an excellent job of rejecting out-of-band signals and decreasing overload susceptibility at a small fraction of the cost of a narrow-band tracker.

Characteristics

FREQUENCY RELATED

Bypass Mode – Frequency Range: 9 kHz to 1800 MHz. Insertion Loss: 3 dB <1 GHz.

Filters – Frequency Range: 9 kHz to 1800 MHz in eight switch-selectable ranges. Bandpass/Highpass Flatness: 1.5 dB max.

INPUT RELATED

RF Input/Output Connectors – Type N.

Input/Output Impedance – 50 Ω nominal.

VSWR (max) – 1.8:1.

Ultimate Rejection, Stop Band – 60 dB typical. 40 dB min. below 500 MHz and 30 dB min. above 500 MHz.

Maximum Input – +20 dBm, 50 V DC.

Switching Speed (max) – 10 ms.

IEEE 488 Interface Support – AH1, L4, SH1, T6, SR1, PP1, DC1, DT0, RL1, C0, E1, TE0, and LE0.

GENERAL CHARACTERISTICS

Power Requirements – 90 to 250 V AC, 48 to 63 Hz, 10 W max.

PHYSICAL CHARACTERISTICS

Dimensions	cm	in.
Width	32.7	12.87
Height	8.8	3.46
Depth	43.1	16.97
Weight	**kg**	**lb.**
Net	5.9	13

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

2706
Stepping RF Preselector.
Includes: Power Cord (U.S. 115 V, 60 Hz), Operator's Manual.

271X Spectrum Analyzer Mounting Hardware and RF Interconnect Cable– Order 118-8800-00.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

SOFTWARE

See page 223 for complete description.

Commercial EMI Test Software – Order S26EM12.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – United Kingdom 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.

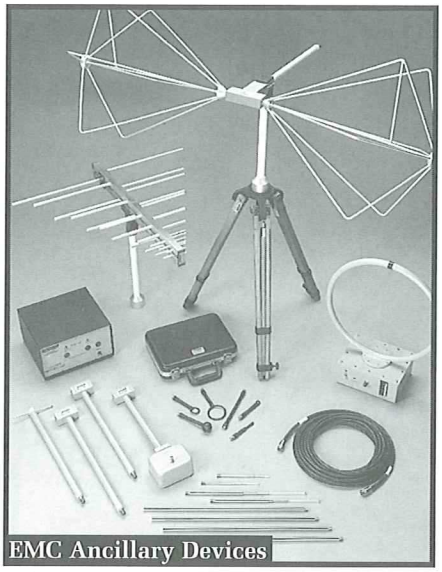
See Customer Information Section for additional description.

EMC Ancillary Devices

Features

EMC ANCILLARY DEVICES

- Active Loop Antenna
- Adjustable-length Dipoles
- Biconical Antenna
- Log-periodic Antenna
- RF Near-field Probe Set
- LISN
- Transient Limiter
- 10 m Low-loss Coaxial Cable
- Adjustable Tripod



Tektronix offers a complete line of calibrated antennas and other sensor products for EMI testing.

Sensors or transducers are required for EMI signal reception. The sensor picks up the EMI signal and couples it to the spectrum analyzer. The spectrum analyzer then displays the EMI signal as a plot of amplitude (vertically) versus frequency (horizontally).

The type of sensor needed depends on the test standard and the nature of the test (radiated or conducted electric field, or radiated magnetic field). For radiated electric (E) field tests, a biconical, log periodic, or dipole antenna may be used. Electrostatically shielded loop antennas are used for magnetic (H) field tests.

The specific transducer type required also depends on the test standard and frequency range. Tektronix has available a line of antennas and other sensors, as shown in the figure at left.

For conducted measurement, Tektronix offers a Line Impedance Stabilization Network (LISN). It is inserted between the AC power source and the EUT. Outputs on the LISN couple the EMI emitted by the EUT to the spectrum analyzer's input.

Our complete line of ancillary devices is listed in the ordering information below.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

LOOP ANTENNA
9 kHz to 30 MHz. Order No. 119-4144-00.
Application Information: Radiated H-field (magnetic) emissions. Active loop provides gain and low-frequency sensitivity.

ADJUSTABLE-LENGTH DIPOLES
28 MHz to 1 GHz. Order No. 119-4145-00.
Application Information: Radiated E-field emissions/CATV leakage. Ideal for EMI testing and site attenuation measurements. Includes four baluns.

BICONICAL ANTENNA
30 MHz to 300 MHz. Order No. 119-4148-00.
Application Information: Radiated E-field emissions. Broadband frequency capability eliminates need for band switching, element extension, or external tuning.

LOG-PERIODIC ANTENNA
200 MHz to 1 GHz. Order No. 119-4142-00.
Application Information: Radiated E-field (electric) emissions. Linearly polarized design permits separate measurement of horizontal and vertical fields. Broadband frequency.

RF PROBE SET
9 kHz to 1.8 GHz. Order No. 119-4146-00.
Application Information: Locates RF "Hot Spots." Useful in diagnostic testing. Includes five probes (3H-field, 2 E-field) plus extension.

LISN
10 kHz to 100 MHz. Order No. 119-4147-00.
Application Information: Facilitates measurement of conducted emissions on power line from equipment under test. Filters undesired signals imported on mains supply.

TRANSIENT LIMITER
9 kHz to 100 MHz. Order No. 011-0164-00.
Application Information: Use with LISN to prevent inadvertent damage to spectrum analyzer input.

10 M COAXIAL CABLE
Order No. 012-1291-00.
Application Information: Couples antenna to spectrum analyzer (male fittings).

ADJUSTABLE TRIPOD
Order No. 016-1102-00.
Application Information: Mounting for all above antennas. Wooden frame reduces field disturbance.

EMI/RFI Solutions

PR326150 • PR326160 • PR326170

Features

PR326150/60/70

- Allows Quick and Easy System Set-up for Specific Measurements
- Simplified Operation
- Real-time Display of Corrected Data Such As Antenna Factors and Cable Loss

Applications

- EMC Measurements
- Field-strength Measurement
- Voltage Measurement
- Interfacing Power Measurement
- Automated Power Measurement



Memory cards provide automated EMI measurements.

PR326150, PR326160, PR326170 Memory Cards

The PR326150/60/70 Memory Cards allow easy system setup and operation for EMI measurements with the R3261/R3265/R3271. The system design is based upon a concept of an EMC automatic measurement system aided by personal computers. With these memory cards, however, a controller is not required, since all operations take place within the instrument itself as controlled by the program on the memory cards.

The memory cards can store measurement sequences, receiver setting requirements, standard values, measurement band, correction coefficients, and measured data. The display on the test instrument monitors corrected data such as antenna factors and cable loss on a real-time basis.

Measurement procedures are included in the preliminary measurement menu. A maximum noise at up to 50 points can be searched for at high speed with the aid of the peak search function of the spectrum analyzer. When the preliminary measurement is completed, final measurements can be easily performed. The display shows the preliminary and final measurement results superimposed for easy comparison.

Measurement capabilities include:

- PR326150 Field-strength Measurement Card: Provides automated radiated emissions measurements in accordance with all relevant commercial EMI standards
- PR326160 Voltage Measurement Card: Provides automated line conducted emissions measurement in accordance with all relevant commercial EMI standards
- PR326170 Interfacing Power Measurements Card: Provides automated power measurement in accordance with all relevant commercial EMI standards

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

PR326150
Field-strength Measurement Card.

PR326160
Voltage Measurement Card.

PR326170
Interfacing Power Measurement Card.

EMI, Field Strength

ESAI • ESBI • ESMI

Features

ESAI/ESBI/ESMI

- 20 Hz to 1.8 GHz Frequency Range (ESAI)
- 20 Hz to 5 GHz Frequency Range (ESBI)
- 20 Hz to 26.5 GHz Frequency Range (ESMI)
- RF Level Switchable from 0 to 120 dB in 2 dB Steps (ESMI, 0 to 75 dB in 5 dB steps)
- Preselector with Eleven Filters with Fixed Tuning and Four Tracking Filters (ESAI, Ten Filters)
- Low-noise Preamplifier with Wide Dynamic Range Fitted Between Preselector and First Mixer
- Five Parallel Detectors for Peak, Quasi-peak, Average, and RMS Weighting
- Overload Detectors at the Mixers and in the RF and IF Signal Paths to Avoid Incorrect Measurements and to Ensure Optimum Setting in the Autorange Mode

Applications

Conforms to following industrial and military standards:

COMMERCIAL:

- CISPR
- VDE
- FCC
- EN
- VCCI

MILITARY:

- MIL-STD
- DEF-STAN
- BS
- DO 160
- GAM EG 13

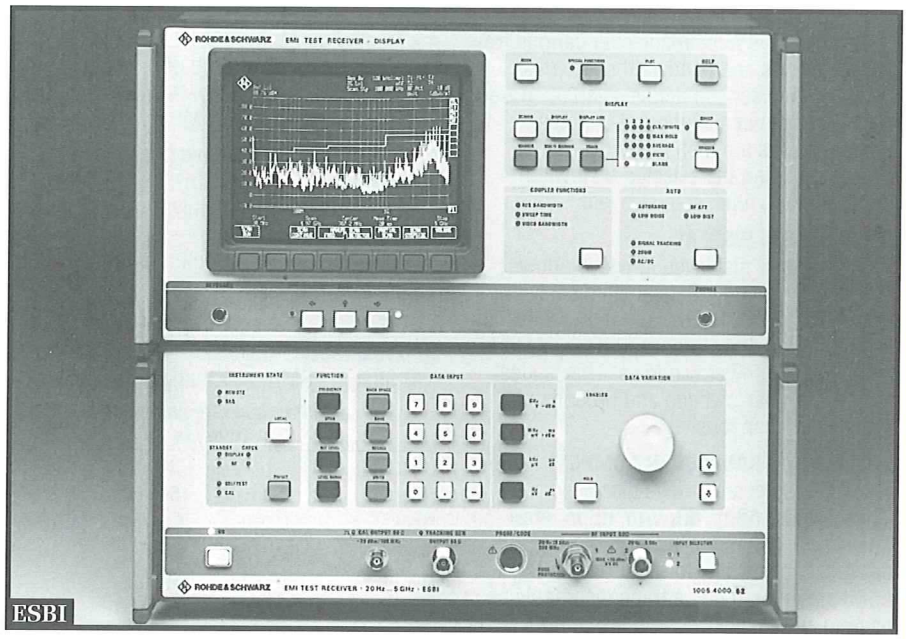
For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488

Product(s) complies with IEEE Standard 488.2-1987.

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



ESBI

Introduction

The ESAI, ESBI, ESMI EMI Test Receivers combine world-class EMI specifications with the performance of high-speed spectrum analyzers. Integral measurement and analysis functions simplify and speed up measurements to the relevant commercial and military standards.

LARGE DYNAMIC RANGE AND HIGH SENSITIVITY

The ESAI, ESBI, ESMI EMI Test Receivers feature a large dynamic range and high sensitivity. Moreover, the test receiver settings completely conform to CISPR requirements, i.e., the dynamic range is large enough to allow correct weighting of single pulses.

Refined preselection filtering provides the required large dynamic range for wideband signals. A low-noise preamplifier, which can be switched after the preselector, is used to increase sensitivity. To measure high-energy pulses, a second input is provided which can handle pulses in the frequency range from 20 Hz to 200 MHz. An automatic overload detector checks sensitive points in the signal path.

SIGNAL ANALYSIS

These EMI receivers have a variety of maximum, minimum, average, RMS, and quasi-peak detectors for simultaneous signal analysis. Built-in AM/FM demodulators allow audio monitoring of interference signals.

A pulse calibration source for checking the CISPR weighting curves is provided in addition to the built-in sine calibration source. This ensures extremely high measurement accuracy. A tracking generator for EMC measurements covering the entire range of the receiver is also provided.

OVERVIEW MODE SPEEDS ANALYSIS

In the OVERVIEW mode, the whole interference spectrum is displayed on the screen of the test receivers. The IF resolution bandwidths can be adjusted to CISPR standards; the IF selectivity also has a quasi-analog setting mode to optimize the sweep time. The interference spectrum can be displayed on the screen using a linear or logarithmic frequency scale. A maximum of eight different limit lines can be displayed on the screen. Out-of-limit values are automatically detected and displayed.

FAST, FLEXIBLE SCAN

In the SCAN mode the ESAI, ESBI, ESMI function in a way that is comparable to a conventional test receiver. In addition to measurements at the selected frequency, automatic scans between a start and a stop frequency at an adjustable step size are possible. Manual adjustments, which can be made while the scan is in progress, and repeat measurements over selectable subranges reduce the time required for complete EMI measurements.

EMI, Field Strength

ESAI • ESBI • ESMI

To conform with relevant standards, measurements have to be made over various frequency ranges and bandwidths. For this purpose, the user can define a variety of frequency ranges in a configuration table. Measurements are then made over these subranges using the selected bandwidth measurement, time, step size, etc.

SPLIT-SCREEN DISPLAY
The results are displayed in two windows obtained by splitting the screen display horizontally. Different traces, and thus the results from different detectors, can be displayed in the upper and lower windows. This is ideal for showing narrowband and broadband signals simultaneously.

AUTOMATIC TRANSDUCER COMPENSATION
The test results are always displayed with correct units (dBµV, dBµV/m, dBµA, etc.). Correction factors for the transducers designed specifically for the ESAI, ESBI, ESMI are entered into a transducer table and used to automatically compensate for the frequency dependence of the transducer factor. A maximum of four correction-factor tables are available and can be used independently or combined.

DOCUMENT TEST RESULTS TO PRINTERS AND PLOTTERS
Test results can be output to a wide range of printers and plotters to provide clear documentation of measurement results. The ESAI, ESBI, and ESMI support monochrome and color hardcopy devices including laser printers and plotters.

Characteristics

FREQUENCY RELATED

Frequency Range – ESAI: 20 Hz to 1.8 GHz; ESBI: 20 Hz to 5 GHz; ESMI: 20 Hz to 26.5 GHz (to 110 GHz with external mixers).

Frequency Setting – By step keys and spinwheel. Frequency Resolution: 1 Hz. Error of Frequency Reference: $<1 \times 10^{-7}$; Frequency Scale: Selectable LIN/LOG.

Frequency Display – Error (span >5 MHz, Sweep Time <100 ms): $<8 \times 10^{-3}$ x span.

Frequency Span – Range: ESAI: 10 Hz to 2 GHz; ESBI: 10 Hz to 5.2 GHz; ESMI: 10 Hz to 26.5 GHz; Error: Span 10 Hz to 5 MHz: $<2 \times 10^{-3}$ x span; Span >5 MHz: $<5 \times 10^{-3}$ x span.

Frequency Counter – Scan setting: <1000 x resolution bandwidth; Resolution: 0.1 Hz to 10 kHz; Error limit: <readout x 10^{-7} ±2 x resolution.

Spurious with Discrete Frequencies – n x Mains Frequency: >70 dBc; m x Line Frequency (26.4 kHz): >80 dBc; 100 kHz (span ≤5 MHz): >90 dBc; –10.7 MHz: >90 dBc; Other for Δf >1 MHz: >75 dBc.

Internal Spurious Response (input terminated with 50 Ω) – f >1 MHz: <–110 dBm (<–3 dBµV); ESBI, ESMI only: f <1 MHz, f >4.7 GHz, f = 1.585 GHz: <–95 dBm (<12 dBµV); Oscillator feedthrough: –25 dBm typical.

FILTERS

RF Preselector – Selectable filters (except YIG filter in ESMI), automatically switched.

	Passband frequencies from / to		Filter Type
Filter 1	DC	9 kHz	LP, fixed
Filter 2	9 kHz	150 kHz	BP, fixed
Filter 3	150 kHz	2 MHz	BP, fixed
Filter 4	2 MHz	10 MHz	BP, fixed
Filer 5	10 MHz	30 MHz	BP, fixed
Filter 6	30 MHz	50 MHz	BP, fixed
Filter 7	50 MHz	80 MHz	BP, fixed
Filter 8	80 MHz	110 MHz	BP, fixed
Filter 9	110 MHz	140 MHz	BP, fixed
Filter 10	140 MHz	260 MHz	BP, tuned
Filter 11	260 MHz	450 MHz	BP, tuned
Filter 12	450 MHz	700 MHz	BP, tuned
Filter 13	700 MHz	1 GHz	BP, tuned
Filter 14 (ESAI)	1 GHz	2 GHz	BP, fixed
Filter 14 (ESBI, ESMI)	1 GHz	1.9 GHz	BP, fixed
Filter 15 (ESBI)	1.9 GHz	5.2 GHz	BP, fixed
Filter 15 (ESMI)	1.9 GHz	5.0 GHz	BP, fixed
Filter 16 (ESMI)	4.9 GHz	26.5 GHz	YIG filter

NOTE: The 6 dB bandwidth of the tunable bandpass filters is typically <85 MHz, that of the YIG filter increases from typically 50 MHz at 5 GHz to typically 100 MHz at 26.5 GHz.

IF Filters – Overview mode (3 dB bandwidths): <10 Hz (6 Hz typical) to 3 MHz in 5% steps (except 30 to 80 kHz).
EMI receiver mode (6 dB bandwidths): 10 Hz*1, 100 Hz, 200 Hz, 1 kHz, 9 kHz, 10 kHz, 100 kHz, 120 kHz, and 1 MHz.
Bandwidth factor: –60 dB/–3 dB: <12.
–80 dB/–3 dB: <20.

Video Filters (1st order RC lowpass after IF rectifier) – Bandwidths (–3 dB): 1 Hz to 3 MHz in 1, 3, 10 steps.

*1 *Ambient temperature 15 to 35°C.*

AMPLITUDE RELATED

Maximum Input Level – DC voltage:
DC coupling: <0 V; AC coupling: <20 V.
AC voltage (sinewave): RF attenuation 0 dB: <20 dBm (100 mW; 127 dBµV); RF attenuation ≥10 dB: <30 dBm (1 W; 137 dBµV);
Pulse spectral density (RF attenuation 0 dB):
RF preselector on: f <150 kHz: <130 dBµV/MHz;
f = 150 kHz to 1 GHz: <90 dBµV/MHz;
f ≥1 GHz: <61 dBµV/MHz.
RF preselector off: <61 dBµV/MHz.
Maximum pulse voltage (RF attenuation ≥10 dB): Input 1: <150 V; Input 2: <50 V.
Maximum pulse energy (τ = 10 µs, RF attenuation ≥10 dB): Input 1: ESAI, ESBI: <1 mWs (= 100 W for 10 µs); ESMI: <10 mWs (= 1 kW for 1 µs); Input 2: <1 mWs (= 100 W for 10 µs).

Level Compression – Pulse spectral density at 1 dB compression (RF attenuation 0 dB, RF preselector on, RF preamplifier off).

	1 dB Compression for	
Frequency	ESAI	ESBI, ESMI
f <150 kHz	>102 dB µV/MHz	>110 dB µV/MHz
150 kHz to 5 MHz	>83 dB µV/MHz	>86 dB µV/MHz
5 MHz to 30 MHz	>77 dB µV/MHz	>80 dB µV/MHz
30 MHz to 300 MHz	>72 dB µV/MHz	>76 dB µV/MHz
300 MHz to 1 GHz	>72 dB µV/MHz	>75 dB µV/MHz
>1 GHz	>50 dB µV/MHz	>50 dB µV/MHz

Maximum Inherent Noise Indication in CISPR Bands – See Table 1. RF preamplifier off, RF attenuation 0 dB, discrete spuria excepted.

Inherent Noise Indication – All units, maximum sensitivity setting in the frequency range 20 to 200 Hz (bandwidth 10 Hz, video bandwidth 1 Hz, preamplifier off): 45 dBµV.

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SPECTRAL SENSITIVITY
Resolution Bandwidth 1 MHz, f >30 MHz, Peak-value Indication –

Unit	Preamplifier 0 dB	10 dB
ESAI/ESBI	<30 dBµV/MHz	<21 dBµV/MHz
ESMI (<18 GHz)	<32 dBµV/MHz	<23 dBµV/MHz

Level Measurement Error After Internal Calibration (sum error in indication range and in temperature range 15 to 35°C) –
ESAI (f = 9 kHz to 1 GHz): <1.5 dB.
ESBI (f = 9 kHz to 1 GHz): <1.5 dB; up to 5 GHz, 3 dB maximum typical.
ESMI (f = 9 kHz to 1 GHz): <1.5 dB; up to 26.5 GHz, 4 dB maximum typical.

SWEEP RELATED
Sweep Time – See Table 2.

Trigger Modes – Free run, line, video, external.

SCALAR NETWORK ANALYSIS
Tracking-generator Frequencies and Levels – See Table 3.

IF and Image Frequency Rejection –
IF rejection: >100 dB (>110 dB typical).
Applies to all IF frequencies used except:
ESAI, 221.4 MHz: >75 dB (90 dB typical).
ESMI, 221.4 MHz: >90 dB (110 dB typical).
Image frequency: ESAI, f + 4.4428 GHz: >90 dB (100 dB typical).
ESBI/ESMI, f + 10.8428 GHz: >80 dB (90 dB typical).
ESAI/ESBI, f + 442.8 MHz: >100 dB (115 dB typical).
ESMI, f + 442.8 MHz: >85 dB (100 dB typical).
All units, f + 42.8 MHz: >100 dB (115 dB typical).
All units, f + 8.388 MHz: >100 dB (115 dB typical).

Measurement Ranges for Gain and Attenuation –
Measurement Range

Unit	Gain	Attenuation	Frequency Offset
ESAI	130 dB	120 dB	Not provided
ESBI	110 dB	110 dB	0 to ±1 GHz
ESMI (to 5 GHz)	105 dB	110 dB	0 to ±1 GHz
ESMI with Opt. 01 5 GHz to 18 GHz	105 dB	105 dB	Not provided
18 GHz to 26.5 GHz	105 dB	100 dB	Not provided

Demodulation – AM and FM.
Evaluation (modulation analysis): Measurement of modulation depth and frequency deviation. Auto-monitoring: Built-in loudspeaker and headphones output.

INPUTS AND OUTPUTS
Front Panel of RF Unit –
Input 1: Connector: BNC female, 50 Ω.
DC coupling: 20 Hz to 200 MHz.
AC coupling: 9 kHz to 200 MHz.
VSWR: RF attenuation 0 dB: <2.0.
RF attenuation ≥10 dB: <1.2.
Protection: Fuse, surge arrester.
Input 2 (DC coupling only): Connector:
ESAI, ESBI: N female, 50 Ω.
ESMI: 3.5 mm SMA female.
VSWR:

Unit	RF atten. 0 dB	RF atten. ≥10 dB	RF atten. RF ≥20 dB
ESAI			
f <1 GHz	<2.0	<1.2	–
f = 1 to 1.8 GHz	<3.0	<1.5	–
ESBI			
f <1 GHz	<2.0	<1.2	–
f = 1 to 2.7 GHz	<3.0	<1.5	–
f = 2.7 to 4.8 GHz	<3.0	<1.8	–
ESMI			
f <1 GHz	<2.0	<1.2	–
f = 1 to 2.7 GHz	<3.0	<1.5	–
f = 2.7 to 4.8 GHz	<3.0	<1.8	–
f = 4.8 to 26.5 GHz	<3.0 (typical)	–	<2

Selectable preamplifier:
ESAI: 100 Hz to 1.8 GHz, 10 dB and 20 dB.
ESBI: 100 Hz to 5 GHz, 10 dB.
ESMI: 100 Hz to 26.5 GHz, 10 dB.

Continued on next page

TABLE 1 – INHERENT NOISE INDICATION

Frequency Range	CISPR Band/ Bandwidth	Unit	Indication (in dBµV) Average	Quasi-peak	Peak
9 kHz to 150 kHz	A / 200 Hz	ESAI	–17	–15	–6
		ESBI, ESMI	–7	–5	+4
150 kHz to 5 MHz	B / 9 kHz	ESAI	–3	0	+8
		ESBI, ESMI	0	+3	+11
5 MHz to 30 MHz	B / 9 kHz	ESAI	–13	–10	–2
		ESBI, ESMI	–5	–2	+6
30 MHz to 300 MHz	C / 120 kHz	ESAI	0	+4	+11
		ESBI, ESMI	+5	+9	+16
300 MHz to 1 GHz	D / 120 kHz	ESAI	+5	+9	+16
		ESBI, ESMI	+8	+12	+19

NOTE: In the frequency range from 20 Hz to 1 MHz, figures for the noise indication are valid in the temperature range 15 to 35°C. Outside this temperature range, the specified values may vary by 10 dB maximum. The guaranteed sensitivity value in the CISPR bands is improved by 9 dB with the preamplifier on.

TABLE 2 – SWEEP

Sweep Time	Span = 0 Hz Step Size	Error	Span >0 Hz (sampling rate: 1/8.9 µs) Step Size	Error
0.2 ms to 10 ms	–	–	1, 2, 4, 8, 10	<2%
20 ms to 2 s	20 ms	10^{-3}	20 ms	10^{-3}
2 s to 20 s	200 ms	10^{-3}	200 ms	10^{-3}
20 s to 1980 s	2 s	10^{-3}	2 s	10^{-3}

TABLE 3 – SCALAR NETWORK ANALYSIS

Unit	Output Frequency Min	Max	Output Level Min	Max	Steps
ESAI	100 Hz	1.8 GHz	7 dBµV	102 dBµV	0.1 dB
ESBI	100 Hz	5 GHz	26 dBµV	107 dBµV	0.1 dB
ESMI	100 Hz	5 GHz	32 dBµV	107 dBµV	5 dB

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Input divider:
ESAI, ESBI: 0 to 120 dB in steps of 2 dB.
ESMI: 0 to 75 dB in steps of 5 dB.
Calibration output: Connector: BNC female, 50 Ω.
Signal: Unpulsed: 100 MHz, 87 dBµV; Pulsed: Pulse area to CISPR 16-1, Pulse Repetition Frequency: 1 Hz to 1 kHz.
Coding and supply connector: Connector: 12-contact Tuchel female:
Supply voltage: +10 V, –10 V, 100 mA maximum each.

Front Panel of Display Unit –
PHONES: Connector: JK34 jack; Frequency Range: 100 Hz to 15 kHz; EMF (V p-p maximum): 10 V.
Output impedance: 30 Ω.
KEYBOARD: Connector: JK34 jack.

Rear Panel of RF Unit –
IF OUTPUT 21.4 MHz: Connector: BNC female, 50 Ω; VSWR: ≤2.
Gain (referenced to level at input mixer = reference level – RF attenuation) ≤–20 dBm (87 dBµV): +8 dB ±2 dB. >–20 dBm (87 dBµV): 0 dB ±2 dB. Bandwidth (–6 dB): >10 MHz.
10-MHz Reference: Connector; BNC female.
Output level with internal reference (Z_{in} = 50 Ω): +10 dBm +3/–1 dB. Input level with external reference (Z_L >500 Ω): 0 to 5 V.
EXT ALC: Connector: BNC female.
Input voltage: 0 to –1 V.
SWEEP OUTPUT: Connector: BNC female.
Output voltage (Z_L >500 Ω): 0 to +5 V.
START-SWEEP-STOP: Connector; BNC female.
Output: TTL pulse (t = 1.4 µs) occurring upon sweep start or stop.

Rear Panel Display Unit –
IF OUTPUT (narrow); 21.4 MHz: Connector: BNC female, 50 Ω. VSWR: <2.
Level with reference level; –15 dBm ±3 dB.
EXT SWEEP TRIG: Connector: BNC female.
VIDEO OUTPUT: Connector: BNC female.
EXTERNAL MONITOR: Connector: BNC female. Outputs; RED, GREEN, BLUE, COMP VIDEO; V SYNC; H SYNC. Line frequency: 29.5 kHz. Sync pulse: 2 µs.
EXT FLOPPY: Connector: 37-contact Cannon D female.
RS-232C: Connector; 25-contact Cannon D female.
PARALLEL INTERFACE: (Centronics) Connector: 36-contact Amphenol female.
USER PORT: Connector: 25-contact Cannon D female.
PHONES: Connector: JK34 jack. Frequency range (–3 dB): 100 Hz to 15 kHz; EMF: 10 V p-p. Source impedance: 30 Ω.
IEC 625 bus (IEEE 488): Connector: 24-contact Amphenol female. Bus functions: AH1, SH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C1 to C4, C11.

DISPLAY RELATED
Monitor – 9 inch color CRT.

Resolution – 1024 x 512 points.

Display Mode – Full display height or 2 x 1/2 display height (split screen).

Number of Display Memories – 4.

Output to Plotter – HPGL, pinwriter (24-Pin) laser printer.

Plotter Functions – Curve arithmetic (swap, subtract), comparison with tolerance curves, averaging, peak hold.

POWER REQUIREMENTS
Line Voltage – 100, 120, 220, 240 ±10%.

Line Frequency – 45 to 66 Hz.

Power Consumption – 500 VA.

ENVIRONMENTAL CHARACTERISTICS
Temperature –
Operating: 0 to +55°C. Storage: –40 to +70°C. Relative humidity: 20 to 90% (without condensation).

EMC – To EN 50081-1 and EN 50082-1 (EEC Directive): FCC DOC 20780: Part 15, Subpart 5.

Warmup Period – Operating temperature attained after one hour after cold start at T_{amb} = 0 to 55°C.

PHYSICAL CHARACTERISTICS

	ESAI, ESBI		ESMI	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	435	17.1	435	17.1
Height	413	16.3	457	18.0
Depth	590	23.2	590	23.2
Weight	**kg**	**lb.**	**kg**	**lb.**
Net	64	141.1	68	150

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

ESAI
EMI Test Receiver (20 Hz to 1.8 GHz).
Includes: Power Cord, Manual.

ESBI
EMI Test Receiver (20 Hz to 5 GHz).
Includes: Power Cord, Manual.

ESMI
EMI Test Receiver (20 Hz to 26.5 GHz).
Includes: Power Cord, Manual.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.

RECOMMENDED ACCESSORIES
Service Kit – Order FS-Z1.

Connecting Cable Kit (for servicing, 1 m) – Order FS-Z2.

ES-K1 Software – EMC Compliance Test Software. See page 244 for details.

Adapters –
N-male to BNC-female Adapter. Order 103-0045-00.
N-female to BNC-male Adapter. Order 103-0058-00.
3.5 mm Male-to-Male Adapter. Order 015-0551-00.
3.5 mm Female-to-Female Adapter. Order 015-0550-01.

ADDITIONAL ACCESSORIES
Also see page 434.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

EMI/RFI Solutions

ESHS • ESVS • ESS

Features

- Complies with CISPR 16, VDE 0876, and ANSI c63.2
- Measurements to European Standards 55 011 to 55 022, ETS, FCC, VCCI, and VDE 0871 to 0879

ESHS

- Frequency Range 9 kHz to 30 MHz
- Operation from AC Supply or Internal/External Battery

ESVS

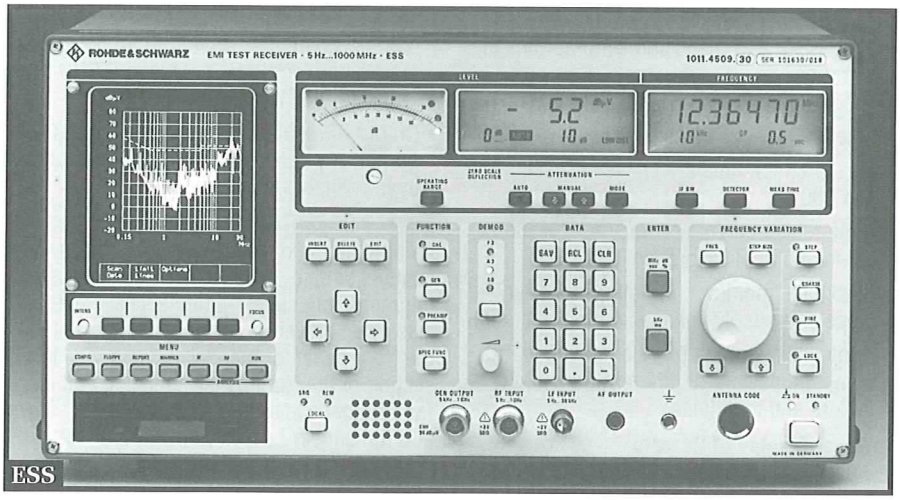
- Frequency Range 20 MHz to 1 GHz
- Operation from AC Supply or Internal/External Battery

ESS

- Frequency Range 5 Hz to 1 GHz
- Resolution Bandwidths from 2 Hz to 1 MHz
- Operation from AC Supply or External Battery
- Measurements to Military Standards MIL-STD-461, DEF STAN 59-41, GAM-EG 13, and VG 95370 and 95673

Applications

- EMI Measurements to All Relevant Commercial and MIL-STD Specifications
- Field-strength Measurements Using Test Antennas



Introduction

The number of measurements required to ensure electromagnetic compatibility is continuously increasing. Thanks to the built-in intelligence of the ESHS/ESVS/ESS EMI Test Receivers, the time required for such measurements is reduced considerably. These test receivers are specialized for measurements to the applicable CISPR, CEN/ELEC, ETSI, FCC, VCCI, and VDE standards. In addition, the ESS provides measurements to the relevant military standards as well – MIL, VG, DEF, and STAN.

The ESHS/ESVS/ESS feature high frequency resolution and accurate level indication in peak average and quasi-peak detection (ESS provides RMS also). The real strength, however, is the automatic measurement of RFI voltage, current, power, and field strength. After a fast pre-scan measurement, it compares the results with prescribed limits, displays the interference spectrum with the limits on the screen, and furnishes a comprehensive test report with all the necessary information. The time-consuming quasi-peak measurement is only carried out in cases where the peak value is close to the relevant limit.

EMI TEST RECEIVER FEATURES

The ESHS 10, ESHS 30, ESVS 10, ESVS 30, and ESS share the same basic design and performance characteristics. The various models provide differing features which provide full EMI measurement performance from 5 Hz to 1 GHz. All models feature an excellent price/performance ratio, compact design, high measurement speed, and great operating convenience. Following are the primary features; features are shared by all instruments unless noted otherwise:

RF Section –

- High pulse loading capacity of calibrated attenuator
- Comprehensive preselection filters
- Switchable preamplifier with wide dynamic range
- Crystal-stabilized, fast synthesizer with high resolution and sweep
- High-level mixer with high oscillator rejection
- IF filters with low delay distortion

Demodulation –

- Parallel detectors for average, peak, and quasi-peak indication (ESS also provides RMS indication)
- 60 dB operating ranges for quasi-peak and average value indication
- Highly linear envelope detector
- AM and A0 demodulators (ESVS and ESS also provide FM demodulation)
- Logarithmic amplifier with more than 70 dB dynamic range
- Automatic overload detection in the mixer stages and in the test channel by permanently activated peak detectors

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

EMI/RFI Solutions

ESHS • ESVS • ESS

Powerful Processor System –

- Macros for automatic and semi-automatic test runs
- 12-Bit A/D converter with short conversion time
- Measurement time selectable between 1 ms and 100 s
- High measurement accuracy as a result of automatic total calibration
- Automatic monitoring of all synthesizer loops and supply voltages during operation
- Nonvolatile storage of 10 complete instrument setups and 22 different transducer factors and limit lines

Optimal Display of Results for Every Application –

- Measurement of voltage, field strength, current, and pulse spectral density with full indication of units
- Indication of level on analog meter and digital readout with 0.1-dB resolution
- Display of interference spectra (RF ANALYSIS) including limit lines on low-emission screen
- IF analysis for visual check of interference spectrum in manual measurement mode (ESHS 30, ESVS 30, ESS)
- Built-in tracking generator for attenuation and gain measurements (ESHS 30, ESVS 30, ESS)

Storage and Listing of Results –

- Built-in 3.5 in. disk drive for storing test results and instrument settings (ESHS 30, ESVS 30, ESS)
- Output of results as lists and diagrams on printer or plotter including limit lines and user-definable labeling

SIMPLE OPERATION

A combination of hardkeys and softkeys ensures simple operation and fast access to the menu functions. All models have the classic test receiver controls on the right of the front panel for manual settings. The left section of the front panel is used to edit data for automatic test runs, tables for limit values and transducer factors (for example, for current and voltage probes and antennas), as well as special functions and the information required for test reports.

OPTIMIZED TEST RUNS

EMI measurements have differing degrees of complexity. The simplest case is measurement of the EMI spectrum on a data line. In the most complicated case, many parameters have to be varied and additional conditions observed to find the maximum spurious emission and then weight it correctly with quasi-peak weighting. The time-consuming quasi-peak measurement is only carried out in cases where the peak value is close to the relevant limit.

These EMI test receivers offer a choice between automatic, semi-automatic, and user-controlled test runs. Scan options are available for prescan measurements, data reduction, and final measurements.

Data reduction is the main criterion for optimizing the test run. It's the link between prescan interface measurement and correct weighting with test-parameter variation (final measurement) to reduce measurement time. Scan options are also available to take account of the test configuration: for instance, measuring RFI voltage with LISNs, RFI power with an absorbing clamp, and RFI and field strength with antennas.

CHARACTERISTICS

	ESHS	ESVS	ESS
Frequency Related			
Frequency Range	9 kHz to 30 MHz	20 MHz to 1 GHz	5 Hz to 1 GHz, subdivided into following ranges:
Range I	–	–	5 Hz to 50 kHz (tunable down to 1 Hz)
Range II	–	–	9 kHz to 30 MHz
Range III	–	–	20 MHz to 1 GHz (automatic range selection, depending upon IF bandwidth and RF input (balanced/unbalanced))
Frequency Setting			
With tuning knob	In 10 Hz, 10 kHz, or any step size (switch selectable)	In 100 Hz, 100 kHz steps or any step size selectable	Fine or coarse increments or freely selectable step size:
Range I	–	–	Fine, 0.1 Hz; Coarse, 100 Hz
Range II	–	–	Fine, 10 Hz; Coarse, 10 kHz
Range III	–	–	Fine, 100 Hz; Coarse, 100 kHz
Numerical	Via keyboard entry	Via keyboard entry	Via keyboard entry
In steps	Any selectable size	Any selectable size	Any selectable size
Automatic scanning	For RF analysis	For RF analysis	For RF analysis

EMI/RFI Solutions

ESHS • ESVS • ESS

	ESHS	ESVS	ESS
Frequency Related (Continued)			
Frequency Display	7-digit LCD	8-digit LCD	8-digit LCD
Resolution	10 Hz	100 Hz	–
Range I	–	–	0.1 Hz
Range II	–	–	10 Hz
Range III	–	–	100 Hz
Setting Error	$<3 \times 10^{-6} + 30$ Hz	$<3 \times 10^{-6}$	$<3 \times 10^{-6}$
RF Input			
Connector	N connector, female	N connector, female	–
5 Hz to 1 GHz, unbalanced	–	–	N connector, female
5 Hz to 50 kHz, balanced	–	–	Twinax connector, female
Impedance	50 Ω	50 Ω	50 Ω
VSWR			
≥10 dB RF attenuation	<1.2	<1.2	<1.2
0 dB RF attenuation	<2	<2	<2
Oscillator Reradiation at RF Input (0 dB RF attenuation)			
Without preamplifier	<20 dBµV	<20 dBµV	<20 dBµV
With preamplifier	<10 dBµV	<10 dBµV	<10 dBµV
Preamplifier	Switchable between input filter and 1st mixer	Switchable between preselector and 1st mixer	Switchable between preselector and 1st mixer
Gain	10 dB	10 dB	10 dB
Preselector	5 bandpass filters: 9 kHz to <150 kHz 150 kHz to <4.05 MHz 4.05 MHz to <12.8 MHz 12.8 MHz to <21.55 MHz 21.55 MHz to 30 MHz	1 fixed-tuned filter: 20 to <51.3 MHz 5 tracking filters: 51.3 to <125.3 MHz 125.3 to <273.3 MHz 273.3 to <495.3 MHz 495.3 to <717.3 MHz 717.3 to 1 GHz	–
Range I	–	–	1 fixed bandpass filter: 5 Hz to 50 kHz
Range II	–	–	5 fixed bandpass filters: 9 kHz to <150 kHz 150 kHz to <4.05 MHz 4.05 MHz to <12.8 MHz 12.8 MHz to <21.55 MHz 21.55 MHz to 30 MHz
Range III	–	–	1 fixed bandpass filter: 20 MHz to <51.3 MHz 5 tracking bandpass filters: 51.3 MHz to <125.3 MHz 125.3 MHz to <273.3 MHz 273.3 MHz to <495.3 MHz 495.3 MHz to <717.3 MHz 717.3 MHz to 1 GHz

EMI/RFI Solutions

ESHS • ESVS • ESS

RF Input (continued)	ESHS	ESVS	ESS
Maximum Input Level (with and without preamplifier)			
RF attenuation 0 dB (AC-coupled)			
DC voltage	7 V	50 V	7 V
Sinewave AC voltage	130 dBµV	130 dBµV	130 dBµV
Pulse spectral density	96 dBµV/MHz	97 dBµV/MHz (100 V for 0.5 ns)	97 dBµV/MHz
RF attenuation ≥10 dB (DC-coupled)			
DC voltage	7 V (= 1 W)	50 V	–
Sinewave AC voltage	137 dBµV	137 dBµV (corresponds to 1 W)	–
Maximum pulse voltage (10 µs)	700 V	150 V	–
Maximum pulse energy	100 mWs (10 µs)	10 mWs (20 µs)	–
Range I and II			
DC voltage	–	–	7 V (corresponds to 1 W)
Sinewave AC voltage	–	–	137 dBµV
Maximum pulse voltage	–	–	700 V
Maximum pulse energy (10 µs)	–	–	100 mWs
Range III			
DC voltage	–	–	7 V (corresponds to 1 W)
Sinewave AC voltage	–	–	137 dBµV
Maximum pulse voltage	–	–	1500 V
Maximum pulse energy (10 µs)	–	–	100 mWs
Interference Rejection, Non-linearities			
Image frequency rejection			
1st IF	>90 dB, 100 dB typical	>90 dB, 100 dB typical	>90 dB, 100 dB typical
2nd IF	>75 dB	>90 dB, 100 dB typical	
IF rejection	>90 dB, 100 dB typical	>90 dB, 100 dB typical	>90 dB, 100 dB typical

IF Bandwidths	Nominal Bandwidth	–3 dB (±20%)	–6 dB	Shape Factor $BW_{6\ dB}/BW_{50\ dB}$ (Selectable in Range)
ESHS	200 Hz*1	140 Hz	200 Hz +20/–30 Hz	1:8 typical
	10 Hz*2	7 kHz	9.5 kHz ±0.5 kHz	1:3.5 typical
ESVS	10 kHz	7 kHz	9.5 kHz ±0.5 kHz	1:4 typical
	120 kHz	90 kHz	120 kHz ±10%	1:5.5 typical
ESS	2 Hz	1.4 Hz	2 Hz	1:2.5 (I)
	5 Hz	3.5 Hz	5 Hz	1:2.5 (I)
	10 Hz	7 Hz	10 Hz	1:2.5 (I)
	20 Hz	14 Hz	20 Hz	1:2.5 (I)
	50 Hz	35 Hz	50 Hz	1:2.5 (I+II)
	100 Hz	70 Hz	100 Hz	1:2.5 (I+II)
	200 Hz	140 Hz	200 Hz	1:2.5 n(I+II)
	500 Hz	350 Hz	500 Hz	1:2.5 (I+II+III)
	1 kHz	700 Hz	1 kHz	1:2.5 (I+II+III)
	10 kHz*3	7 kHz	9.5 kHz ±10.5 kHz	1:4 (II+III)
	100 kHz	70 kHz	100 kHz	1:5 (II+III)
	120 kHz	90 kHz	120 kHz	1:5 (II+III)
	1 MHz	700 kHz	1 MHz	1:5 (II+III)

*1 *Meets tolerances to CISPR 16.*

*2 *Meets tolerances to CISPR 16 (minimum 8 kHz, 10 kHz maximum) and complies with MIL tolerances (10 kHz ±10%).*

*3 *Complies with tolerances to CISPR and MIL tolerances of 10 kHz ±10%.*

EMI/RFI Solutions

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Noise Indication	Preamplifier off	Preamplifier on
ESHS		
Average value, BW 200 Hz		
f_{in} 9 to 50 kHz	<–24 to <–30 dBµV	<–30 to <–36 dBµV
f_{in} >50 kHz	<–30 dBµV, –35 dBµV typical	<–36 dBµV, –41 dBµV typical
Average value, BW 10 kHz		
f_{in} >50 kHz	<–14 dBµV, –17 dBµV typical	<–20 dBµV, –25 dBµV typical
Peak value (typical increase against average value)	+11 dB	+11 dB
Quasi-peak		
Band A		
9 to 50 kHz	–24 to –30 dBµV typical	–30 to –36 dBµV typical
50 to 150 kHz	–32 dBµV typical	–38 dBµV typical
Band B ≥150 kHz	–13 dBµV typical	–19 dBµV typical
PK/MHz (BW 10 kHz)	34 dBµV/MHz typical	28 dBµV/MHz typical
ESVS		
Average value		
BW 10 kHz	<–12 dBµV, –15 dBµV typical	<–16 dBµV, –21 dBµV typical
BW 120 kHz	<–1 dBµV, –4 dBµV typical	<–5 dBµV, –10 dBµV typical
Peak value		
BW 10 kHz	–4 dBµV typical	–9 dBµV typical
BW 120 kHz	+7 dBµV typical	+1 dBµV typical
Quasi-peak Band C/D	+2 dBµV typical	–4 dBµV typical
PK/MHz (spectral density measurement, BW 120 kHz)	25 dBµV/MHz typical	21 dBµV/MHz typical
ESS		
Average value, Range I		
BW 2 kHz, f_{in} = 5 to 30 Hz	<–38 to –48 dBµV typical	<–38 to –52 dBµV typical
BW 10 kHz, f_{in} = >30 Hz	<–40 dBµV, –44 dBµV typical	<–41 dBµV, –48 dBµV typical
Average value, Range II		
BW 200 kHz, f_{in} = 9 to 50 Hz	<–24 to –30 dBµV typical	<–30 to –36 dBµV typical
BW 200 kHz, f_{in} = >50 Hz	<–30 dBµV, –35 dBµV typical	<–36 dBµV, –41 dBµV typical
Average value, Range III		
BW 120 kHz	<1 dBµV, –6 dBµV typical	<–5 dBµV, –10 dBµV typical
RMS value (typical increase vs. average reading)	+1 dB	+1 dB
Peak (PK) value (increase vs. average reading)	+11 dB	+11 dB
ESS		
Quasi-peak		
Band A		
9 to 50 kHz	–27 dBµV	–30 dBµV
50 to 150 kHz	–32 dBµV	–38 dBµV
Band B	–13 dBµV	–19 dBµV
Band C/D	+2 dBµV	–4 dBµV
PK/MHz		
Range II, BW 10 kHz	34 dBµV/MHz	28 dBµV/MHz
Range III, BW 1 MHz	16 dBµV/MHz	12 dBµV/MHz

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Voltage Measurement Range	Preamplifier off	Preamplifier on
ESHS (f >50 kHz)		
Lower limit (additional error caused by inherent noise <1 dB)		
Average indication (AV)		
BW_{IF} 10 kHz	–6 dBµV, –10 dBµV typical	<–12 dBµV, –18 dBµV typical
BW_{IF} 200 Hz	–26 dBµV, –31 dBµV typical	<–32 dBµV, –37 dBµV typical
Peak indication (PK)		
BW_{IF} 10 kHz	–10 dBµV typical	+4 dBµV typical
BW_{IF} 200 kHz	–8 dBµV typical	–14 dBµV typical
Quasi-peak indication (QP)		
CISPR band A (25 Hz pulse repetition frequency)	–30 dBµV typical	–36 dBµV typical
CISPR band B (100 Hz pulse repetition frequency)	–11 dBµV typical	–17 dBµV typical
Spectral density (PK/MHz)	50 dBµV/MHz typical	44 dBµV/MHz typical
Upper limit (AV, PK, QP)	137 dBµV (RF attenuation ≥10 dB)	137 dBµV (RF attenuation ≥10 dB)
Inherent spurious response	<–10 dBµV (equivalent input voltage)	<–10 dBµV (equivalent input voltage)
ESVS		
Lower limit (additional error caused by inherent noise <1 dB)		
Average indication (AV)		
BW 10 kHz	<–8 dBµV, –11 dBµV typical	<–12 dBµV, –17 dBµV typical
BW 120 kHz	<+3 dBµV, 0 dBµV typical	<–1 dBµV, –6 dBµV typical
Peak indication (PK)		
BW 10 kHz	+12 dBµV typical	+7 dBµV typical
BW 120 kHz	+23 dBµV typical	+17 dBµV typical
Quasi-peak indication (QP)		
CISPR band C/D (100 Hz pulse repetition frequency)	<+10 dBµV, +6 dBµV typical	<+4 dBµV, 0 dBµV typical
Upper limit (AV, PK, QP)	137 dBµV (RF attenuation ≥10 dB)	137 dBµV (RF attenuation ≥10 dB)
Inherent spurious response	<0 dBµV (equivalent input voltage)	<0 dBµV (equivalent input voltage)
ESS		
Lower limit (additional error caused by inherent noise ≤1 dB)		
Average (AV)	4 dB above noise indication	4 dB above noise indication
RMS	5 dB above noise indication	5 dB above noise indication
Peak (PK)	15 dB above noise indication	15 dB above noise indication
Quasi-peak (QP) (25/100 Hz pulse repetition frequency)	3 dB above noise indication	3 dB above noise indication
Upper limit (AV, RMS, PK, QP)	137 dBµV (RF attenuation ≥10 dB)	137 dBµV (RF attenuation ≥10 dB)
Inherent spurious response (equivalent input voltage)		
5 Hz to 30 MHz	<–10 dBµV	<–10 dBµV
30 MHz to 1 GHz	<0 dBµV	<0 dBµV

EMI/RFI Solutions

ESHS • ESVS • ESS

Characteristics *(continued)*

DISPLAY RELATED

Level Display –
Digital, Digits: 3 1/2. Resolution: 0.1 dB. Units: dBµV, dBµA, dBm, dBµV/m, dBµA/m, dBµV/MHz, dBµA/MHz, dBµV/m/MHz, dBµA/m/MHz, dBpW, dBpT. Analog: Moving-coil meter in operating range of IF detector with additional digital display of lower range limit. Operating ranges, 30, 60 dB.

Screen (ESHS 30, ESVS 30, ESS) –
(RF analysis), Display: 5-inch CRT with digital video memory. Resolution: 1024 x 1024 pixels. Display range, X axis (frequency): Freely selectable, linear or logarithmic (ESS, maximum 1 GHz). Y-axis (level): 10 to 200 dB, adjustable. Marker Functions: Marker, delta marker, marker set to maximum, receiver frequency set to marker frequency.

Display Modes (detectors) – Average (AV), RMS (ESS only), peak (PK), spectral density measurement (PK/MHz), quasi-peak (QP). Averaging, Hold, and Measuring Times: 1 ms to 100 s (1-2-5 steps).

Measurement Error –
(ESHS) (AV for S/N >16 dB), Digital Display: <1 dB. Analog Display: <2 dB typical. Level Calibration: Harmonics generator.

(ESVS) (AV for S/N >16 dB), Digital Display: 0 to +55°C: ≤1 dB. –10 to 0°C: <1.5 dB. Analog Display: <2 dB typical.

(ESS) (AV for S/N >16 dB), Digital display: Range I and II: <1 dB. Range III: 0 to +55°C: <1 dB. –10 to 0°C: ≤1.5 dB. Analog Display: <2 dB typical. Level Calibration: Sinewave and harmonics generator.

Demodulation Modes –
(ESHS), A0 (zero beat); A3 (for A3E emissions).

(ESVS, ESS), A0 (zero beat); A3 (for A3E emissions); F3 (for F3E).

IF Analysis (ESHS 30, ESVS 30, ESS Range II and III) – Display Range: 10 kHz to 2 MHz (in 1-2-5 steps). Input Attenuation: 0 and 20 dB, selectable.

Nominal bandwidth	Resolution –3 dB (±20%)	Shape Factor BW6 dB:BW60 dB
10 kHz	10 kHz	1:4
3 kHz	3 kHz	1:6
1 kHz	1 kHz	1:9

Sweep Time: 50 ms to 10 s (1-2-5 steps). Level Display Range: 80 dB. Level Display (ESS only): Normal and normal + max hold. Marker Functions: Marker, delta marker, marker set to maximum, marker set to center frequency (receiver frequency).

Date, Time of Day – Internal clock, permanently operated from internal battery.

INPUT/OUTPUT

Floppy Disk Drive (ESHS 30, ESVS 30, ESS) –
3.5 inch, 1.44 MB formatted. Formatting: MS-DOS compatible. Data format HP-GL or binary.

Remote Control –
IEC 625-2 (IEEE 488). Connector: 24-contact Amphenol connector. Interface Functions: AH1, L4, SH1, T6, SR1, PP1, RL1, DC1, DT1, C1, C2, C3, C11. Plotter language: HP-GL (via IEC/IEEE bus interface).

Front-panel Outputs –
Supply and Coding Connector for Antennas, etc.: 12-contact Tuchel connector.

AF Output, Connector: JK34 jack. Impedance: 10 Ω. EMF: Adjustable up to 1.5 V.

Generator output 9 kHz to 1 GHz; (ESHS 30, ESS), Connector: N female. Impedance: 50 Ω. EMF: 96 dBµV ±1 dB.

Rear-panel Outputs –
IF 74.7 MHz (ESHS 10, ESVS 10), Connector: BNC female. Impedance: 50 Ω. Gain Referred to RF Input (RF attenuation 0 dB): 10 dB without preamplifier, 20 dB with preamplifier. Bandwidth (–3 dB): 2 MHz or bandwidth of preselector.

IF 10.7 MHz (ESVS, ESS), Connector: BNC female. Impedance: 50 Ω. EMF in Range of Analog Level Display for Unmodulated Sinewave Signal: Operating range 30 dB, 1 to 30 mV; Operating Range 60 dB, 1 mV to 1 V. Bandwidth (–3 dB): IF bandwidth.

IF 80 kHz (ESHS), Connector: BNC female. Impedance: 50 Ω. EMF in Range of Analog Level Display for Unmodulated Sinewave Signal: Operating range 30 dB, 1 to 30 mV; Operating range 60 dB, 1 mV to 1 V. Bandwidth: IF bandwidth.

Video Output (envelope detector), Connector: BNC female. EMF in Range of Analog Level Display: Operating range 30 dB, 4 to 126 mV; Operating range 60 dB, 4 mV to 4 V.

User Interface, Connector: 25-contact Cannon connector. Function: Six control lines for an external device (e.g., artificial mains network), display voltage with and without meter simulation, input for external triggering, RS-232C interface for firmware updating.

Printer Connection, Connector: 15-contact Cannon connector. Function: Parallel interface.

Keyboard connector, Connector: 5-contact DIN connector. Function: For MF2 keyboard.

Rear-panel Inputs –
External Reference Frequency, Connector: BNC female. Required level: EMF ≥1 V from 50 Ω. Frequency: 5/10 MHz.

External battery, Connector: 3-contact connector. Required voltage: 11 to 33 V.

EMI/RFI Solutions

ESHS • ESVS • ESS

POWER REQUIREMENTS

AC Operation –
Line Voltage: 100 V, 120 V, 220 V, 240 V ±10% (ESS, 230 V +6%/–10%). Line Frequency: 47 to 440 Hz. Power Consumption: ESHS 10, 50 VA; ESVS 10, 60 VA; ESHS 30, 80 VA; ESVS 30, 90 VA; ESS, 110 VA.

DC Operation –
Internal Battery (ESHS 10, ESVS 10): 12 V, 10 AH. Operating Time: ESHS 10: approximately 4 hours; ESVS 10: approximately 2.5 hours.

External battery –
Voltage Range: 11 to 33 V. Current Drain 24/12 V: ESHS 10, 1.2 A/2.3A; ESVS 10, 1.9 A/3.3A; ESHS 30, 2.1 A/3.9 A; ESVS 30, 2.6 A/4.8 A; ESS, 3A/5.5A.

GENERAL SPECIFICATIONS

Environmental Characteristics –
Rated Temperature Range: –10 to +55°C (without condensation). Temperature Range for floppy Disk Drive: +5 to +50°C. Storage Temperature Range: –25 to +70°C. Mechanical Resistance: Shock-tested to MIL-STD-810 D (shock spectrum 40g), Vibration-tested to MIL-T-28800 D, Class 5; complies with IEC Publication 68-2-6. RFI Suppression: Complies with VDE 0876, Part 1a, Regulation 527/1979 and MIL-STD-461 B (CE03 and RE02).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	236	9.3
Width	435	17.1
Depth		
ESHS 10	363	14.3
ESHS 30	463	18.2
ESS	572	22.5
Weight	**kg**	**lb.**
ESHS 10 without battery	18	39.7
ESVS 10 without battery	20.4	45
ESHS 10 with battery	21	46.3
ESVS 10 with battery	23.7	52.2
ESHS 30	28.6	63.1
ESVS 30	26.4	58.2
ESS	32.1	70.8

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

ESHS 10
EMI Test Receiver.
Includes: Power Cord, Manual.

ESHS 30
EMI Test Receiver.
Includes: Power Cord, Manual.

ESVS 10
EMI Test Receiver.
Includes: Power Cord, Manual.

ESVS 30
EMI Test Receiver.
Includes: Power Cord, Manual.

Opt. 01/ESVS-B1 – Pulse Power Attenuator. Maximum pulse voltage 1500 V.

ESS TEST RECEIVER
EMI Test Receiver.
Includes: Power Cable, Connector for External Battery, N-BNC Adapter, Sun Shield for Screen (ESS only), Manual.

Opt. 01/ESS-B1 –
OCXO Reference Oscillator. 1 x 10^{-7} setting error, 1 x 10^{-9}/day aging error and 1 x 10^{-9}/°C temperature drift.

SERVICE ASSURANCE OPTIONS
Opt. C5 (ESVS 30 and ESS) –
Adds five years of Calibration Services.

ADDITIONAL ACCESSORIES
Also see page 434.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

EMI/Radio Monitoring Solutions

ESVB • ESVD • ESVN • ESN

Features

ESVB

- Frequency Range 20 MHz to 1 GHz (2.05 GHz with Option 02)

ESVD

- Frequency Range 20 MHz to 1 GHz (2.05 GHz with Option 02)
- Frequency Accuracy to GSM Recommendations
- In-phase and Quadrature Output for Evaluating Any Modulated Signal

ESVN

- Frequency Range 20 MHz to 1 GHz
- Remote Control via IEEE 488 Interface
- Operation from AC Supply or Internal/External Battery

ESN

- Frequency Range 9 kHz to 1 GHz (2.05 GHz with Option 01)
- Remote Control via IEEE 488 Interface
- Operation from AC Supply or External Battery

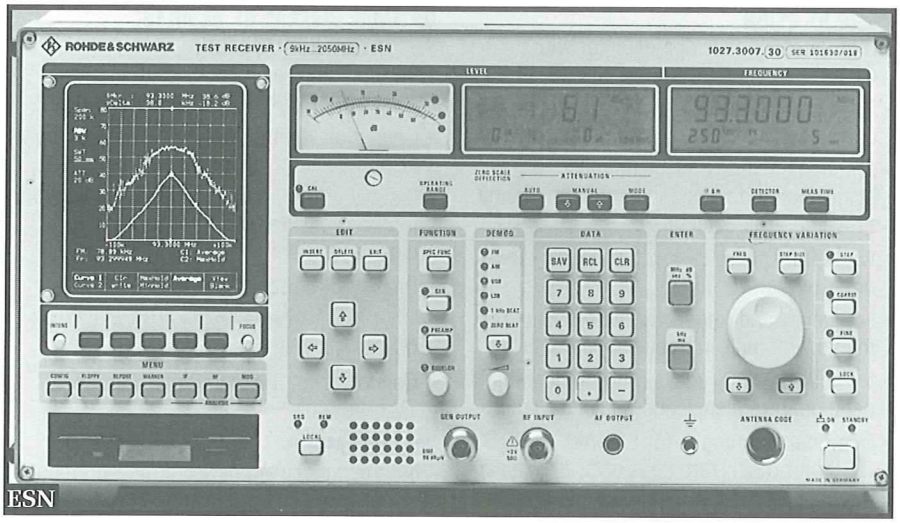
Applications

- Field-strength Measurements Using Test Antennas
- Radio Monitoring to CCIR
- Coverage Measurements
- Selective Voltage Measurements in Labs and Test Shops
- Radio Interference Measurements to EN 55011 to 55022, ETS, FCC and ANSI C63.4, VCCI, and VDE 0871 to 0879
- Digital Audio Broadcasting Networks (ESVB)
- Mobile Radio Networks – GSM, PCN (ESVD)

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



ESN

Introduction

The ESVB/ESVD/ESVN/ESN Test Receivers are ideal instruments for all applications in the fields of radio monitoring and radio network planning, civil RFI measurements to all relevant standards, as well as for selective voltage and two-port measurements in manual and automatic mode. ESVB/ESVD/ESVN/ESN are used to measure and demodulate both amplitude-modulated (DSB, SSB pulse) and frequency-modulated signals, as well as narrowband and broadband interference in the range from 20 MHz to 1 GHz (ESVN), 9 kHz to 2.050 MHz (ESN), and 20 MHz to 2.05 GHz (ESVB/ESVD Option 02).

Manual operation or automatic mode, with spectrum display on screen and reports of results on printer or plotter, make these Test Receivers extremely versatile for many applications.

TEST RECEIVER FEATURES
The ESVB/ESVD/ESVN/ESN Test Receivers combine three different types of test receivers in one:

- A compact, manually tuned and battery-operated test receiver
- A test receiver which automatically performs measurements and reports the results
- A system-compatible test receiver

Following are the primary features which are shared by both instruments unless noted otherwise:

RF UNIT

- High measurement accuracy: error <1 dB, <0.5 dB typical
- Refined preselection
- Switchable preamplifier with wide dynamic range
- Crystal-stabilized synthesizer (ESN): sweep mode for fast frequency scans, frequency resolution down to 10 and 100 Hz
- Wide dynamic range: noise figure typically 7 dB with preamplifier, 12 dB without preamplifier, third-order intercept point typically 20 dBm (without preamplifier)
- Tracking generator for attenuation and gain measurements with ESVN 30 and ESN (9 kHz to 1 GHz)
- High-level mixer ensuring high suppression of 1st LO
- IF analysis with resolution bandwidth of 1, 3, and 10 kHz; span 0.01 to 10 MHz; runs in parallel with level measurements

EMI/Radio Monitoring Solutions

ESVB • ESVD • ESVN • ESN

DEMODULATION

- High-linearity envelope detector with dynamic range of more than 70 dB
- Peak, average, RMS, and quasi-peak detectors
- Automatic overload detection in mixer stages and in test channel by permanently activated peak detectors
- Logarithmic amplifier with dynamic range of more than 70 dB
- Frequency and frequency-offset measurements with built-in frequency counter
- Demodulators for measuring modulation depth and frequency and phase deviation
- Demodulator circuits for FM, AM, SSB (LSB and USB), zero beat, and 1-kHz beat
- Built-in loudspeakers and headphones connector; demodulation using signal processors
- Separate signal channel with 5 MHz bandwidth and demodulator for TV signals with switchover to all common TV standards

POWERFUL PROCESSOR SYSTEM

- Macros for automatic test runs
- Test runs over up to 400 freely selectable channels with programmable thresholds
- Automatic level calibration and consideration of frequency-dependent transducer factors (e.g., of antennas)
- Non-volatile storage of 10 complete instrument setups, 22 different antenna factors and limit lines
- Built-in 3.5 in. floppy disk drive
- Output of results as lists and diagrams on plotter or printer including limit lines and user-defined labeling
- 12-Bit A/D converter with short conversion time
- Measurement time adjustable between 1 ms and 100 s, 50 µs for overview measurements
- 16-Bit processor; flash EPROM allowing convenient and fast firmware updating
- Automatic calibration at a keystroke with the aid of an internal high-precision generator
- Automatic monitoring of all synthesizer loop and supply voltages during operation

OPTIMAL DISPLAY OF RESULTS FOR EVERY APPLICATION

- Measurement of voltage, field-strength, and current with full indication of units
- Level indication on analog meter and digital display with 0.1 dB resolution
- Display of modulation depth, deviation, and frequency or frequency offset with very high resolution
- Display of frequency spectra (RF ANALYSIS) including limit values
- IF analysis with spans of up to 10 MHz
- Connector for TV monitor to identify TV programs

MANUAL MODE

These test receivers perform measurements at a fixed frequency with the desired bandwidth, attenuation, measurement time, and display mode. Level measurement, modulation, and deviation measurement, as well as frequency and frequency offset measurement, are carried out simultaneously.

While measurements are being performed, the IF analysis function allows the spectrum about the receive frequency to be analyzed. Measurement of level, modulation, or frequency, as well as signal assessment using the built-in loudspeaker, are made at the center frequency of the extended spectrum with the settings selected. Two test curves can be displayed simultaneously on the screen, the display mode for the two curves being selectable independently of one another.

Max Hold, Max/Min, and Average display modes allow fast identification and measurement of useful and interference signals in a signal spectrum. Marker functions are provided for fast evaluation and measurement of the identified signals in the receive channel.

AUTOMATIC MODE

The receive frequency range is scanned and the result displayed as a spectrum on the screen. The measurement parameters such as start frequency, stop frequency, IF bandwidth, measurement time, attenuation, and display mode can be freely selected.

Single-shot or repetitive scanning can be selected. Two test traces can be displayed at a time. For comparison measurements, waveforms can also be loaded from a floppy disk.

THREE OPERATING MODES FOR FREQUENCY SCANNING

Overview Mode: Frequency scanning over the desired frequency range is at maximum speed and with fixed attenuation.

Scan Mode: Frequency scanning is quasi-continuous with selectable step size and measurement time as well as automatic attenuation setting.

Channel Mode: Frequency scanning over a defined data set with up to 400 frequencies.

DOCUMENTATION OF RESULTS

The results, along with all relevant information, can be output in graphical form or as lists on a plotter or printer. In addition, data can be stored on a floppy disk along with the complete receiver setup. Information can be entered via a line editor or, more conveniently, via an optional keyboard. Date, time, and receiver settings are automatically recorded.

USE IN COMPUTER-CONTROLLED SYSTEMS

Full use of the high measurement rate of these test receivers is possible only in the remote mode using a high-speed controller. In the determination of field-strength profiles, the receivers furnish 5,000 measured values per second after being triggered by a positioning system or a time base. The field strength can be determined at different frequencies with a particular frequency band at a rate of 2.5 ms per measured value. In cellular radio networks, it is thus possible to measure the field strength of several base stations according to Lee's statistical method using a single receiver at the normal speed of the test vehicle.

For radio monitoring, up to 10,000 frequencies can be stored in the receivers and scanned at high speed with range-related receiver settings. The results are then output to the process controller.

EMI/Radio Monitoring Solutions

ESVB • ESVD • ESVN • ESN

Characteristics

FREQUENCY RELATED
Frequency Range –

	ESVB/ESVD/ESVN	ESN
Range I	–	9 kHz to 30 MHz
Range II	20 MHz to 1 GHz	30 MHz to 1 GHz
Range III	1 GHz to 2.050 GHz (ESVB/ESVD)	1 GHz to 2.050 GHz (with Opt. 01)

Frequency Setting –
With tuning knob: Fine, coarse or any step size selectable. Numerical: Via keyboard entry. Step size: Any selectable size. Automatic scanning: For RF analysis.

Frequency Display – 8-digit LCD.

Resolution – Range I: 10 Hz. Range II and III: 100 Hz.

Frequency Error – ESVN: $<3 \times 10^{-6}$. ESN and ESVN with Option 01 (after 30 minutes warm-up): $<1 \times 10^{-7}$.

Temperature Drift – $<1 \times 10^{-9}$/°C.

Aging – $<1 \times 10^{-7}$/year.

RF INPUT
Connector – N connector, female.

Impedance – 50 Ω.

RF Attenuator – 0 to 120 dB, switchable in 10 dB steps.

VSWR –
9 kHz to 1 GHz – 10 dB RF attenuation: <1.2. 0 dB RF attenuation: <2.

1 GHz to 2.050 GHz – 10 dB RF attenuation: <1.35. 0 dB RF attenuation: <2.

Input Filters – Range I: Five fixed-frequency bandpass filter. Range II: One fixed-frequency and five tracking bandpass filters. Range III: Four fixed-frequency bandpass filters.

Preamplifier – Can be connected between input filter and 1st mixer. Gain: 10 dB.

TABLE 1

ESVB/ESVD Nominal Bandwidth	–3 dB (±10%)	–6 dB (±10%)	Shape Factor $BW_{6\ dB}/BW_{60\ dB}$
10 kHz	7 kHz	9.5 kHz	1:4 typ.
120 kHz	90 kHz	120 kHz	1:5 typ.
300 kHz	300 kHz	400 kHz	1:6 typ.
1 MHz	800 kHz	1 MHz	1:4 typ. (ESVD)
1.5 MHz	1.5 MHz	1.8 MHz	1:2.7 typ. (ESVB)

TABLE 2

ESVB/ESVD Noise Indication	Preamplifier off	Preamplifier on
20 to 1000 MHz		
Average value, BW – 10 kHz	< –12 dBµV, typ. –16 dBµV	< –16 dBµV, typ. –20 dBµV
BW – 120 kHz	typ. –5 dBµV	typ. –9 dBµV
BW – 300 kHz	typ. 0 dBµV	typ. –4 dBµV
BW – 1 MHz	typ. 4 dBµV (ESVD)	typ. 0 dBµV (ESVD)
BW – 1.5 MHz	typ. 7 dBµV (ESVB)	typ. 3 dBµV (ESVB)
1000 to 2050 MHz		
Average value, BW – 10 kHz	< –10 dBµV, typ. –15 dBµV	< –16 dBµV, typ. –20 dBµV
BW – 120 kHz	typ. –3 dBµV	typ. –9 dBµV
BW – 300 kHz	typ. 2 dBµV	typ. –4 dBµV
BW – 1 MHz	typ. 6 dBµV (ESVD)	typ. 0 dBµV (ESVD)
BW – 1.5 MHz	typ. 9 dBµV (ESVB)	typ. 3 dBµV (ESVB)

TABLE 3

ESN/ESVN Nominal Bandwidth	–3 dB (±20%)	–6 dB	Shape Factor $BW_{6\ dB}/BW_{50\ dB}$
1 kHz	1 kHz	1.2 kHz ±20%	1:2.8
3 kHz	3 kHz	3.15 kHz ±10%	1:1.8
9 kHz*1	7 kHz	9.5 kHz ±20%	1:2.2
15 kHz	15 kHz	17 kHz ±10%	1:1.8
120 kHz*1	90 kHz	120 kHz ±20%	1:5
250 kHz	250 kHz	330 kHz ±10%	1:3.7

*1 *Meets tolerances to CISPR 16.*

TABLE 4

ESN/ESVN Noise Indication	Preamplifier off	Preamplifier on
Average value, BW 1 kHz		
Range I (f_{in} >50 kHz)	<–22 dBµV, –27 dBµV typical	<–28 dBµV, –33 dBµV typical
Range II	<–18 dBµV, –23 dBµV typical	<–22 dBµV, –28 dBµV typical
Range III	<–16 dBµV, –22 dBµV typical	<–22 dBµV, –28 dBµV typical

EMI/Radio Monitoring Solutions

ESVB • ESVD • ESVN • ESN

Maximum Input Level (with and without preamplifier) –
RF attenuation 0 dB (AC-coupled); DC Voltage: 50 V. Sinewave AC Voltage: 130 dBµV. Spectral Pulse Density: 97 dBµV/MHz.

RF Attenuation >0 dB (DC-coupled); DC Voltage: 7 V (corresponds to 1 W). Sinewave AC Voltage: 137 dBµV. Maximum Pulse Voltage: Range 1, 700 V; Range II and III, 150 V. Maximum Pulse Energy: Range 1, 100 mWs; Range II and III, 1 mWs.

RF Shielding – Voltage Indication at a Field Strength of 10 V/m with 0-dB RF attenuation ($f \neq f_{in}$): <0 dBµV. Additional Error in CISPR Indication Range (10 V/m): <1 dB. Interference: Complies with tolerances to EN50081-1. Interference Immunity: Complies with tolerances to EN50082-1.

IF Bandwidths – ESVB/ESVD: See Table 1, ESVN/ESN: See Table 3.

Noise Indication – ESVB/ESVD: See Table 2, ESN/ESVN: See Table 4.
RMS Value (noise indication average value): +1 dB typical.
Peak (PK) Value (noise indication average value): +12 dB typical.

Voltage Measurement Range –
Lower Limit (additional error caused by inherent noise <1 dB); Average Value (AV): 4 dB above noise indication. RMS Value (RMS): 5 dB above noise indication. Peak Value (PK): 15 dB above noise indication. Quasi-peak (QP) (100 Hz pulse frequency): 3 dB above noise indication.

Upper Limit (AV, RMS, PK, QP): 137 dBµV (RF attenuation >0 dB).

Inherent Spurious Response (equivalent input voltage); Range I: <–10 dBµV. Range II and III: <0 dBµV.

DISPLAY RELATED
Level Display –
Digital; Digits: 3. Resolution: 0.1 dB. Units: dBµV, dBµA, dBm, dBµV/m, dBµA/m, dBpW.

Analog: Moving-coil meter in operating range of IF detector with additional digital display of lower range limit.

Operating ranges: 30, 60 dB.

Screen –
Display: 5 inch CRT with digital memory.

Resolution: 1024 x 1024 pixels.

Display range; X-axis (frequency): Freely selectable, linear or logarithmic. Y-axis (level): 10 to 200 dB, adjustable in 10 dB steps.

Test Curves: Maximum 2 traces. Display Modes: Clr/Write, Max Hold, View.

Frequency Scan Modes; Overview: Scan with fixed attenuation and step size at maximum speed. Scan: Scan with automatic attenuation setting and selectable step size. Channel: Scan at up to 400 predefinable frequency values.

Marker: 2 markers with digital display of frequency and level. Marker Functions: Normal marker, delta marker, marker-to-peak, marker-to-receiver frequency.

Indication Modes – Average value (AV), RMS value (RMS), peak value (PK), quasi-peak value (QP, f_{in} >150 kHz). Measurement time: 1 ms to 100 s (1-2-5 steps).

Measurement Error (average value for S/N >16 dB) –
Digital Display; Range I: <1 dB. Range II: 0 to +55°C: <1 dB. –10 to 0°C: ≤1.5 dB. Range III: <2 dB.

Internal Level Calibration: Short or total calibration by keystroke. Generator: Sinewave and harmonics generator.

Frequency Drift (digital in kHz) –
Resolution: 0.1 to 100 Hz. Measurement Range: 0.5 IF bandwidth. Measurement Time: 1 ms to 100 s. Measurement error: Same as frequency error.

Frequency Deviation (digital in kHz) –
Resolution: 0.1/0.01 kHz. Measurement Range: Deviation + f_{mod} <0.5 IF bandwidth. Measurement Frequency f_{mod}: 1<100 kHz. Measurement Error (signal-to-noise >40 dB, AF = 1 kHz); IF Bandwidths 1, 3, 9, and 15 kHz: 100 Hz + 3% of measured value. IF Bandwidths 120 and 1250 kHz: 2 kHz + 3% of measured value.

Phase Deviation (bandwidths 1, 3, 9, 15 kHz) – Resolution: 0.1. Maximum Deviation: 8 rad. Modulation Frequency: 300 Hz to 5 kHz. Measurement Error (signal-to-noise >40 dB, m = 50%, AF = 1 kHz): 0.1 rad + 5% of measured value.

Modulation Depth (digital in %) –
Resolution: 0.1%. Measurement range 1 to 99%. Modulation Frequency f_{mod}: <100 kHz. Measurement Error (signal-to-noise >40 dB, m = 50%, AF = 1 kHz): 5% (absolute).

IF Analysis –
Frequency Display; Range I: 10 kHz to 2 MHz (1-2-5 steps). Range II and III: 10 kHz to 10 MHz (1-2-5 steps).

Level Display Range: 80 dB.

Attenuation Switchover (in IF path): 0/20 dB.

Resolution Bandwidth (–3 dB): 1, 3, 10 kHz.

Sweep Time: 50 ms to 10 s (1-2-5 steps).

Number of Test Curves: Maximum 2 traces.

Display Modes: Clr/Write, Max Hold, Min Hold, Average, View.

Marker: 2 markers with digital display of frequency and level.

Marker Functions: Normal marker, delta marker, marker-to-peak, marker-to-center frequency (= receiver frequency).

AF Demodulation Modes – Zero beat, 1 kHz beat, AM (for A3E emissions), USB and LSB (for SSB emissions), FM (for F3E emissions). Squelch: Adjustable with front-panel knob.

Trigger Functions – External: TTL level, positive- or negative-going edge. Internal: Controlled by RF level, threshold adjustable.

Date, Time of Day – Internal clock, permanently operated from internal battery.

EMI/Radio Monitoring Solutions

ESVB • ESVD • ESVN • ESN

INPUT/OUTPUT

Remote Control – IEC 625-2 (IEEE 488). Connector: 24-contact Amphenol connector. Interface functions: AH1, L4, SH1, T6, SR1, PP1, RL1, DC1, DT1, C1, C2, C3, C11.

Plotter – Via IEC/IEEE-bus interface. Plotter Language: HP-GL.

Printer – Connector: 15-contact Cannon connector, Parallel interface.

Keyboard – Connector: 5-contact DIN female.

Floppy Disk Drive – 3.5 in., 1.44 MB formatted, MS-DOS compatible.

Front-panel Outputs – Supply and Coding Connector for Antennas, etc.: 12-contact Tuchel connector.

AF output –
Connector: JK34 jack. Impedance: 10 Ω. EMF: Adjustable up to 1.5 V.

Generator output (tracking generator): (ESVN 30, ESN); Connector: N female. Impedance: 50 Ω. Bandwidth: ESVN 30, 20 MHz to 1 GHz; ESN, 9 kHz to 1 GHz. EMF: 96 dBµV ±1 dB.

Rear-panel Outputs –
IF 10.7 MHz (switch selected between leveled and unleveled IF voltage); Connector: BNC female. Impedance: 50 Ω. Bandwidth (–3 dB): IF bandwidth. EMF in range of analog level display for unmodulated sinewave signal: Operating range 30 dB, 1 to 30 mV; Operating range 60 dB, 1 mV to 1 V. Regulated Output: 700 mV.

AM/FM; Signal: Demodulated AF voltage. AM output voltage (EMF) (m = 50%, DC-coupled): 2 V p-p. FM (DC-coupled); Bandwidth 1, 3 kHz: 2 V/kHz. Bandwidth 9, 15 kHz: 0.2 V/kHz. Bandwidth 120, 250 kHz: 0.3 V/10 kHz. φM (AC-coupled): 0.2 V/rad.

I/Q Demodulator Outputs, AC-coupled (with Option 01 only); Connector: BNC female. Impedance: 50 Ω with external load >200 Ω. EMF (peak value regulated): 3 V, can be switched to external control). Bandwidth: 0.5 IF bandwidth. Phase error between I and Q for signal-to-noise >40 dB, output frequency 10 to 100 kHz: <1° typical.

CCVS Output; Connector: BNC female. Signal: Video polarity and vision/sound carrier offset can be selected for all TV standards.

Reference Output; Connector: BNC female. Function: Can be switched to input for external reference. Frequency: 10 MHz. Level: 7 dBm.

User Port; Connector: 25-contact Cannon connector. Function: Six TTL control lines for an external device (e.g., driven by RF level), analog voltage indication, input for external triggering, input for IF control, RS-232-C interface for firmware update.

Rear-panel Inputs –
External battery; Connector: 3-contact connector. Required voltage: 11 to 33 V.

Reference input; Connector: BNC female. Function: Can be switched to reference output. Level required: EMF >1 V from 50 Ω. Frequency: 5/10 MHz.

POWER REQUIREMENTS

AC Operation – Line voltage: 100 V, 120 V, 220 V, 240 V ±10%: 230 V +6%/–10%. Line frequency: 47 to 440 Hz. Power consumption: ESVN, 125 VA; ESN, 155 VA.

DC Operation – External Battery (switch-on voltage >12 V); Voltage Range: 11 to 33 V. Current Drain 24/12 V: ESVN, 3.7 A/6.8 A; ESN, 4.4A/8 A.

GENERAL SPECIFICATIONS

Environmental Characteristics – Rated Temperature Range: –10 to +55°C without condensation. Storage Temperature Range: –25 to +70°C. Mechanical Resistance: Shock-tested to MIL-STD-810 D (shock spectrum 40 g), Vibration-tested to MIL-T-28800 D, class 5; complies with IEC Publication 68-2-6. RFI Suppression: Complies with VDE 0876, Part 1a, Regulation 527/1979 and MIL-STD-461 B (CE03 and RE02).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	236	9.3
Width	435	17.1
Depth		
ESVN	460	18.1
ESN	572	22.5
Weight	**kg**	**lb.**
ESVN	29	63.9
ESN	32	70.5

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

ESVB
Test Receiver.
Includes: Power Cable, Manual.

Opt. 01/ESVD-B1 – I/Q Demodulator.

Opt. 02/ESVD-B2 – Frequency Extension to 2.05 GHz. (Opt. 01 required).

ESVD
Test Receiver.
Includes: Power Cable, Manual.

Opt. 01/ESVD-B1 – I/Q Demodulator.

Opt. 02/ESVD-B2 – Frequency Extension to 2.05 GHz. (Opt. 01 required).

ESVN 20
Test Receiver.
Includes: Power Cable, Manual.

Opt. 01/ESS-B1 – Reference Oscillator OCXO.

ESVN 30
Test Receiver with Tracking Generator.
Includes: Power Cable, Manual.

Opt. 01/ESS-B1 – Reference Oscillator OCXO.

ESN
EMI Test Receiver.
Includes: Power Cable, Connector for External Battery, N-BNC Adapter, Viewing Hood, Operating Manual.

Opt. 01/ESN-B1 – Frequency Extension. 1 GHz to 2.050 GHz operation.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

ADDITIONAL ACCESSORIES
Also see page 434.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

EMI Software

ES-K1

Features

ES-K1

- Fully Automatic and Interactive Operation for Maximum Speed, Reproducibility, and User Friendliness
- Automatic Compensation of Transducers (Correction Factors) and Limit Lines
- Evaluation of Narrowband/Broadband Interference
- Test Setup Calibration
- Convenient and Flexible Result Documentation
- Easy and Open-ended Expandability for System Applications Due to Modular Design

Applications

Conforms to following commercial and military standards:

Commercial:

- CISPR
- EN
- ANSI
- FCC
- EACL
- VDE

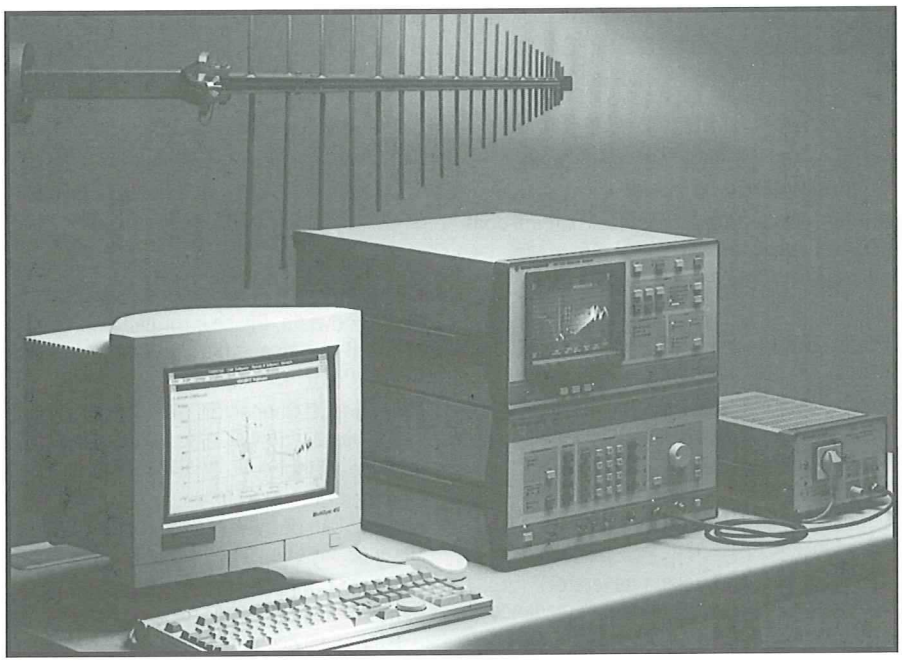
Military:

- MIL
- VG
- DEF-STAN
- GAM-EGI 3
- Can Be Adapted to Other Standards

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



Fully automated EMI compliance software.

ES-K1 EMI Software

ES-K1 EMI Software is an advanced, user-friendly tool which can be used for highly effective measurements for all conducted and radiated emission measurements. The number of measurements required for ensuring electromagnetic compatibility is ever increasing – and with it the demand to make these measurements reliable, reproducible, and economical.

ES-K1 EMI Software complies with these exacting requirements for measurements to both commercial standards (CISPR, EN, ANSI, FCC, EACL, VDE) and military standards (MIL, VG, DEF-STAN, GAM-EGI 3). Adaptation to other standards is possible.

When used with Rohde & Schwarz EMI test receivers and accessories, the ES-K1 EMI Test Software provides fully automatic operation. The interactive mode allows the operator to use his/her experience to the fullest for most accurate and thorough measurements. At the same time, operation under Windows provides easy access and operation for the first-time user. The friendly graphics user interface allows the operator to concentrate on the measurement at hand. Concise documentation of results in graphic and tabular forms is possible along with the associated test setup.

REQUIREMENTS

- PC-compatible controller fully compatible with Windows 3.1 with a minimum of 4 MB RAM
- Windows 3.1
- 4 MB available storage capacity on hard disk
- IEC/IEEE/488-bus interface with Windows driver (DLL), compatible with National Instruments IEEE 488-bus card AT-GPIB or PCIIA

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

ES-K1
EMI Test Software.
Includes: Program Disks, Manual.

RECOMMENDED ACCESSORIES
Script Development Kit – Order ES-K2.

ESHS/ESVS/ESVD Driver – Order ES-K10.
ESS Driver – Order ES-K11.
ESAI/ESBI/ESMI Driver – Order ES-K12.
ESVP/ESH3 Driver – Order ES-K13.

ESVP/ESH3/EZM Driver – Order ES-K14.
FSA/FSB/FSM Driver – Order ES-K15.
EMCO 1050/1060 Driver – Order ES-K32.

Communications Test Sets

Communications Test Sets

SIGNALING

Radio test sets, covering major national and international standards, including GSM, DCS 1800, DCS 1900, CDMA, and AMPS, are described here.

If in-depth analysis is required, including modulation without signaling, refer to the Spectrum Analyzers section. In particular, see information on the FSEA, FSEB, R3465, R2465, and R2471.

In addition to the conventional RF and AF measuring facilities, many units also include special signaling capabilities. Testers with signaling simulate the base station and perform all signaling measurements to PTT regulations, in addition to all conventional radio measurements. For large cellular-radio networks, they also provide base-station testing, including signaling.

Integration of a signaling unit into the radio tester ensures fast data exchange between the control units, thus creating the prerequisites for real-time measurements under practical conditions.

CONTENTS

COMMUNICATIONS TEST SETS

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Communications Test Sets

CMS50 • CMS52

Features

CMS50/CMS52

- Compact, Versatile and Full-featured Radiotelephone Tester
- Low Weight and Small Size for Stationary, Portable, and Mobile Use
- High-contrast Backlit LCD Screen with Large Characters and Simultaneous Indication of All Settings and Results
- Numerous Additional Features Such As Spectrum Monitor, Oscilloscope, Continuously Tunable Distortion Meter, and Adjustable AF Filters
- Learn Mode for Easy Programming
- Signaling Unit for Cellular Radio, e.g., E-AMPS, Trunked Radio, Paging Systems, and ZVEI Digital
- High-sensitivity Second IF Input for Off-air Measurements; Can Be Used Independently for Testing Modules, Including Frequency Converting DUTs
- Full-duplex Operation Without Compromise on Measurements
- Remote Control via IEC/IEEE Bus
- Automatic Self-adjustment Functions and Comprehensive Self-test
- Built-in Automatic Test Routines for Recurring Test Sequences

Applications

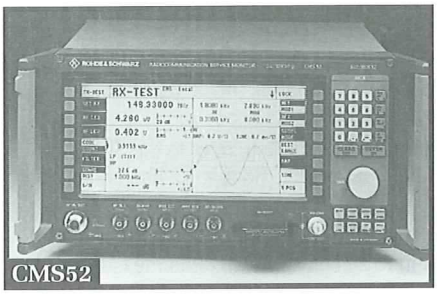
- Radiocom Tests
- Portable and Handheld Mobile
- Phone Test

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2.*

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



CMS50/CMS52 Radiocommunication Service Monitor

The CMS52 Radiocommunication Service Monitor is the ideal radio tester for service, maintenance, and test departments. With its full-featured configuration plus additional test facilities, it not only satisfies all requirements of radio measurements, but is also able to perform tests in related fields. The lightweight and compact instrument is particularly suitable for mobile use. With its extensive test facilities, it's also a valuable aid in development laboratories.

The CMS50 Radiocommunication Service Monitor is a budget-priced version of the CMS52, providing many of the same measurement capabilities. Differences are in the basic configuration, variety of options, and data tolerances (see following information).

OVERVIEW OF OPERATION

The CMS has a large, high-resolution LCD screen with backlighting and graphics capability. It's operated via softkeys at both sides of the display. A straightforward menu structure allows fast, direct access to the test facilities provided by the CMS50/52. Numbers and units can be entered directly via the keyboard; settings can be varied by means of the spinwheel with variable step size.

In the learn mode, the CMS stores all manual settings and measurements and produces a ready-to-start automatic test routine. The user doesn't need to have any programming knowledge or learn equipment-specific command sets. Tolerances, comments, and conditions (e.g., loops, jumps, queries, and control commands) can be easily inserted into these test routines. Generated programs and test results can be saved on a memory card. Programs and test results can be output to an optional printer.

Characteristics

TIMEBASE

Timebase/Standard –

Temperature effect (0° to +35°C): ≤1 x 10^{-6}.
Aging: ≤1 x 10^{-7}/day; ≤1 x 10^{-6}/month; ≤2 x 10^{-6}/year.

RECEIVER MEASUREMENTS

Signal Generator –

Frequency range: 0.4 MHz to 1 GHz.
Frequency resolution: CMS52, 10 Hz; CMS50, 50 Hz.
Frequency error: Same as timebase.
Level – FM: φM, CW: ≤–134 to 0 dBm.
AM: –134 to –3 dBm.
Level resolution: 0.1 dB.
Fine variation of level – FM: φM, CW: 0 to –19.9 dB, non-interrupting. AM: 0 to –4.9 dB, non-interrupting.
Level error (level ≤–3 dBm, f > 1 MHz): ≤2 dB.
Harmonics: CMS52, ≤–25 dBc; CMS50, ≤–20 dBc.
Non-harmonics: ≤–50 dBc (≤5 kHz from carrier, level –3 dBm).
Residual AM (CCITT, RMS): CMS52, ≤0.03%; CMS50, ≤0.1%.
Residual FM (CMS52) (CCITT, RMS) – 400 kHz to 250 MHz, 500 MHz to 1 GHz: ≤10 Hz. 250 to 500 MHz: ≤5 Hz.
Residual FM (CMS50) (CCITT, RMS): ≤10 Hz.
Phase noise (CMS52): ≤–110 dBc/Hz (20 kHz from carrier).

Modulation –

Frequency range: CMS52, 0.4 MHz to 1 GHz; CMS50, 2 to 500 MHz.
AM modulation depth: 0 to 99%.
Resolution: 0.5%.
Modulation frequency range (CMS52): f <8 MHz, DC to 10 kHz; f ≥8 MHz, DC to 20 kHz. (CMS50): 15 Hz to 10 kHz. f<8 MHz.
Modulation distortion (m <0.8, f_{AF} = 1 kHz): ≤2%.
Modulation error (m <0.8, f_{AF} = 300 Hz to 3 kHz): ≤5% + resolution + residual AM.
FM deviation: CMS52, 0 to 100 kHz; CMS50, 50 Hz to 50 kHz.
Resolution: Δf <100 Hz, 1 Hz; Δf ≥100 Hz, 1%.
Modulation frequency range: 20 Hz to 20 kHz; suitable for POCSAG. Modulation distortion (f_{AF} = 1 kHz, Δf <1 kHz): ≤1%.
Modulation error: ≤5% + resolution + residual FM.
φM deviation (internal): 0 to 10 rad.

Communications Test Sets

CMS50 • CMS52

Resolution: $\Delta\varphi$ <0.1 rad, 1 mrad; $\Delta\varphi \geq$0.1 rad, 1%.
Modulation frequency range: 100 Hz to 6 kHz.
Modulation distortion (f_{AF}=1 kHz, $\Delta\varphi \leq$1 rad): ≤1%.
Modulation error: ≤5% + resolution + residual φM.
Modulation modes: Internal (single tone/two-tone), external, internal + external.

AF Voltmeter –
Frequency range: 50 Hz to 20 kHz.
Measurement range: 0.1 mV to 30 V.
Resolution: V<10 mV: 100 µV. V≥10 mV: 1%.
Error: <5% + resolution.
Input impedance: Approximately 1 MΩ.

Distortion Meter, SINAD Meter, AF Frequency Counter – See transmitter and receiver measurements.

TRANSMITTER MEASUREMENTS
RF Power Meter –
Frequency range: CMS52, 1.5 MHz to 1 GHz; CMS50, 2 MHz to 1 GHz.
Measurement range: 5 mW to 50 W.
Resolution – P<100 mW: 1 mW.
P≥100 mW: 1%.
Error (P>20 mW, AM = 0%): ≤0.4 dB + resolution.

RF Frequency Counter –
Frequency range: 0.5 MHz to 1 GHz.
Input level range: 5 mW to 50 W.
Resolution: 10 Hz, 1 Hz.
Error: Same as timebase + resolution.

Frequency Deviation Meter –
Operating modes: +PK, –PK, ±PK/2, PK HOLD, RMS, RMS $\sqrt{2}$.
Input level range: 5 mW to 50 W.
RF frequency range: 1.5 MHz to 1 GHz.
Deviation measurement range: CMS52, 0 Hz to 100 kHz; CMS50, 0 Hz to 50 kHz.
AF frequency range: CMS52, 20 Hz to 20 kHz; CMS50, 20 Hz to 15 kHz.
Resolution – Δf <1 kHz: 1 Hz. Δf ≥1 kHz: 1%.
Residual FM (CCITT, RMS): ≤10 Hz.
Error: ≤5% + resolution + residual FM.

Phase Deviation Meter –
Operating modes: +PK, –PK, ±PK/2, RMS, RMS $\sqrt{2}$.
Input level range: 5 mW to 50 W.
RF frequency range: 1.5 MHz to 1 GHz.
Measurement range: 0.001 to 5 rad.
AF frequency range: 300 Hz to 6 kHz.
Resolution: $\Delta\varphi \leq$0.1 rad: 0.001 rad.
$\Delta\varphi$ >0.1 rad: 1%.
Error: Same as frequency deviation meter + 2% frequency response.

AM Depth Meter –
Operating modes: +PK, –PK, ±PK/2, RMS, RMS $\sqrt{2}$.
Input level range: 20 mW to 50 W.
RF frequency range: 1.5 MHz to 1 GHz.
Modulation depth measurement range: 0.01% to 99%.
AF frequency range: CMS52, 50 Hz to 20 kHz; CMS50, 50 Hz to 10 kHz.
Resolution – m<0.1: 0.01%. m ≥0.1, 0.1%.
Residual AM (CCITT, RMS): ≤0.03%.
Error (m ≤0.8, f_{AF} = 0.3 to 3 kHz): ≤7% + resolution + residual AM.
Distortion meter, SINAD meter, AF frequency counter: See transmitter and receiver measurements.

RF Spectrum Monitor –
Frequency range: 1 MHz to 1 GHz.
Reference level: +47 to –47 dBm (Input 1).
Display dynamic range: >60 dB (≥7 dBm reference level at input 1).
Span: 0 (zero span) to 50 MHz.
Filters (3-dB bandwidth): 150 Hz, 6 kHz, 16 kHz, 50 kHz, 300 kHz, 1/3 MHz (coupled to span).
Error: ≤3 dB + resolution.

Tracking Generator (Option 04 or 24 required) –
Frequency range: 400 kHz to 1 GHz.
Reference level: –27 to –67 dBm.
Display dynamic range – f = 1 to 500 MHz: 50 dB. f = 500 MHz to 1 GHz: 45 dB.
Span: 0 (zero span) to full span.
Filters (3-dB bandwidth): 150 Hz, 6 kHz, 16 kHz, 50 kHz, 300 kHz, 1/3 MHz (coupled to span).
Error: <3 dB (<0.5 dB with relative measurement).
Resolution 0.4 dB: Output Level: 0 to –128 dBm.
Frequency offset: 0 to ±999 MHz (depending on span and center frequency).

TRANSMITTER MEASUREMENTS AT 2ND RF INPUT
Second RF Input –
Measurement of RF frequency, modulation (AM, FM , φM), modulation frequency and spectrum (level) of small RF signals (e.g., in off-air or module measurements, for low input levels).

RF Frequency Counter –
30 µV (selective frequency counter with presetting).

Modulation Meter –
IF narrow: 5 µV.
IF narrow, selective measurement: 1 µV.

Selective Level Measurement –
Without weighting filter: –75 to –35 dBm.
With 2 kHz resonance filter: –100 to –35 dBm.

TRANSMITTER AND RECEIVER MEASUREMENTS
Modulation Generator I and II –
Frequency range: CMS52, 20 Hz to 30 kHz; CMS50, 20 Hz to 20 kHz.
Frequency resolution: 0.1 Hz.
Frequency error: Same as timebase + 1/2 x resolution.
Output level range: 10 µV to 5 V.
Resolution – V<1 mV: 10 µV. V ≥1 mV: 1%.
Error: V>1 mV: ≤5%.
Output impedance: ≤4 Ω.
Maximum output current (peak): 20 mA.
Distortion: ≤0.5%.

Distortion Meter –
Frequency: CMS52, 100 Hz to 5 kHz in 10-Hz steps; CMS50, 100 Hz to 3 kHz in 10-Hz steps.
Input level range: 100 mV to 30 V.
Measurement range: 0.1 to 50%.
Resolution: 0.1%.
Inherent distortion: ≤0.5%.
Measurement bandwidth weighting: 12 kHz.
Error: ≤5% + inherent distortion.

SINAD Meter –
Frequency: CMS52, 100 Hz to 5 kHz ±10 Hz; CMS50, 1 kHz ±10 Hz.
Measurement Range: 1 to 46 dB.
Input level range: 100 mV to 30 V.
Resolution: 0.1 dB.
Weighting bandwidth: 12 kHz.
Error: ≤1 dB + inherent distortion.

AF Frequency Counter –
Operating modes: Demodulation, AF, beat (frequency offset), external.
Frequency range: CMS52, 20 Hz to 500 kHz, CMS50, 20 Hz to 20 kHz (superimposed RF).
Input level range (f <20 kHz): 10 mV to 30 V.
Resolution: 1 Hz/0: 1 Hz.
Error: Same as timebase + resolution.

Oscilloscope –
Bandwidth – DC: DC to 20 kHz.
AC: 10 Hz to 20 kHz.
Horizontal deflection: 20 to 0.1 ms/div.
Vertical deflection: Scaled in kHz (FM), rad (φM), % (AM), mV/V (AF).
Input level range: 0 to 40 V peak.
Input impedance: Approximately 1 MΩ.

Communications Test Sets
CMS50 • CMS52

AF Filters –
Highpass f_{cutoff} = 300 Hz (attenuation at 200 Hz, typical 40 dB).
Lowpass f_{cutoff} = 3.4 kHz (attenuation at 10 kHz, typical 40 dB).
Bandpass (broadband): Highpass + lowpass.
Bandpass (narrowband): CMS52, 50 Hz to 5 kHz in 10-Hz steps; attenuation typical 40 dB for 0.8 x f and 1.2 x f. CMS50, 50 Hz to 3 kHz in 10-Hz steps, attenuation typical 40 dB for 0.8 x f and 1.2 x f.
Notch filter: CMS52, 100 Hz to 5 kHz in 10-Hz steps, +40 dB; CMS50, 100 Hz to 3 kHz in 10-Hz steps, typ. 40 dB.
CCITT filter: See Opt. 03 or 06.

Selective Call Encoder/Decoder –
Tone sequences: ZVE11, 2/CCIR/EIA/EEA/EURO/NATEL/CCITT/VDEW/DTMF/VDEW direct dialing/user-defined sequences.

Audio Monitor (loudspeaker) – Demodulated signal, AF signal, beat (frequency offset).

OTHER CHARACTERISTICS
IEC/IEEE Bus (CMS52 only) – Interface to IEC 625-1 (IEEE 488) with listener/talker function.

POWER REQUIREMENTS
AC –
Line voltage: 100, 120, 220, 240 V AC ±10%.
Line frequency: 47 to 420 Hz.

DC – 11 to 32 V.

Power Consumption – 50 W.

ENVIRONMENTAL CHARACTERISTICS
RFI Suppression – To VDE 0871/0875 and postal regulations 1046/84.

Operating Temperature Range – 0 to +50°C.

Storage Temperature Range – –40 to +70°C.

Shock, Vibration, and Humidity Testing – To MIL-T-28800, type III, class 3, style C.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	175	6.9
Width	320	12.6
Depth	375	14.8
Weight	**kg**	**lb.**
Net	13	28.7

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CMS50
Radiocommunication Service Monitor.
Includes: Power Cable, Spare Fuses, Manual.

CMS52
Radiocommunication Service Monitor.
Includes: Power Cable, Spare Fuses, Manual.

Opt. 01/CMS-B1 – OCXO Reference Oscillator for high long-term stability. Temperature effect 0 to 50°, ≤1 x 10^{-7}; aging, ≤5 x 10^{-9}/day after 30 days of operation ≤2 x 10^{-7}/year.

Opt. 02/CMS-B2 – OCXO Reference Oscillator for more exacting requirements on long-term stability. Specifications same as Opt. 01 except for aging: ≤1 x 10^{-7}/year.

Opt. 03/CMS-B5 – Control Interface.

Opt. 04/CMS-B9 (CMS52 only) – Duplex Modulation Meter for measurements on duplex radios, cellular radio phones, relay stations, and frequency-converting modules (two-part measurements, also, on frequency-converting DUTs). Including Adjacent Channel Power (ACP) meter. Dynamic range, ≥70 dB with 25 kHz Channel Spacing.

Opt. 05/CMS-B13 (CMS52 only) – Signaling Unit for Cellular Radio. (also requires Opt. 04 or 24) Same as Opt. 20 with the addition of C-Net.
Note: Opt. 20 may be used as an alternative to Opt. 05.

Opt. 06/CMS-B20 – U/I DC Meter, CCITT Filter, DTMF Decoder.

Opt. 07/CMS-B21 (CMS52 only) – Programmable Universal Modem for FFSK Signals (instead of Opt. 05). For modulation and demodulation of data. Bit rate, 10 to 2400 Hz.

Opt. 08/CMS-B22 – 10-MHz Reference Frequency Input/Output for external synchronization of measuring systems. Output, TTL levels; Z_{out}, 50 Ω; f, 10 MHz. Input, level >1.5 V_{p-p}; Z_{in}, 50 Ω; f, 10 MHz ±500 Hz.

Opt. 09/CMS-B25 (CMS52 only) – NMT Base Station Test Software for Opt. 05 in conjunction with Opt. 18.

Opt. 10/CMS-B26 (for Opt. 05 or 20) – POCSAG, ZVEI/VDEW Digital Signaling Software for testing of POCSAG radio-paging receivers and ZVEI/VDEW mobile and base stations.

Opt. 11/CMS-B28 (for Opt. 05 or 20) – MPT 1327/1343 Software Signaling for testing of trunked radio networks.

Opt. 13/CMS-B30 – RS-232-C Interface for remote control of DUTs.

Opt. 14/CMS-B31 – Additional RF Input/Output for two-signal measurements and connection of further measuring instruments; bidirectional RF connector for additional measuring instruments. Maximum input power, 20 mW; Attenuation RF_{IN} to RF_{OUT}, 32 dB.

Opt. 15/CMS-B32 – 100-W RF Power Meter for measurement of high RF input power. Measurement range, 10 mW to 100 W.

Opt. 16/CMS-B33 (for Opt. 03 or 22) – 300 Hz Lowpass Filter for fast frequency and deviation measurement of unknown modulated subaudio tones. Attenuation approximately 50 dB at frequencies above 300 Hz.

Opt. 17/CMS-B34 – 13 dBm Output.

Opt. 18/CMS-B39 – 600 Ω AF Transformer.

Opt. 19/ZZA-99 – 19 inch Rack Adapter.

Opt. 20/CMS-B53 – Signaling Unit for Cellular Radio. (also requires Opt. 04 or 24) NMT 450 (SIS), NMT 900 (SIS), E-AMPS, E-TACS, J-TACS, TACS Issue 4, R 2000.
Note: Opt. 05 may be used as an alternative to Opt. 20.

Opt. 21/CMS-B54 (CMS50) – IEC/IEEE Bus Interface.

Opt. 22/CMS-B55 – Centronics Interface.

Opt. 23/CM-Z30 – ERMES Coder with Software.

Opt. 24/CMS-B27 – Same as Opt. 04, but without Adjacent Channel Power (ACP) meter.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.

ADDITIONAL ACCESSORIES – Also see page 434.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Communications Test Sets

CMS54 • CMS57

Features

CMS54

- Compact, Versatile, Full-featured Radio-telephone Tester
- Low Weight and Small Size for Stationary, Portable, and Mobile Use
- High-contrast Backlit LCD Screen with Large Characters and Simultaneous Indication of All Settings and Results
- Numerous Additional Features Such As Full-span Spectrum Monitor, Oscilloscope, Transient Frequency/Power Measurements, Harmonic Measurement, Continuously Tunable Distortion Meter, and Adjustable AF Filter
- Learn Mode for Easy Programming
- Signaling Unit for Cellular Radio, e.g., E-AMPS, Trunked Radio, Paging Systems, and ZVEI Digital
- High-sensitivity Second IF Input for Off-air Measurements; Can Be Used Independently for Testing Modules, Including Frequency Converting DUTs
- Remote Control via IEC/IEEE Bus
- Automatic Self-adjustment Functions and Comprehensive Self-test

CMS57

- All Features of CMS52
- Built-in VOR/ILS Generator

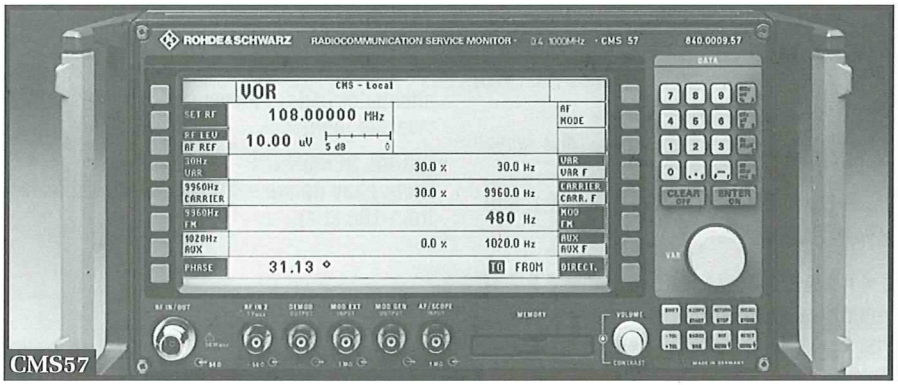
Applications

- High-end Radiocommunications Test
- RF Module R&D
- Portable and Handheld Mobile Phone Test
- VOR (VHF Omnidirectional Range)
- ILS (Instrument Landing System)
- MB (Marker Beacon)
- Autopilot

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



CMS54/57 Radiocommunication Service Monitors

The CMS54 and CMS57 Radiocommunications Service Monitors can perform transmitter and receiver testing, measurements on antennas, diplexers, filters, and frequency-converting modules as well as modulation spectrum analysis. They can be used for all transmitter and receiver measurements on transceivers with AM, FM, or φM modulation. The CMS57 adds avionics test capability.

CMS54 SSB TRANSCEIVER TESTING
The CMS54 is suitable for SSB transceiver testing as well as for measurements on mobile units for cellular and trunked radio networks. This lightweight and compact instrument is particularly suitable for mobile use. With its extensive test facilities, it's also a valuable tool for development laboratories.

CMS57 VOR/ILS SIGNAL GENERATION
The CMS57 includes a built-in VOR/ILS signal generator to generate all test signals for VOR, ILS, and MB tests. This combination of conventional radio-telephone and radio-navigation measurement allows a full range of avionics measurements to be performed by a single instrument.

LARGE, EASY-TO-READ DISPLAY
The CMS54/57 has a large, high-resolution LCD screen with back lighting and graphics capability. Functions are selected via softkeys at both sides of the display. A straightforward menu structure allows fast, direct access to the test facilities provided by the CMS54/57. Numbers and units can be entered directly via the keyboard; settings can be varied by means of the spinwheel with variable step size.

Characteristics (CMS54)

RF SPECTRUM MONITOR

Frequency Range – 1 to 1000 MHz.

Span – 0 (zero span) to 50 MHz; full span for frequency range 10 to 10000 MHz.

Reference Level – +47 to –47 dBm (input 1).

Sensitivity – <–110 dBm (for resolution filter; ±6 kHz and reference level ≤37 dBm at input 2 f ≥10 MHz).

Inherent Spurious Responses – <–50 dBc (for reference level >10 dBm and f >50 MHz).

Display Dynamic Range – >65 dB (for reference level >–7 dBm at input 1).

Scaling – 2/5/10 dB/div.

Display Range – ≤80 dB.

Resolution Filter (3 dB bandwidth) – 150 Hz (for modulation analysis), 6/16/50/300 kHz/1/3 MHz (for full span), coupled to span.

Error – <3 dB + resolution.

Resolution – 0.4 dB.

TRANSIENT RECORDER
Measurement of power and frequency as a function of time with graphical display and selectable zoom.

Time Scale – 50 us/div to 1 s/div, max. recording time 40 s.

Frequency Transients – RF measurement range: 1 to 1000 MHz FM deviation measurement range: 0 to ±100 kHz. Scaling: 0.5 to 50 kHz/div. Triggering: Internal, automatic (frequency changes >8 kHz).

Power Transients – RF measurement range: 1 to 1000 MHz Display dynamic range: 60 dB (for 47 dBm at input 1). Scaling: 2/5/10/20 dB/div. Triggering: Internal, automatic (power 10%).

HARMONIC MEASUREMENTS
Display of 1st to 4th harmonic.

Communications Test Sets

CMS54 • CMS57

Max. Harmonic Frequency – 1000 MHz.

Dynamic Range – >60 dB; >90 dB in frequency range 26.965 to 27.405 MHz (CB radio).

RF FREQUENCY COUNTER

Frequency Range – 0.5 to 1000 MHz (usable from 100 kHz, IF narrow).

Input Level Range (CW, FM) – Input 1: 0 to +47 dBm; Input 2: –40 to +7 dBm.

TRANSMITTER MEASUREMENT, 2ND RF INPUT

Additional internal switch-selectable 0/24 dB attenuator pad for measurements with higher levels at Input 2.

SIGNAL GENERATOR

Frequency Range – 0.4 to 1000 MHz (usable from 100 kHz).

Common Characteristics (CMS54/CMS57)

TIMEBASE

Timebase/Standard –

Temperature effect (0° to +35°C): ≤1 x 10^{-6}. Aging: ≤1 x 10^{-7}/day; ≤1 x 10^{-6}/month; ≤2 x 10^{-6}/year.

CHARACTERISTICS (CMS57 ONLY)

VOR/ILS generator

VOR	Range	Resolution	Error
Phase			
RF output	0 to 360°	0.01°	typ. 0.05°
AF output	0 to 360°	0.01°	≤0.04°
9960-Hz carrier			
Modulation frequency	7.9 to 12 kHz		
Amplitude modulation			
–128 to –9 dBm	0 to 100%	0.1% AM	typ. <2% for 30% AM
–85 to –45 dBm	0 to 100%	0.1% AM	<2% for 30% AM
FM deviation	384 to 576 Hz	1 Hz	≤1 Hz
30-Hz VAR			
Modulation frequency	24 to 36 Hz		
Amplitude modulation			
–128 to –9 dBm	0 to 100%	0.1% AM	typ. <2% for 30% AM
–85 to –45 dBm	0 to 100%	0.1% AM	<2% for 30% AM
1020-Hz AUX			
Modulation frequency	50 Hz to 20 kHz		
Amplitude modulation	0 to 100%	0.1% AM	≤3%, for 1020 Hz and 10 to 20% AM
ILS			
90-Hz and 150-Hz phase	0 to 108°, referred to 150 Hz	0.01°	≤1°
90-Hz tone Modulation frequency	72 to 108 Hz		
150-Hz tone Modulation frequency	120 to 180 Hz		
1020-Hz tone (AUX)			
Modulation frequency	50 Hz to 20 kHz		
Amplitude modulation	0 to 100%	0.1% AM	≤3%, for 1020 Hz and 10 to 20% AM
ILS Localizer			
Amplitude modulation			
–128 to –9 dBm	0 to 50%	0.01% AM	typ. <2% for 20% AM
–85 to –45 dBm	0 to 50%	0.1% AM	<2% for 20% AM
DDM1 RF output	±0 to 0.4 DDM for 20% AM	0.001 DDM	
On-course error, –128 to –9 dBm			<0.0004 DDM
Off-course error, –128 to –9 dBm			<2% + 0.0004 DDM for IDDMI ≤0.2
DDM AF output	0 to 0.4 DDM for 20% AM*1	0.001 DDM	≤3% + 0.0002 DDM for IDDMI ≤0.4, AF level 0.5 to 5 V
ILS Glideslope			
Amplitude modulation			
–128 to –9 dBm	0 to 50%	0.1% AM	typ. <2% for 40% AM
–85 to –45 dBm	0 to 50%	0.1% AM	<2% for 40% AM
DDM RF output	±0 to 0.8 DDM for 40% AM	0.001 DDM	≤3% + 0.002 DDM for IDDMI ≤0.4, AF level 0.5 to 5 V
Marker beacon (MD)			
Modulation frequency	400, 1300, 3000 Hz		
Amplitude modulation	0 to 100%	0.1% AM	≤5% for 95% AM
1020-Hz tone (AUX)			
Modulation frequency	50 Hz to 20 kHz		
Amplitude modulation	0 to 100%	0.1% AM	≤5% + resolution + residual AM

**1 Difference in Depth of Modulation; describes the modulation depth difference between the 90-Hz and the 150-Hz tone; IDDMI=I (90-MHz modulation in % – 150-Hz modulation in %) 1/100%.*

Communications Test Sets

CMS54 • CMS57

RECEIVER MEASUREMENTS

Signal Generator –
Frequency range: 0.4 MHz to 1 GHz.
Frequency resolution: 10 Hz.
Frequency error: Same as timebase.
Level – FM: φM, CW: ≤–134 to 0 dBm.
AM: –134 to –3 dBm.
Level resolution: 0.1 dB.
Fine variation of level – FM: φM, CW: 0 to –19.9 dB, non-interrupting.
AM: 0 to –4.9 dB, non-interrupting.
Level error (level ≤–3 dBm, f > 1 MHz): ≤2 dB.
Harmonics: ≤–25 dBc.
Non-harmonics: ≤–50 dBc (≤5 kHz from carrier, level –3 dBm).
Residual AM (CCITT, RMS): ≤0.03%.
Residual FM (CCITT, RMS) – 400 kHz to 250 MHz, 500 MHz to 1 GHz: ≤10 Hz.
250 to 500 MHz: ≤5 Hz.
Phase noise: ≤–110 dBc/Hz (20 kHz from carrier).

Modulation –
Frequency range: 0.4 MHz to 1 GHz.
AM modulation depth: 0 to 99%.
Resolution: 0.5%.
Modulation frequency range: f <8 MHz, DC to 10 kHz; f ≥8 MHz, DC to 20 kHz.
Modulation error (m <0.8, f_{AF} = 300 Hz to 3 kHz): ≤5% + resolution + residual AM.
FM deviation: 0 to 100 kHz.
Resolution: Δf <100 Hz, 1 Hz; Δf ≥100 Hz, 1%.
Modulation frequency range: 20 Hz to 20 kHz; suitable for POCSAG.
Modulation distortion (f_{AF} = 1 kHz, Δf <1 kHz): ≤1%.
Modulation error: ≤5% + resolution + residual FM.
φM deviation (internal): 0 to 10 rad.
Resolution: Δφ <0.1 rad, 1 mrad; Δφ ≥0.1 rad, 1%.
Modulation frequency range: 100 Hz to 6 kHz.
Modulation distortion (f_{AF}=1 kHz, Δφ ≤1 rad): ≤1%.
Modulation error: ≤5% + resolution + residual φM.
Modulation modes: Internal (single tone/two-tone), external, internal + external.

AF Voltmeter –
Frequency range: 50 Hz to 20 kHz.
Measurement range: 0.1 mV to 30 V.
Resolution: V <10 mV: 100 µV. V ≥10 mV: 1%.
Error: <5% + resolution.
Input impedance: Approximately 1 MΩ.

Distortion Meter, SINAD Meter, AF Frequency Counter – See transmitter and receiver measurements.

TRANSMITTER MEASUREMENTS

RF Power Meter –
Frequency range: 1.5 MHz to 1 GHz.
Measurement range: 5 mW to 50 W.
Resolution – P<100 mW: 1 mW.
P≥100 mW: 1%.
Error (P>20 mW, AM = 0%): ≤0.4 dB + resolution.

RF Frequency Counter –
Frequency range: 0.5 MHz to 1 GHz.
Input level range: 5 mW to 50 W.
Resolution: 10 Hz, 1 Hz.
Error: Same as timebase + resolution.

Frequency Deviation Meter –
Operating modes: +PK, –PK, ±PK/2, PK HOLD, RMS, RMS $\sqrt{2}$.
Input level range: 5 mW to 50 W.
RF frequency range: 1.5 MHz to 1 GHz.
Deviation measurement range: 0 Hz to 100 kHz. AF frequency range: 20 Hz to 20 kHz. Resolution – Δf <1 kHz: 1 Hz. Δf ≥1 kHz: 1%. Residual FM (CCITT, RMS): ≤10 Hz.
Error: ≤5% + resolution + residual FM.

Phase Deviation Meter –
Operating modes: +PK, –PK, ±PK/2, RMS, RMS $\sqrt{2}$.
Input level range: 5 mW to 50 W.
RF frequency range: 1.5 MHz to 1 GHz.
Measurement range: 0.001 to 5 rad.
AF frequency range: 300 Hz to 6 kHz.
Resolution: Δφ ≤0.1 rad: 0.001 rad.
Δφ >0.1 rad: 1%.
Error: Same as frequency deviation meter + 2% frequency response.

AM Depth Meter –
Operating modes: +PK, –PK, ±PK/2, RMS, RMS $\sqrt{2}$.
Input level range: 20 mW to 50 W.
RF frequency range: 1.5 MHz to 1 GHz.
Modulation depth measurement range: 0.01% to 99%.
AF frequency range: 50 Hz to 20 kHz.
Resolution – m<0.1: 0.01%. m ≥0.1, 0.1%.
Residual AM (CCITT, RMS): ≤0.03%.
Error (m ≤0.8, f_{AF} = 0.3 to 3 kHz): ≤7% + resolution + residual AM.
Distortion meter, SINAD meter, AF frequency counter: See transmitter and receiver measurements.

RF Spectrum Monitor –
Frequency range: 1 MHz to 1 GHz.
Reference level: +47 to –47 dBm (Input 1).
Display dynamic range: >60 dB (≥7 dBm reference level at input 1).
Span: 0 (zero span) to 50 MHz.
Filters (3-dB bandwidth): 150 Hz, 6 kHz, 16 kHz, 50 kHz, 300 kHz, 1/3 MHz (coupled to span).
Error: ≤3 dB + resolution.

Tracking Generator (Option 04 or 24 required) –
Frequency range: 400 kHz to 1 GHz.
Reference level: –27 to –67 dBm.
Display dynamic range – f = 1 to 500 MHz: 50 dB. f = 500 MHz to 1 GHz: 45 dB.
Span: 0 (zero span) to full span.
Filters (3-dB bandwidth): 150 Hz, 6 kHz, 16 kHz, 50 kHz, 300 kHz, 1/3 MHz (coupled to span).
Error: <3 dB (<0.5 dB with relative measurement). Resolution 0.4 dB: Output Level: 0 to –128 dBm. Frequency offset: 0 to ±999 MHz (depending on span and center frequency).

TRANSMITTER MEASUREMENTS AT 2ND RF INPUT

Second RF Input –
Measurement of RF frequency, modulation (AM, FM , φM), modulation frequency and spectrum (level) of small RF signals (e.g., in off-air or module measurements, for low input levels).

RF Frequency Counter –
30 µV (selective frequency counter with presetting).

Modulation Meter –
IF narrow: 5 µV.
IF narrow, selective measurement: 1 µV.

Selective Level Measurement –
Without weighting filter: –75 to –35 dBm.
With 2 kHz resonance filter: –100 to –35 dBm.

TRANSMITTER AND RECEIVER MEASUREMENTS

Modulation Generator I and II –
Frequency range: 20 Hz to 30 kHz.
Frequency resolution: 0.1 Hz.
Frequency error: Same as timebase + 1/2 x resolution.
Output level range: 10 µV to 5 V.
Resolution – V<1 mV: 10 µV. V ≥1 mV: 1%.
Error: V>1 mV: ≤5%.
Output impedance: ≤4 Ω.
Maximum output current (peak): 20 mA.
Distortion: ≤0.5%.

Distortion Meter –
Frequency: 100 Hz to 5 kHz in 10-Hz steps.
Input level range: 100 mV to 30 V.
Measurement range: 0.1 to 50%.
Resolution: 0.1%. Inherent distortion: ≤0.5%.
Measurement bandwidth weighting: 12 kHz.
Error: ≤5% + inherent distortion.

SINAD Meter –
Frequency: 100 Hz to 5 kHz ±10 Hz.
Measurement Range: 1 to 46 dB.
Input level range: 100 mV to 30 V.
Resolution: 0.1 dB.
Weighting bandwidth: 12 kHz.
Error: ≤1 dB + inherent distortion.

Communications Test Sets

CMS54 • CMS57

AF Frequency Counter –
Operating modes: Demodulation, AF, beat (frequency offset), external.
Frequency range: 20 Hz to 500 kHz.
Input level range (f<20 kHz): 10 mV to 30 V.
Resolution: 1 Hz/0: 1 Hz.
Error: Same as timebase + resolution.

Oscilloscope –
Bandwidth – DC: DC to 20 kHz.
AC: 10 Hz to 20 kHz.
Horizontal deflection: 20 to 0.1 ms/div.
Vertical deflection: Scaled in kHz (FM), rad (φM), % (AM), mV/V (AF).
Input level range: 0 to 40 V peak.
Input impedance: Approximately 1 MΩ.

AF Filters –
Highpass f_{cutoff} = 300 Hz (attenuation at 200 Hz, typical 40 dB).
Lowpass f_{cutoff} = 3.4 kHz (attenuation at 10 kHz, typical 40 dB).
Bandpass (broadband): Highpass + lowpass.
Bandpass (narrowband): 50 Hz to 5 kHz in 10-Hz steps; attenuation typical 40 dB for 0.8 x f and 1.2 x f.
Notch filter: 100 Hz to 5 kHz in 10-Hz steps, +40 dB.
CCITT filter: See Opt. 03 or 06.

Selective Call Encoder/Decoder –
Tone sequences: ZVE11, 2/CCIR/EIA/EEA/EURO/NATEL/CCITT/VDEW/DTMF/VDEW direct dialing/user-defined sequences.

Audio Monitor (loudspeaker) – Demodulated signal, AF signal, beat (frequency offset).

OTHER
IEC/IEEE Bus – Interface to IEC 625-1 (IEEE 488) with listener/talker function.

POWER REQUIREMENTS
AC – Line Voltage: 100, 120, 220, 240 V AC ±10%. Line Frequency: 47 to 420 Hz.

DC – 11 to 32 V.

Power Consumption – 50 W.

ENVIRONMENTAL CHARACTERISTICS
RFI Suppression – To VDE 0871/0875 and postal regulations 1046/84.

Operating Temperature Range – 0 to +50°C.

Storage Temperature Range – –40 to +70°C.

Shock, Vibration, and Humidity Testing – To MIL-T-28800, Type III, Class 3, style C.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	175	6.9
Width	320	12.6
Depth	375	14.8
Weight	**kg**	**lb.**
Net	13	28.7

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CMS54 (INCLUDES OPT. 04)
Radiocommunication Service Monitor.
Includes: Power Cable, Spare Fuses, Manual.

CMS57
Radiocommunication Service Monitor.
Includes: Power Cable, Spare Fuses, Manual.

Opt. 01/CMS-B1 – OCXO Reference Oscillator for high long-term stability. Temperature, ≤1 x 10^{-7}; aging, ≤5 x 10^{-9}/day after 30 days with ≤2 x 10^{-7}/year.

Opt. 02/CMS-B2 – OCXO Reference Oscillator for more exacting requirements on long-term stability. Specifications same as Opt. 01 except for aging: ≤1 x 10^{-7}/year.

Opt. 03/CMS-B5 – Control Interface.

Opt. 04/CMS-B9 (CMS57) – Duplex Modulation Meter for measurements on duplex radios, cellular radio phones, relay stations, and frequency-converting modules (two-part measurements, also, on frequency-converting DUTs). Including Adjacent Channel Power (ACP) meter. Dynamic range, ≥70 dB with 25 kHz Channel Spacing.

Opt. 05/CMS-B13 – Signaling Unit for Cellular Radio (also requires Opt. 04 or 24). Same as Opt. 20 with the addition of C-Net.
Note: Opt. 20 may be used as an alternative to Opt. 05.

Opt. 06/CMS-B20 – U/I DC Meter, CCITT Filter, DTMF Decoder.

Opt. 07/CMS-B21 – Programmable Universal Modem for FFSK Signals (instead of Opt. 05). For modulation and demodulation of data. Bit rate, 10 to 2400 Hz.

Opt. 08/CMS-B22 – 10-MHz Reference Frequency Input/Output for external synchronization of measuring systems. Output, TTL levels; Z_{out}, 50 Ω; f, 10 MHz. Input, level >1.5 V_{p-p}; Z_{in}, 50 Ω; f, 10 MHz ±500 Hz.

Opt. 09/CMS-B25 – NMT Base Station Test Software for Opt. 05 in conjunction with Opt. 18.

Opt. 10/CMS-B26 (for Opt. 05 or 20) – POCSAG, ZVEI/VDEW Digital Signaling Software for testing of POCSAG radio-paging receivers and ZVEI/VDEW mobile and base stations.

Opt. 11/CMS-B28 (for Opt. 05 or 20) – MPT 1327/1343 Signaling for testing of trunked radio networks.

Opt. 13/CMS-B30 – RS-232C Interface for remote control of DUTs.

Opt. 14/CMS-B31 – Additional RF Input/Output for two-signal measurements and connection of further measuring instruments; bidirectional RF connector for additional measuring instruments. Maximum input power, 20 mW; Attenuation RF_{IN} to RF_{OUT}, 32 dB.

Opt. 15/CMS-B32 – 100-W RF Power Meter for measurement of high RF input power. Measurement range, 10 mW to 100 W.

Opt. 16/CMS-B33 (for Opt. 05 or 20) – 300-Hz Lowpass Filter for fast frequency and deviation measurement of unknown modulated subaudio tones. Attenuation approximately 50 dB at frequencies above 300 Hz.

Opt. 17/CMS-B34 – 13 dBm Output.

Opt. 18/CMS-B39 – 600 Ω AF Transformer.

Opt. 19/ZZA-99 – 19-inch Rack Adapter.

Opt. 20/CMS-B53 – Signaling Unit for Cellular Radio (also requires Opt. 04 or 24). NMT 450 (SIS), NMT 900 (SIS), E-AMPS, E-TACS, J-TACS, TACS Issue 4, R 2000.
Note: Opt. 05 may be used as an alternative to Opt. 20.

Opt. 22/CMS-B55 – Centronics Interface.

Opt. 23/CM-Z30 – ERMES Coder with Software.

Opt. 24/CMS-B27 (CMS57) – Same as Opt. 04, but without Adjacent Channel Power (ACP) meter.

Opt. 25/CMS-B38 (CMS57 only) – Autopilot Generator for ILS Operation.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.

ADDITIONAL ACCESSORIES – Also see page 434.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Communications Test Sets

CMD55

Features

CMD55

- Low Weight and Small Size for Stationary, Portable, and Mobile Use
- High-contrast Backlit LCD Screen with Large Characters and Simultaneous Indication of All Settings and Results
- Softkey Menu Control for Operator Convenience
- Remote Control via IEC/IEEE Bus (with Option 7)

TEST FUNCTIONS (BASIC UNIT)

- Mobile Synchronization
- Location Update
- Incoming Call Setup
- Outgoing Call Setup
- Mobile Power Level Control
- Channel Charge
- Peak Power Measurements
- SACCH Measurements (e.g., RxLev, RxQual, Power Level)
- Echo Test
- Call Clearing by Mobile
- Call Clearing by CMD55

Applications

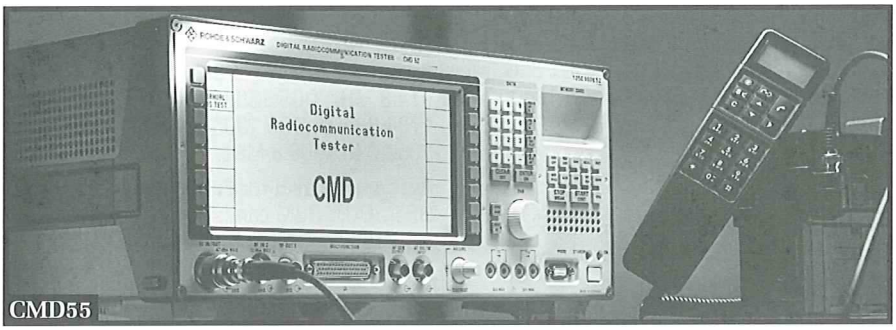
- GSM (Global System for Mobile Communications) Testing
- DCS 1800
- DCS 1900

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2 with SCPI conformance.*

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



CMD55

CMD55 Digital Radiocommunications Tester

The CMD55 Digital Radiocommunications Tester is a compact unit for testing GSM (Global System for Mobile communications), PCN (DCS 1800), and PCS (DCS 1900) mobiles. It combines small dimensions with high measurement accuracy and speed.

The range of capabilities offered by the CMD55 includes all signaling, generator, and measurement functions required for verifying the correct operation of the device-under-test. GO/NO-GO tests and accurate analysis using optional extensions makes the CMD55 equally well suited for service and production.

SIMPLE OPERATION

Operation of the CMD55 is extremely user-friendly and requires no detailed GSM knowledge in order to make accurate measurements. The high-contrast, backlit LCD provides a clear display of measurement results. Softkeys along both sides of the display allows convenient call-up of test routines under menu control. Selected parameters and measured values are displayed in easy-to-read form.

Various specific parameters are preset and permit direct testing without any operator control. The operator can modify all parameters individually in the configuration menus for customized testing.

TEST CAPABILITIES

For testing mobile phones, the CMD55 simulates a GSM, PCN, and PCS (with Option 10) base station. Using its two RF synthesizers, it delivers a continuous BCCH signal in addition to the TCH.

Characteristics

Time Base TCXO (standard) – Nominal frequency: 10 MHz. Frequency drift (0 to 35°C): ≤1.5 x 10^{-6}. Aging (at 35°C): ≤0.5 x 10^{-6}/year.

Time Base OCXO (with Option 01) – Nominal frequency: 10 MHz. Frequency drift (0 to 50°C): ≤1 x 10^{-7}. Aging: ≤5 x 10^{-9}/day (after 30 days of operation); ≤2 x 10^{-7}/year. Warmup time (at 25°C): Approx. 5 minutes.

RF GENERATOR 1

Frequency Range – GSM band: 935.2 to 959.8 MHz; DCS 1800 band: 1805.2 to 1879.8 MHz; DCS 1900 band (Option 10): 1930.2 to 1909.8 MHz.

Frequency Error – Same as time base.

Resolution – Same as channel spacing in the GSM and DCS bands.

Frequency Setting Time – ≤3 ms for phase error <2°.

Output Level – RF IN/OUT: GSM and DCS 1800 band: –35 to –120 dBm; DCS 1900 band (Option 10): –37 to –120 dBm.

RF OUT 2: GSM and DCS 1800 band: +11 to –77 dBm; DCS 1900 band (Option 10): +9 to –77 dBm.

Resolution – 0.1 dB.

Level Error – RF IN/OUT: ≤1.5 dB (≤1 dB at –104 dBm); RF OUT 2: ≤2 dB.

Harmonics RF IN/OUT – <–30 dBc.

Modulation – GMSK, B x T = 0.3.

Phase Error – ≤4° rms, ≤10° peak.

RF GENERATOR 2

Frequency Range – GSM band: 935.2 to 959.8 MHz; DCS 1800 band: 1805.2 to 1879.8 MHz; DCS 1900 band (Option 10): 1930.2 to 1909.8 MHz.

Frequency Error – Same as time base.

Resolution – Same as channel spacing in the GSM and DCS bands.

Frequency Setting Time – ≤3 ms for phase error <2°.

Communications Test Sets

CMD55

Maximum Output Level – RF IN/OUT: GSM and DCS 1800 band: –37 dBm; DCS 1900 band (Option 10): –39 dBm; RF OUT 2: GSM and DCS 1800 band: +9 dBm; DCS 1900 band (Option 10): +7 dBm.

Resolution – 0.1 dB.

Level Error –
RF IN/OUT: ≤1.5 dB; RF OUT 2: ≤2 dB.

Harmonics RF IN/OUT – <–30 dBc.

Modulation – GMSK, B x T = 0.3.

Phase Error – ≤4° rms, ≤10° peak.

PEAK POWER METER (RF IN/OUT)
Frequency Range – GSM band: 800 to 1000 MHz; DCS 1800 band: 1700 to 1900 MHz; DCS 1900 band (Option 10): 1700 to 2000 MHz.

Measurement Range – GSM band – 0 to 47 dB; DCS 1800 and DCS 1900 band (Option 10): 0 to 33 dBm.

Resolution – 0.1 dB.

Error – GSM band: ≤0.5 dB + resolution (P > 10 dBm); DCS 1800 and DCS 1900 band (Option 10): ≤0.8 dB + resolution (P > 4 dBm).

VSWR – ≤1.3.

PHASE AND FREQUENCY ERROR MEASUREMENT (WITH OPTION 03)

Frequency Range – GSM band: 890.2 to 914.8 MHz; DCS 1800 band: 1710.2 to 1784.8 MHz; DCS 1900 band (Option 10): 1850.2 to 1909.8 MHz.

Level Range – RF IN/OUT: GSM band: 0 to 47 dBm; DCS 1800 and DCS 1900 band (Option 10): 0 to 33 dBm. RF IN 2: –60 to 0 dBm.

Inherent Phase Error – <1.5° rms, <5° peak.

Frequency Measurement Error – <5 Hz + time base.

BURST POWER MEASUREMENT (WITH OPTION 03)
Frequency Range – GSM band: 890.2 to 914.8 MHz; DCS 1800 band: 1717.2 to 1784.8 MHz; DCS 1900 band (Option 10): 1850.2 to 1909.8 MHz.

Reference Level for Full Dynamic Range – RF IN/OUT: GSM band: 10 to 47 dBm; DCS 1800 and DCS 1900 (Option 10): 0 to 33 dBm band. RF IN 2: GSM and DCS 1800 band: –37 to 0 dBm; DCS 1900 band (Option 10): –31 to 0 dBm.

Absolute Measurement Error of Peak Power – RF IN/OUT: GSM band: ≤0.5 dBm + resolution (P > 10 dBm); DCS 1800 and DCS 1900 band (Option 10): ≤0.8 dBm + resolution (P > 4 dBm). RF IN 2: GSM and DCS 1800 band: ≤1.3 dB; DCS 1800 and DCS 1900 band (Option 10): ≤1.5 dBm.

Inherent Ripple in Active Part of Time Slot – 0.1 dB.

BURST ANALYSIS WITH HIGH DYNAMIC RANGE (WITH OPTION 06)
Relative Error of Individual Test Samples – ≤1.5 dB to 72 dB below peak power.

Dynamic Range – >72 dB.

Measurement Limit – RF IN/OUT: GSM band: <–36 dBm; DCS 1800 band: <–48 dBm; DCS 1900 band (Option 10): <–42 dBm. RF IN 2: GSM band: <–83 dBm; DCS 1800 band: <–85 dBm.; DCS 1900 band (Option 10): <–79 dBm.

Reference Frequency Inputs/Outputs (with Option 02) –
Synchronization input – Frequency (selectable): GSM bit clock (270.8 kHz), 2, 4, 16 times GSM bit clock, 1 to 13 MHz in 1 MHz steps, 2.048, 26, 39, 52 MHz; Impedance: Approximately 100 Ω. Level: 0 dBm to TTL.

Synchronization output 1 – Frequency: 10 MHz with internal reference or frequency at synchronization input with external reference. Level: TTL, R_{out} = 50 Ω.

Synchronization output 2 – Frequency (selectable): GSM bit clock (270.8 kHz), 2, 4, 16 times GSM bit clock, 1, 2, 4, or 13 MHz; Level: TTL, R_{out} = 50 Ω.

IEC/IEEE Bus Interface (with Option 07) – Interface to IEC 625-1 (IEEE 488), SCPI-compatible instruction set. Option 04 required.

POWER REQUIREMENTS
Line Voltage – 100 to 120 V AC ±10%, 200 to 240 V AC ±10%.

Line Frequency – 50 to 400 Hz ±5%.

Power Consumption (with options) – Approximately 85 W.

ENVIRONMENTAL CHARACTERISTICS
Operating Temperature Range – 0 to 45°C to DIN IEC 68-2-1/2.

Storage Temperature Range – –40 to +60°C.

Electromagnetic Compatibility – Corresponds to requirements of European EMC guidelines (89/336/EEC).

Mechanical Resistance – Sine Vibration: DIN EIC 68-2-6, 5 to 55 Hz, amplitude 0.15 mm, two cycles; Random Vibration: DIN 40046, part 24, 10 to 300 Hz, 10 m/s^2, 5 minutes/axis; Shock: To MIL-STD 810 D, 400 m/s^2, shock spectrum in 6 main axes.

Electrical Safety – VDE 0411, Class 1.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	192	7.6
Width	435	17.1
Depth	363	14.3
Weight	**kg**	**lb.**
without options	Approx. 13.5	Approx. 29.8

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CMD55
Digital Radiocommunication Tester.
Includes: Power Cord, Spare Fuses, Operating Manual.

Opt. 01/CMD–B1 – OCXO Reference Oscillator.

Opt. 02/CMD–B3 – Reference Frequency Inputs/Outputs.

Opt. 03/CMD–B4 – Fast Power Ramp, Phase/Frequency Error, and BER Measurement.

Opt. 04/CMD–B6 – Bit Interference and TDMA Synchronization (required for Opt. 07 and 08).

Opt. 05/CMD–B41 – Audio Measurements (Opt. 03 required).

Opt. 06/CMD–B42 – High Dynamic Burst Analysis (Opt. 03 required).

Opt. 07/CMD–B61 – IEC/IEEE Bus Interface (Opt. 04 required).

Opt. 08/CMD–B62 – Memory Card Interface (Opt. 04 required).

Opt. 10/CMD–B19 – DCS 1900 Mobile/Base Station Test.

Opt. 13/CMD-B43 – Measurement of spectrum due to modulation and switching (requires Opt. 03 and 06).

ADDITIONAL ACCESSORIES – Also see page 434.

CRT-Z2 – GSM Test SIM.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Communications Test Sets

New CMD57

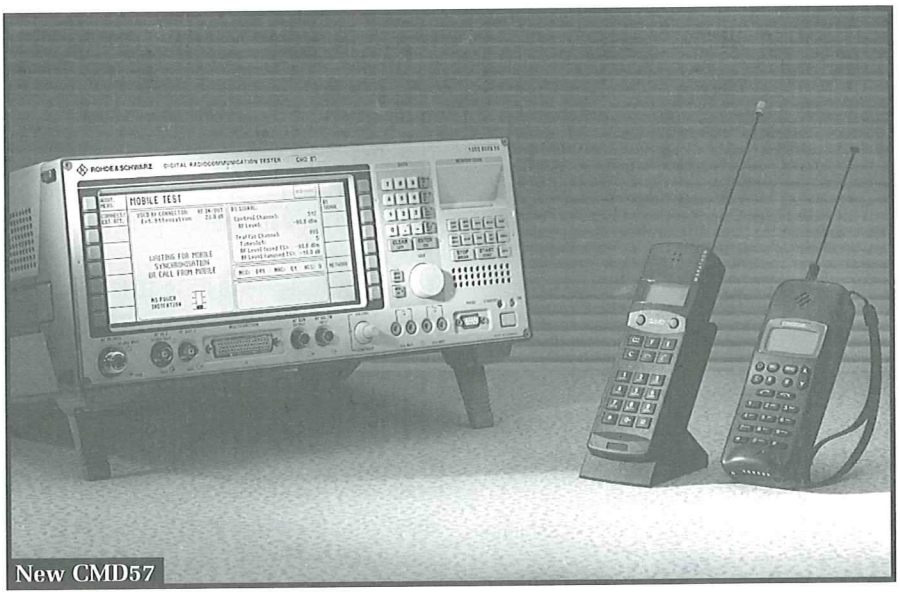
Features

CMD57

- Complete Range of Transmitter and Receiver Measurements
- Large Illuminated LCD Display for Fast Reading of Parameters and Measured Values
- Menu-guided User Interface for Quick Tests as Well as for In-depth Analysis
- Softkey Control with Display of All the Important Parameters Enabling Operator to Work Error-free
- Extremely Short Setting and Measuring TImes for Both Manual and Remote Control via IEEE Bus

Applications

- GSM 900, DCS 1800, and DCS 1900 Base Station Measurements
- Manufacturing, Installation, and Maintenance



New CMD57

CMD57 Digital Radiocommunication Tester for GSM, DCS 1800, and DCS 1900

The CMD57 base station tester is specifically designed to be used for the installation, service, and production of GSM, DCS 1800, and DCS 1900 base stations. It combines high measurement rates to ensure short testing times with top-class technical specifications for both transmitter and receiver testing. It combines compact size, low weight, and great ease of operation for a complete range of test and measurement capabilities.

EASY-TO-USE INTERFACE

A user interface, with large illuminated LCD display and softkeys on both sides to select the different menus, allows easy operation, even without detailed GSM knowledge. Numerical values are input with the hardkeys. Various test-specific parameters are preset and, as well as the measured values, displayed in easy-to-read form. The optional IEEE bus allows fast automated testing. The test results can also be logged on a printer.

Characteristics

TIME BASE TCXO

Standard –

Nominal frequency: 10 MHz;
Frequency drift (0 to 35° C): ≤1.5 x 10^{-6};
Aging (at 35° C): ≤0.5 x 10^{-6}/year.

With Opt. 01 –

Nominal frequency: 10 MHz; Frequency drift (0 to 50° C): ≤1 x 10^{-7}; Aging – ≤2 x 10^{-7}/year, ≤5 x 10^{-9}/day after 30 days operation.
Warmup time (at 25° C): Approximately 5 minutes.

Continued on next page.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2.*

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Communications Test Sets

New CMD57

DC VOLTMETER
Measurement Range – 0 to ±30 V.
Resolution – 10 mV.
Error – ≤% + resolution.

DC AMMETER
Operating Modes – Current averaging with GSM-adapted time constant, current peak measurement (maximum and minimum).
Measurement Range – 0 to ±10 A.
Common-mode Rejection – ±30 V.
Resistance – 50 mΩ.
Resolution for Current Averaging – 1 mA/10 mA.
Resolution for Peak Measurement – 10 mA.
Residual Indication (no current at input) – ≤10 mA (at room temperature).
Error – ≤2% + residual indication + resolution.

AF MEASUREMENT UNIT
With Opt. 05 – Level, frequency, and distortion measurement in the range from 50 Hz to 10 kHz; frequency counter up to 60 MHz.

AF GENERATOR
Frequency Range – 50 Hz to 10 kHz;
Frequency resolution: 0.1 Hz;
Frequency Error: Same as timebase + half of resolution.
Level Range – 10 µV to 5 V;
Level resolution: At voltage <1 mV: 10 µV,
At voltage ≥1 mV: ≤1%;
Level error at voltage ≥1 mV: ≤5%.
Distortion – ≤0.5%.
Maximum Output Current – 20 mA.
Output Impedance – <5 Ω.

AF VOLTMETER
Frequency Range – 50 Hz to 10 kHz.
Measurement Range – 0.1 mV to 30 V.
Resolution –
At voltage <10 mV: 100 µV;
At voltage ≥10 mV: 1%.
Error – ≤5% + resolution.
Input Impedance – 1 MΩ.

DISTORTION METER
Frequency Range – 300 Hz to 3 kHz.
Input Level Range – 100 mV to 30 V.
Resolution – 0.1% of THD.
Inherent Distortion – ≤0.5%.
Error – ≤5% + inherent distortion.
Measurement Bandwidth – 10 kHz.

AF COUNTER
Frequency Range – 20 Hz to 10 kHz.
Input Level Range – 10 mV to 30 V.
Resolution – ≤1 Hz.
Error – Same as reference + resolution.
Input Impedance – 1 MΩ.

IF COUNTER
Frequency Range – 10 kHz to 60 MHz.
Input Level Range – 100 mV_{rms} to TTL.
Resolution – 1 Hz.
Error – Same as reference + resolution.
Input Impedance – Approx. 1 MΩ paralleled by 100 pG.

RF GENERATOR
Frequency Range –
GSM band: 890.2 to 914.8 MHz; DCS 1800 band: 1710.2 to 1784.8 MHz; DCS 1900 band (with Opt. 10): 1850.2 to 1909.8 MHz.
Frequency Accuracy – Same as timebase.
Resolution – GSM channel spacing 200 MHz.
Settling Time – <3 ms for phase error <2°.
Output Level –
RF IN/OUT/OUTPUT 2: GSM, DCS 1800 bands: –35 to –120 dBm; DCS 1900 band (with Opt. 10): –37 to –120 dBm.
Resolution: 0.1 dB;
Level error (RF IN/OUT/OUTPUT 2): ≤1.5 dB (≤1 dB at –104 dBm).
Harmonics (RF IN/OUT) – <–30 dBc.
Modulation – GMSK, B x T = 0.3.
Phase Error – <4° rms, <10° peak.

PEAK POWER METER (RF IN/OUT)
Frequency Range –
GSM band: 800 to 1000 MHz; DCS 1800 band: 1700 to 1900 MHz; DCS 1900 band (with Opt. 10): 1930 to 1990 MHz.
Measurement Range –
GSM band: 0 to 47 dBm; DCS 1800 band: 0 to 33 dBm (47 dBm with Opt. 14);
DCS 1900 band (with Opt. 10): 0 to 33 dBm (47 dBm with Opt. 14).
Resolution – 0.1 dB.
Error –
GSM band: ≤0.5 dB + resolution (P > 10 dBm); DCS 1800 band: ≤0.8 dB + resolution (P >4 dBm); DCS 1900 band (Option 10): ≤0.8 dB + resolution (P >4 dBm).
VSWR – ≤1.3.

PHASE AND FREQUENCY ERROR MEASUREMENT
Frequency Range –
GSM band: 935.2 to 959.8 MHz; DCS 1800 band: 1805.2 to 1879.8 MHz; DCS 1900 band (Option 10): 1930.2 to 1989.8 MHz.
Level Range –
RF IN/OUT: GSM band: 0 to 47 dBm;
DCS 1800 and DCS 1900 band (Option 10): 0 to 33 dBm.
RF IN 2: –60 to 0 dBm.
Inherent Phase Error – ≤1.5° rms, ≤5° peak.
Frequency Measurement Error – ≤5 Hz + timebase error.

BURST POWER MEASUREMENT
Frequency Range –
GSM band: 935.2 to 959.8 MHz; DCS 1800 band: 1805.2 to 1879.8 MHz; DCS 1900 band (with Opt. 10): 1930.2 to 1989.8 MHz.
Reference Level for Full Dynamic Range –
RF IN/OUT: GSM band: 10 to 47 dBm;
DCS 1800 band: 0 to 33 dBm; DCS 1900 band (Option 10): 0 to 33 dBm.
RF IN 2: GSM, DCS 1800 bands: –37 to 0 dBm; DCS 1900 band (Option 10): –31 to 0 dBm.
Absolute Measurement Error of Peak Power –
RF IN/OUT: Unsynchronized: Same as peak power meter;
Synchronized to C0 carrier:
GSM band; ≤1.3 dB; DCS 1800 and DCS 1900 band (Option 10): ≤1.5 dB.
Inherent Ripple in Active Part of Time Slot – ≤0.1 dB.

Communications Test Sets

New CMD57

HIGH-DYNAMIC BURST MEASUREMENT
Relative Error of Individual Test Samples – ≤1.5 dB to 72 dB below peak power.

Dynamic Range – >72 dB.

Measurement Limit –
RF IN/OUT: GSM band: <–36 dBm; DCS 1800 band: <–48 dBm; DCS 1900 (Option 10): <–42 dBm.
RF IN 2: GSM band: <–83 dBm; DCS 1800 band: <–85 dBm; DCS 1900 band (Option 10): <–79 dBm.

SPECTRUM MEASUREMENT
Dynamic Range – 80 dB.

Uncertainty – <±1.5 dB.

INPUT/OUTPUT
Interfaces –
RS-232C: 9-contact; Centronics: 25-contact; IEC/IEEE bus Interface (Option 07): Interface to IEC 625-1/IEEE 488, SCPI-compatible command set.

Reference Frequency Inputs/Outputs (Opt. 02) –
Synchronization input: Frequency (selectable): GSM bit clock (270.8 kHz), 2/4/16 times GSM bit clock, 1 to 13 MHz in 1-MHz steps, 2.048, 26, 39, 52 MHz; Impedance: Approx. 100 Ω; Level: 0 dBm to TTL.
Synchronization output 1: Frequency: 10 MHz with internal reference or frequency at synchronization input with external reference;
Level: TTL, R_{out} = 50 Ω;
Synchronization output 2: Frequency (selectable): GSM bit clock, 2/4/16 times GSM bit clock, 1, 2, 4, or 13 MHz; Level: TTL, R_{out} = 50 Ω.

A_{bis} Interface (Opt. 11) –
Receive channel (traffic/speech): Unbalanced: 75 Ω/high-impedance; Balanced: 120 Ω/high-impedance.
Time slot (selectable): 16 Kbit/s.

ENVIRONMENTAL
Rated Temperature Range – 0 to +45°C (to DIN IEC 68-2-1/2).

Storage Temperature Range – –40 to +60°C.

Electromagnetic Compatibility – Complies with requirements of European EMC directive (89/336/EEC).

Mechanical Resistance –
Sine vibration: DIN IEC 68-2-6, 5 to 55 Hz, amplitude 0.15 mm, two cycles;
Random vibration: DIN 40046, part 24, 10 to 300 Hz, 10 ms/s^2 rms, 5 min/axis;
Shock: To MIL-STD-810D, 400 m/s^2, shock spectrum in six main axes.

POWER REQUIREMENTS
Line Voltage – 100 to 120 V AC ±10%; 200 to 240 V AC ±10%.

Line Frequency – 50 to 400 Hz ±5%.

Power Consumption (without options) – Approx. 85 W.

Electrical Safety – VDE 0411, Class 1.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	192	7.6
Width	435	17.1
Depth	363	14.3
Weight	**kg**	**lb.**
Without options	Approx. 14	30.8

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CMD57
Digital Radiocommunication Tester for GSM, DCS 1800, and DCS 1900.
Includes: Power Cord, Operating Manual, Spare Fuses.

Opt. 01/CMD-B1 – OCXO Reference Oscillator.

Opt. 02/CMD-B3 – Reference Frequency Inputs/Outputs.

Opt. 04/CMD-B6 –
Adapter for Opt. 07 and Opt. 08.

Opt. 05/CMD-B41 – AF Measurement Unit with Frequency Counter.

Opt. 07/CMD-B61 – IEC/IEEE bus Interface (Opt. 04 required).

Opt. 08/CMD-B62 – Memory Card Interface (Opt. 04 required).

Opt. 10/CMD-B19 – DCS 1900 Frequency Band.

Opt. 11/CMD-B7 – A_{bis} Interface.

Opt. 12/CMD-U5 – I/Q-demod Outputs and Trigger Input (BNC connectors added on rear panel).

Opt. 14/CMD-U6 – Extended Attenuation to 47 dB.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

ADDITIONAL ACCESSORIES – Also see page 434.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Communications Test Sets

New CMD80

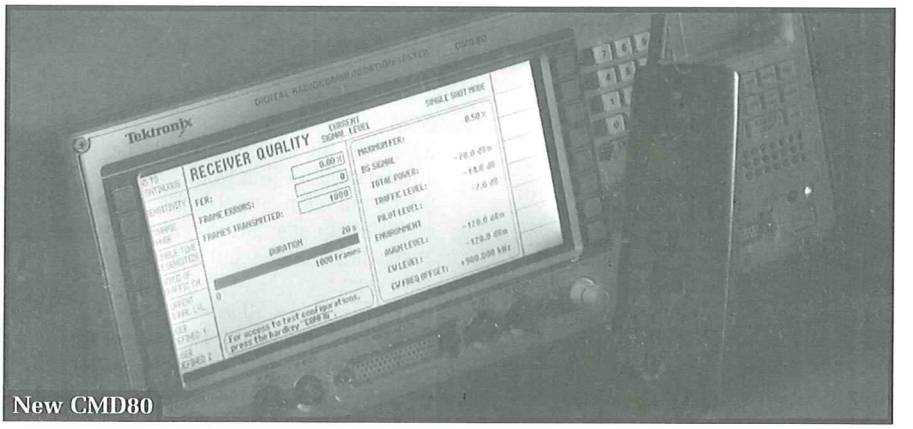
Features

CMD80

- Large LCD Display Enhances the Friendly User Interface
- Functional Tests
- Receiver Quality
- Transmitter Quality
- Power Measurements

Applications

- CDMA Mobile Testing



New CMD80

CMD80 Digital Radiocommunication Tester

The CMD80 Digital Radiocommunication Tester is a compact tester for CDMA mobiles which provides full signaling capabilities. The mobile RF parameters are verified under similar conditions as found in a real network; i.e., the tester simulates a base station, makes a call to the mobile, and performs the measurements without any special test modes in the device-under-test. The CMD80 measures several key IS 95 parameters using IS 98 methods:

- FER service option 2
- Frame errors
- Waveform quality φ
- Error vector magnitude
- Phase error
- Magnitude error
- Carrier feedthrough
- Frequency accuracy
- Power measurements
- Base station signaling for mobile testing

SIMULATION OF A BASE STATION

The CDM80 simulates a CDMA (IS 95) base station and provides all the signaling necessary to hold up a call:

- Synchronization of mobile
- Registration of mobile
- Incoming/outgoing calls
- Handoffs

During the call, the tester verifies the RF performance and implicitly checks the correct operation of the basic signaling features.

The CMD80 does not rely on any special test modes in the mobile station and performs the measurements under conditions almost identical to those in the real network. A voice loop-back allows quick verification of mobile performance as it is perceived by the user.

EASY TO USE

The CMD80 is extremely user friendly and requires little detailed CDMA knowledge. The large high-contrast liquid crystal display provides softkeys on both sides to allow convenient call-up of test routines under menu control.

Easily, the user can switch to a menu and change the current settings of signaling and measurement parameters. The user is guided through the menus by explanatory text and may always return to the default setting with a push of a button.

FAST MEASUREMENTS

State-of-the-art digital technology leads to quick and efficient measurements for rho and power. In remote control mode via IEEE bus, the instrument is exceptionally fast and yields high throughput in production.

TEST CAPABILITIES

All essential characteristics of a CDMA mobile station can be tested with high accuracy. The CMD80 not only verifies the RF performance of a CDMA mobile but, in addition, checks software features of the mobile which are important for the correct operation of the network. In many cases, this avoids the need for expensive custom test beds in development and QA.

HIGH FLEXIBILITY

Almost every signaling and measurement parameter can be modified by the user in the configuration menus, either dynamically during a test or in advance. Even the tolerances for pass/fail verdicts can be changed to match the requirements of the application.

DC MEASUREMENTS

The DC ammeter/voltmeter designed for pulsed signals allows correct measurement of the power consumption of the mobile station.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2.*

Tektronix

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Communications Test Set

New CMD80

Characteristics

SIGNAL GENERATOR

Frequency –
Range: 869 to 894 MHz; Resolution: 1 Hz; Error: Same as timebase.

Output Level –
RF IN/OUT: –20 to –124 dBm; RF OUT 2: +5 to –105 dBm; Resolution: 0.1 dB; Error (RF IN/OUT): ≤1.5 dB.

Modulation –
Carrier suppression: –30 dBc.

ANALYZER

Frequency –
Range: 824 to 849 MHz; Resolution: 1 Hz; Error: Same as timebase.

Power Measurement –
Reference level range: RF IN/OUT (full scale): +41 to –28 dBm; RF IN 2 (full scale): 0 to –69 dBm.
Measurement error: Absolute: ±1.5 dB; Relative: ≤0.4 dB (reference level to –40 dB); Dynamic range: 50 dB below reference level.

Modulation Analyzer –
ρ error (25 ±10° C): 0.003 (for ρ 0.9 to 1); Frequency measurement range: ±3 kHz; Frequency measurement error: Reference ±30 Hz; Timing measurement error: ±60 ns.

Time Base –
Standard: Nominal frequency: 10 MHz; Frequency drift (0 to 35°C): ≤1.5 x 10^{-6}; Frequency aging (at 35°C): ≤0.5 x 10^{-6}/year; With OCXO time base, Option 01: Nominal frequency: 10 MHz; Frequency drift (0 to 45°C): ≤1.1 x 10^{-7}; Frequency aging (after 30 days operation): ≤2 x 10^{-7}/year; ≤0.5 x 10^{-9}/day;
Warm-up time (at 25°C): Approx. 5 minutes.

REFERENCE FREQUENCY INPUTS/OUTPUTS (OPTION 03)

Synchronization Input –
Frequency (selectable): 100 kHz to 50 MHz, step 10 kHz; Impedance: Approx. 100 Ω; Level: 0 dBm to TTL.

Synchronization Output –
Frequency: 10 MHz or frequency at synchronization input; R_{out}: 50 Ω; Level: TTL.

AWGN (Additive White Gaussia Noise) GENERATOR (OPTION 02)

Equivalent Noise Bandwidth –
1.8 MHz, typical.

Gain Adjustment Range – –20 to +6 dB of forward channel power.

DC VOLTAGE MEASUREMENTS

Range – 0 to ±30 V.

Resolution – 10 mV.

Error – 2% + resolution.

DC CURRENT MEASUREMENTS

Mode – Averaging, + peak, – peak.

Range – 0 to ±10 A.

Common-mode Rejection – ±30 V.

Shunt Resistance – 50 mΩ.

Resolution for Averaging – 1 mA/10 mA.

Resolution for Peak – 10 mA.

Residual Indication – <10 mA.

Error – <2 % + resolution + residual indication.

ENVIRONMENTAL

Operating Temperature – 0 to +45°C, to DIN IEC 68-2-1/2.

Storage Temperature – –40 to +60°C.

Electromagnetic Compatibility –
Corresponds to the requirements of European EMC directive (89/336/EEC).

POWER SUPPLY

Line Voltage – 110 to 120 V AC ±10%; 200 to 240 V AC ±10%.

Line Frequency – 50 to 400 Hz ±5%.

Electrical Safety – VDE 0411, Class 1, IEC 1010-1, EN 61010 part d.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	192	7.6
Width	435	17.1
Depth	363	14.3
Weight	**kg**	**lb.**
Without options	Approx. 15	Approx. 33

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CMD80
Digital Radiocommunication Tester.
Includes: Power Cord, Manual.

Opt. 01/CMD-B1 – OCXO Reference Oscillator. Ensures high absolute accuracy, minimum temperature-dependent drift, and especially high long-term stability.

Opt. 02/CMD-B81 – Noise Generator. Allows testing mobile with additional noise (requires Opt. 04 Adapter).

Opt. 03/CMD-B3 – Reference Frequency Inputs/Outputs.

Opt. 04/CMD-B60 – Adapter for Opt. 07 and Opt. 08.

Opt. 07/CMD-B61 – IEEE Bus Interface.

Opt. 08/CMD-B62 – Memory Card Interface (requires Opt. 04 Adapter).

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

ADDITIONAL ACCESSORIES – Also see page 434.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

Tektronix

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Communications Test Sets
CMTA

Features

CMTA

- OCXO Reference Oscillator with High Immunity to Temperature Effects and Low Aging
- Programmable Highpass and Lowpass Filters
- Programmable Notch and Resonance Filters
- Distortion and SINAD Meter with Variable Test Frequency
- Additional RF Attenuator for Signal-to-be-Measured, Yielding Maximum Dynamic Range
- Synthesizer-accurate RF and SSB Analyzer
- Synthesizer-accurate AF Analyzer
- Storage Oscilloscope with Universal Trigger Facilities
- IEC/IEEE Bus Interface, Relay Matrix
- Two Independent AF Synthesizers
- V/I DC Meter
- DTMF Coder and Decoder
- Transient Recorder
- DC Current/Voltage Measurement
- RF Spectrum Monitor
- Cellular-radio-simulator, e.g, AMPS, TACS, Radiocom 2000

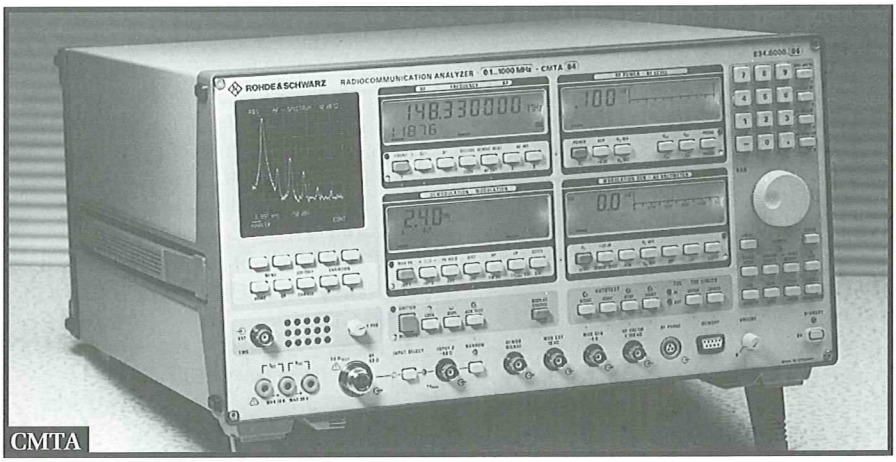
Applications

- AM, FM, φM, and SSB Transceiver Testing
- Mobile and Base Station Radio Networks
- Cellular Radio
- Research and Development
- Quality Assurance
- Acceptance Testing

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



CMTA

CMTA Radiocommunication Analyzer

The CMTA Radiocommunication Analyzer provides complete test capability for radio measurements and related fields. It can perform measurements on AM, FM, φM, and SSB transceivers in mobile and base station radio networks, including cellular radio. A variety of options protects your purchase from obsolescence by allowing you to add additional capability as the need arises. The variety of measurement capabilities provided by the CMTA and its exceptional test depth make it the ideal instrument for development, quality assurance, and acceptance testing.

The CMTA functions as a full-featured electronic minilab. It provides generator, measurement, and control functions, along with numerous built-in RF and AF measuring facilities. This allows it to replace the variety of individual instruments and associated cabling normally required for testing.

EASY OPERATION, EVEN FOR BEGINNERS
The logically organized front panel guarantees error-free, self-explanatory operation with fast access to all measuring capabilities. Even the execution of complex routines remains transparent to the user. Test parameters and results are updated continually and the alphanumeric display provides information on the individual steps of a sequence. Keypad polling and results displays operate in a multi-tasking mode to ensure extremely fast tester response.

RESULTS DISPLAYS
Four large, illuminated LCDs simultaneously indicate all results and parameters. Additional quasi-analog displays with clear scaling, selectable range hold, and resolution of 1% facilitate adjustments. Time constants can be selected to match the displays to various requirements. The full-scale values of the quasi-analog displays are optimally matched to the particular measurement and can also be preset for special adjustments.

TESTER SAVES USER A LOT OF WORK
Switchover between transmitter and receiver tests can be triggered either manually or automatically by the transmitter power of the transceiver. Parts of transmitter and receiver tests can be combined as desired with each individual measuring facility being directly addressable.

Auto-run control and printer interface allow automatic runs for complete transceiver testing to be generated, stored, and printed.

INTEGRATES INTO AUTOMATIC TEST SYSTEMS
The IEC/IEEE bus is the key to expanding the CMTA into a fully automatic, computer-controlled universal radio test system. Simple IEC/IEEE bus commands, as well as the use of internal, automatic test routines ensure fast generation of test runs. Basic software packages make program generation extremely simple without need for programming knowledge. Individual routines can be called up to run related tests. Eight integrated relays are provided for transceiver settings and for controlling additional devices.

Communications Test Sets
CMTA

Characteristics

REFERENCE
Oscillator – OCXO: Reference oscillator.
Aging: <1 x 10^{-9}/day (<1 x 10^{-6}/month) after 30 days of operation; typically <2 x 10^{-7}/year.
Temperature effect: <2 x 10^{-9}/°C.
Warm-up time: None because of standby-mode heating.

RECEIVER MEASUREMENTS
Signal Generator –
Frequency range: 100 kHz to 1 GHz.
Resolution: 1 Hz.
Frequency error: <0.5 x Resolution + Reference.

Level –
CW, FM, φM: –137 to +13 dBm.
AM: –137 to + 7 dBm.
Overrange without specification: Adjustable to +16 dBm.
Resolution: 0.1 dB.
Fine variation: 0 to –19.9 dB, non-interrupting.
Level error for P ≥–127 dBm: ≤±1.5 dB.

Spectral Purity –
Harmonics: <–30 dBc.
Non-harmonics: <–70 to –80 dBc, frequency-dependent.
Spurious AM, RMS at 0.03 to 20 kHz: <0.02%, CCITT-weighted.

MODULATION
Modes – AM, FM, φM, Internal/External, AC or DC, multiple modulation, multitone modulation.

Amplitude Modulation –
Modulation depth: 0 to 99%.
Modulation frequency range: DC to 50 kHz.
Resolution: 0.5%.
Modulation distortion (for 30% AM): <1%.
Error (m <0.8): <5% of setting + spurious AM.

Frequency Modulation –
Maximum deviation: 50 to 800 kHz, frequency-dependent.
Resolution: Δf <1 kHz: 10 Hz; Δf >1 kHz: ≤1%.
Modulation frequency range: FM DC: DC to 100 kHz; FM AC: 10 Hz to 100 kHz.
Modulation distortion: <1%.
Error: <5% of setting + residual FM of signal generator.

Phase Modulation –
Phase deviation: 0 to 80 rad.
Modulation frequency range: 300 Hz to 6 kHz.
Error: Same as FM + 2% frequency response.

AF Voltmeter –
Frequency range: 50 Hz to 20 kHz.
Weighting: RMS, +pk, –pk.
Weighting filters: See transmitter and receiver measurements.
Measurement range: 35 V.
Resolution: V <10 mV: 100 µV; V ≥10 mV: 1%.
Error: ≤±3% of reading + resolution.
Input Impedance: ≥100 kΩ.

AF Frequency Counter –
Frequency range: 20 Hz to 500 kHz.
Resolution: 0.1 Hz/1 kHz, selectable.
Error: Same as reference + resolution.

S/N Meter –
Resolution: 0.1 dB.
Error: <0.5 dB + error due to residual FM/AM of signal generator.

TRANSMITTER MEASUREMENTS
Power Meter –
Frequency range: 1.5 MHz to 1 GHz.
Measurement range: 5 mW to 50 W, usable up to 75 W.
Resolution: Display in dBm: 0.1 dBm. Display in watt: (P <10 mW), 0.1 mW; (P ≥10 mW), 1%. Error: Typically 0.4 dB + resolution.

RF Frequency Counter –
Frequency measurement range: 1 MHz to 1 GHz.
Resolution: 1 Hz/10 Hz, selectable.
Error: Reference + resolution.

Modulation Meter – Specification for duplex off mode.
Operating Modes: +PK, –PK, PK/2, PK HOLD, MAX PK, or RMS.

AM Meter –
Frequency range: 1.5 MHz to 1 GHz.
Measurement range: 0.01% to 99%.
Resolution: m <10%: 0.01% AM; m ≥10%: 0.1% AM.
Demodulation frequency range: 50 Hz to 20 kHz.
Residual AM: <0.03% to CCITT.
Error (m <0.8): <5% of reading + residual AM.
Weighting filters: See transmitter and receiver measurements; 300 Hz highpass filter (can be switched into modulation path).

Frequency Deviation Meter –
Operating modes: Same as AM meter.
Frequency range: 4 MHz to 1 GHz.
Deviation range: 100 kHz.
Demodulation frequency range: Display: 20 Hz to 20 kHz. Resolution: Δf <1 kHz: 1 Hz; Δf ≥1 kHz: 1% of reading.
Output for demodulation signal: DC to 20 kHz.
Residual FM: f_c <500 MHz: ≤3 Hz to CCITT, f_c ≥500 MHz: ≤5 Hz to CCITT.
Error: 3% + error due to residual FM + resolution.
Weighting filters: 750 µs de-emphasis; see transmitter and receiver measurements for more weighting filters.

TRANSMITTER AND RECEIVER MEASUREMENTS
CCITT Filter – According to CCITT specifications.

Programmable Notch Filter –
Programmable notch frequencies: 100 Hz ≤f_{notch} ≤5 kHz.
Error in passband: ≤0.5 dB.
Maximum attenuation (input voltage >100 mV): ≥60 dB.

Programmable Highpass Filter –
Programmable passband cutoff frequencies (0.5 dB): 107 Hz to 10.6 kHz, in 60 steps.
Upper cutoff frequency: 21 kHz or approximately 10 times the passband cutoff frequency.
Error in passband: ≤0.5 dB.
Inherent distortion: <0.3%.
Maximum attenuation (input voltages >100 mV): ≥50 dB.

Programmable Lowpass Filter –
Programmable passband cutoff frequencies (0.5 dB): 235 Hz to 21 kHz, in 60 steps.
Error in passband: <0.5 dB.
Inherent distortion: <0.3%.
Maximum attenuation (input voltages >100 mV): ≥50 dB.

Programmable Bandpass Filter –
Combination of highpass and lowpass filters.

Distortion Measurement –
Test frequency range: 100 Hz to 5 kHz.
Measurement range: up to 50%.
Resolution: 0.1%.
Inherent distortion: ≤0.3%.
Error: <5% of reading + inherent distortion.

SINAD Measurement –
Frequency range: 100 Hz to 5 kHz.
Measurement range: 1 to 50 dB.
Resolution: 0.1 dB.
Error: ≤0.5 dB.

Modulation Generators –
Operating modes: Single-tone modulation, dual-tone modulation (optional).
Frequency range: 20 Hz to 25 kHz, usable up to 30 kHz.
Resolution (f <1/3/6/10/20 kHz): 0.1/0.2/1/2.5/10 Hz.
Frequency error: <0.5 x resolution.
Fixed frequencies: 8, presettable.
Output voltage: 10 µV to 5 V.
Error: (V_0 >1 mV): ≤3%.

Communications Test Sets
CMTA

Selective Call Coder/Decoder –
Standard tone sequences: ZVEI1, ZVEI2/CCIR/EIA/EEA/EURO/VDEW/CCITT, NATEL, and user-specified sequences.
Digits: 0 to 9, A to F.
Call length: 1 to 25 tones.
Automatic Repeat: Selectable.
Encoder: Frequency Offset: Can be set to ±10%. Tone/pause duration: Standard or programmable.
Decoder: Tolerances standard or programmable with out-of-tolerance display.

DTMF Decoder – With Option 05.
Standard: DTMF.
Display: Tones 0 to 9, A to D, *, #.
Call length: 25 digits.

Dual-tone Encoder – With DC Test Adapter 12, to DTMF and user-specific sequences.
Digits: 0 to 9, A to D, *, #.
Call length: 25 dual tones.
Tone/pause duration: To standard or programmable.

DC Measurement – With DC Test Adapter CMT-Z6.
Voltage measurement: 0 to ±30 V. Error: <3%.
Current measurement: 0 to ±10 A, for a short time 15 A.
Error: <3%.

AF Spectrum Analyzer –
Displayable signals: AF voltmeter input, demodulated signals, beat signals, external signals. Input impedance: 1 MΩ.
Frequency range: To 20 kHz (crystal accurate).
Level range (reference level): AF: 1.6 mV to 35 V (RMS). Demodulated FM: 50 Hz to 100 kHz (peak). Demodulated AM: 0.1 to 100% (peak). Demodulated φM: 0.1 to 25 rad (peak).
External signals: 5 mV to 14 V (RMS).
Dynamic range (V_{in} >10 mV): 66 dB.
Scale: Log 10 dB/div, log 2 dB/div, or linear.
Level error (f >50 Hz): ±2 dB to 60 dB below reference level.
Automatic test filter selection: 3 test filters as a function of span.

SSB Spectrum Analyzer –
SSB receiver test: AF analysis via AF input.
SSB transmitter test: AF analysis after internal RF IF conversion. RF frequency: 400 kHz to 1 GHz. Level range (reference level):
RF input/output: –24 to +47 dBm;
2nd input: –64 to +17 dBm.
Dynamic range: 66 dB typical.
Level error: 3 dB typical.

RF Spectrum Monitor –
Frequency range: 400 kHz to 1 GHz.
Level range (reference level) –
RF input/output: –24 to +47 dBm.
2nd input: –64 to +17 dBm.
Dynamic range for input level: >60 dB.
Scale: Log 10 dB/div, log 2 dB/div, or linear.
Level error: <3 dB.
Automatic test filter selection: 4 test filters as a function of span.

Oscilloscope –
Provides digital storage oscilloscope functions.

Displayable signals: External signal, AF, demodulated signals (AM, FM, φM) beats (AC coupling).
External input impedance: Approximately 1 MΩ.
Coupling: AC/DC.
Amplitude: 1/2/5 steps.
External: 2 mV/div to 5 V/div.
AF voltmeter: 1 mV/div to 20 V/div.
Demodulated AM: 0.1%/div to 40%/div.
Demodulated FM: 20 Hz/div to 40 kHz/div.
Demodulated φM: 0.01 rad/div to 25 rad/div.
Timebase: Crystal accurate.
Divisions: 1/2/5; 0.05 to 50 ms/div.
Bandwidth: DC to 20 kHz (usable to 100 kHz).
Trigger slope: + or –.
Trigger level: Full screen height, in 60 steps.
Main operating modes: Scope or single-shot.
Scope mode: Repeat mode with automatic free-running.
Single-shot mode: Recording time: 3.2 ms to 3.2 s. Screen display: 1/8 of the recording (15 overlapping ranges).
Trigger sources: Signal or EXT connector.

POWER REQUIREMENTS
Line Voltage – 88 to 132 V AC, 194 to 264 V AC.

Line Frequency – 47 to 420 Hz.

Power Consumption – 200 VA.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	220	8.7
Width	420	16.5
Depth	460	18.1
Weight	**kg**	**lb.**
Net	26	57.3

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CMTA54
Radiocommunication Tester.
Includes: Power Cord, Manual.

CMTA84 (INCLUDES OPT. 10 AND OPT. 22)
Radiocommunication Tester.
Includes: Power Cord, Manual.

Opt. 03/CM–B8 – RF Millivoltmeter. For determination of extremely small levels down to the microvolt range; frequency range, measurement range, and frequency response are independent of the measuring head used. Frequency range, 10 kHz to 1 GHz; Measurement range, 1 mV to 10 V, 10 mV to 100 V; Readout units, mV, V, W, dBm, or dBμV; Resolution (V >100 mV), 1%; 0.1 dBm Error (+20 to +25°C): <5% + frequency response error.

Opt. 06/CM–B14 (CMTA84 only) –
Signaling for testing trunked radio. Allows free programming of signaling sequences via external computer and predefined signaling.

Opt. 07/CM–B15 (CMTA84 only) –
POCSAG, ZVEI/VDEW (digital Signaling). POCSAG signaling with direct carrier shift keying (NRZ) and FFSK, ZVEI/VDEW digital signaling. Use in conjunction with Opt. 06.

Opt. 20/CMTA–B13 –
Cellular Radio Simulator. Simulation of base station for AMPS, TACS, Radiocom 2000, NMT 450/900, and C-Net.

Opt. 21/CMTA–B5 –
Autorun Control/Printer Interface.

Opt. 22/CMTA–B9 –
Duplex Modulation Meter independent of basic unit. Same as specifications for AM Meter, FM Meter, and φM Meter.

Opt. 31/CM–U20 – Power Measurement of RF Burst Modification Kit CM-U20 enables GSM Power Burst measurements and TDMA applications in general.

ADDITIONAL ACCESSORIES – Also see page 434.

DC Test Adapter – Order CMT-Z6.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Communications Test Sets

New CRTC02 • New CRTP02

Features

CRTC02/CRTP02

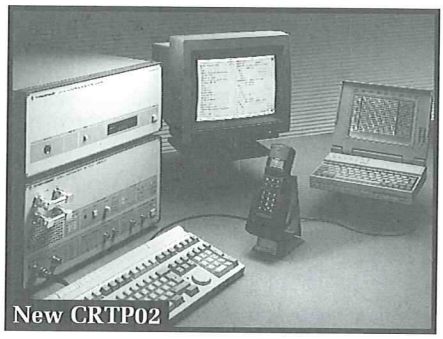
- Automatic Measurements and Logging Using Supplied Test Procedures
- Built-in TTL Inputs/Outputs in the Transmit and Receive Path
- Fast and Reliable Testing of Modules and Complete Mobile Stations
- Automatic Test Routines
- Simulate Base Station with Call Setup, Data Transfer, and All Signaling Procedures Between CRTP02 and the Station-Under-Test
- Log All Signaling Activities in OSI Layers 1, 2, and 3 for Protocol Analysis; Mnemonic Display of Message Content for Protocol Troubleshooting
- Check Error-correction Facilities of the Mobile Station by Implanting Errors in the Data Stream
- Transmitter Measurements:
  – Power Ramp and Phase Trajectory
  – Burst Delay
  – Frequency Error
- Receiver Measurements:
  – Bit Error Rate in Real Time
  – Receiver Sensitivity
- Speech Coder and Decoder Tests
- Numerical and Graphical Output of Results
- IEC/IEEE Bus Interface (Option 04)

Applications

- Measurements on GMSK-modulated RF Signals and Receiver Testing
- Testing for Compliance with GSM, DCS 1800, and DCS 1900 Recommendations
- Simple Generation of Customized Test Procedures
- Research and Development
- Quality Assurance
- Production of PCN (DCS 1800 and DCS 1900) Mobile Telephones

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).


New CRTP02

CRTC02/CRTP02 Radiocommunications Test Set

The CRTC02/CRTP02 provide signal generation, signal measurement, and user-friendly software. They are extremely powerful test sets, providing all simulation and analysis capabilities – from measurement of GSM/DCS 1800/DCS 1900-specific signals to detailed checking for hidden errors in signaling.

SIGNAL GENERATION

The analog unit provides two independent RF generator channels. Using these two channels, the test set can simultaneously simulate and test a control channel (BCCH + FCCH + SCH + CCCH) and a traffic channel (TCH + SACCH). For measuring the receiver sensitivity, a fading simulator can be connected into each of the output circuits.

Transmission with or without frequency hopping is possible on all channels. The two channels are GMSK-modulated and are timed as bursts to occupy exactly one or all of the eight GSM/PCN time slots. The timing of the bursts can be adjusted and the amplitude can be varied dynamically over a 40 dB range.

SIGNAL MEASUREMENT

A receive channel is allocated to each of the generator channels. It's offset by a duplex spacing of 45, 75, or 80 MHz relative to the generator channel, even under hopping conditions.

The digital signal is recovered by a precise GMSK demodulator. In addition, the signal in each of the receive channels is sampled. The phase and amplitude samples are stored and used for computing the signal parameters, such as burst delay, phase trajectory, and power ramping.

USER-FRIENDLY SOFTWARE SAVES TIME

For development and quality control tasks, full flexibility is given by the possibility of varying procedures, signaling parameters, and results display. For production testing, overview measurements, and service tasks, complete test routines supplied with the equipment ensure reliable test results and ease of operation.

A menu-driven editor in conformance with coding rules 4.08 allows convenient entry of messages and system information simply by filling out tables.

A comfortable, window-oriented user interface simplifies the generation of test routines. Test programs are written in Borland Turbo C++. The use of this popular standard language eliminates the long training periods needed for special test languages and offers the user high flexibility.

The complete software, including message library, control programs, and test results, is stored on a hard disk. The built-in floppy drive permits loading stored data and easy backup.

The digital unit may further be used as an IEC/IEEE controller, allowing extension of the test set by including external instruments. The test sets contain both the IEC/IEEE bus interface and the necessary software drivers.

STANDARD MEASUREMENTS

The CRTC02/CRTP02 are supplied with an extensive test software package. These test programs are available in source code and can also be used as starter programs for generating user-specific programs by modifying programs or writing new ones.

The test routines fully comply with specifications:

- Receiver sensitivity in speech channel (TCH/FS) and in user-data and control channels
- Receiver input level range
- Layer 2 signaling of mobile station
- Call setup (mobile station originated and terminated call)
- Absolute delay and timing advance
- Delay measurement function
- Intra-cell power change
- Transmitter power control
- Phase and frequency error
- Power ramp of burst

In addition to the supplied software, other programs are available for test and measurements exactly in line with specifications for type-approval testing.

Communications Test Sets

New CRTC02 • New CRTP02

SIGNALING
The CRTC02/CRTP02 accurately simulate the functions of an ideal base station. For troubleshooting on the unit-under-test, the signaling parameters can also be varied.

All layer 1 channel coding, as well as layer 2 signaling, is automatically performed in real time. The layer 3 signaling sequence is defined by special test programs.

PROTOCOL ANALYSIS
Every transmitted or received layer 2 or layer 3 message, or even the bits of a burst, are marked with a frame number and recorded in the log memory. Depending upon whether everything is logged or just selected logical channels, the log can cover a time interval between ten seconds and 15 minutes. The logged messages are displayed in mnemonic form on the screen, using the same basic mask as the message editor.

BURST ANALYSIS
After data have been logged, power ramping as well as phase and frequency errors are calculated and displayed as a whole. Detailed analysis is supported by the zoom function.

To check the timing-advance measurement function of a mobile station, the CRTC02/CRTP02 measure the arrival time of the burst and monitor the response of the mobile station to timing advance commands in the generator channels.

To check the delay measurement function of a base station, sending the burst can be delayed and the response of the station-under-test monitored.

To permit synchronization of external measuring instruments, a spectrum analyzer for example, the CRTP has a trigger output for automatically starting measurement at the beginning of a burst.

TESTING RECEIVER SENSITIVITY
In the loop-back mode, bit error rates (BER) can be measured in real time to test the receiver sensitivity of a mobile station.

The same test can be made on base stations by applying a signal modulated with a CCITT test pattern to the receiver input.

ACOUSTIC TESTS
These tests are supported by the built-in speech coder function and the Digital Audio Interface (DAI) of the mobile station as defined in Recommendation 11.10.III.6.4.

A serial EMMI is provided for remote control of the mobile station.

AF MEASUREMENTS (OPTION 01)
A wide range of audio measurements can be performed on the AF section of the station-under-test. The AF generator provides single or double tones. The following measurement functions are implemented:

- AF voltmeter with RMS or peak weighting
- Continuously tunable distortion and SINAD meter
- AF frequency counter
- DC ammeter/voltmeter

Characteristics

ANALOG UNIT
SIGNAL GENERATOR
Frequency Range –
GSM band: 935 to 960 MHz;
DCS 1800 band: 1805 to 1880 MHz;
DCS 1900 band (CRTC02 only): 1930.2 to 1989.8 MHz.

Hop Size – Any frequency step within GSM, DCS 1800, or DCS 1900 (CRTC02 only) bands.

Frequency FIne Tuning – 0 to 60 Hz with about 2 Hz resolution.

Frequency Setting TIme – <500 µs (to within <4° of final phase).

Spurious Phase Modulation – <1° RMS, <4° peak.

Frequency Drift – $<2 \times 10^{-9}$/° C

Aging (after 30 days operation) – $<2 \times 10^{-9}$/day.

Maximum Output Level – 13 dBm.

Static Attenuation Setting – 0 to 135 dB. Resolution: 5 dB.

Dynamic Attenuation (electronic) – 0 to 35 dB.

Level Error (dynamic attenuation 0 dB) –
CRTC02: <1.5 dB from – 122 to +13 dBm;
CRTP02: <1.5 dB from – 127 to +13 dBm.

Modulation – GMSK, bit rate 270833 bit/s to GSM Rec. 05.04.

Burst Delay – –4.6 to +4.6 ms, variable in 0.46 steps.

ANALYZER
Frequency Range –
GSM band: 890 to 915 MHz;
DCS 1800 band: 1710 to 1785 MHz;
DCS 1900 band (CRTC02 only): 1850.2 to 1909.8 MHz.

Reference Level for Full Dynamic Range (adjustable in 3 dB steps) –
RF IN/OUT: 9 to 36 dBm;
RF IN 2: –21 to +6 dBm.

Level Error – <2 dB.

Sampler – Two 12-Bit A/D converters for I and G signals, sampled at 1.083 MHz (4 samples per bit).

SYNCHRONIZATION
10 MHz output, 10 MHz input/output, 52 MHz output, slot sync output.

INPUTS/OUTPUTS
Fading Simulator – Two type N connectors, 50 Ω per channel.

Output Level – 8 to 13 dBm.

RF IN/OUT and RF IN 2 – N-type female connectors, 50 Ω.

Speech Coder Input –
Full dynamic range: 20 mV to 2 V;
R_{in}: 100 kΩ.

Speech Decoder Output –
Full dynamic range: 2 V;
R_{out}: <3 Ω.

Audio Monitor – Built-in loudspeaker, headphones connector, volume control.

Modes – Voltmeter, AF generator, speech decoder, speech coder.

DIGITAL UNIT
Processor – 80486 DX, 33 MHz.

RAM – 8 MB.

Hard Disk – 200 MB.

Floppy Disk Drive – 3.5-in., 1.44 MB.

Graphics – VGA.

Interfaces – IEC-625/IEEE 488 bus; RS-232C; Centronics; Keyboard connector on front and rear panels; CODEC input/output; Control interface; DAI/EMMI.

AF MEASUREMENT UNIT (OPTION 01)
AF GENERATOR
Signal Source –
Single or dual tone:
Frequency range: 20 Hz to 20 kHz;
Output level (RMS): 10 µV to 5 V;
Output impedance: <3 Ω.

AF Voltmeter –
Modes: RMS, + Peak, – Peak;
Frequency range: 50 Hz to 20 kHz;
Level range (RMS): 0.1 mV to 30 V.

Weighting Filters –
CCITT filter: To CCITT 0.41;
Programmable highpass filter: 107 Hz to 10.6 kHz;
Programmable lowpass filter: 235 Hz to 21 kHz;
Programmable notch filter: 100 Hz to 5 kHz (notch frequency).

Communications Test Sets

New CRTC02 • New CRTP02

Distortion and SINAD Meter –
Fundamental frequency range: 100 Hz to 5 kHz;
Measurement range: 0 to 50%, 1 to 50 dB.

AF Frequency Counter –
Frequency range: 20 Hz to 500 kHz;
Resolution: 0.1 Hz/1 Hz.

DC Measurements –
Voltage: 0 to ±30 V;
Current: 0 to ±10 A.

I/Q INPUTS/OUTPUTS
I/Q Inputs for Up/Down Converter –
Adjustable level and level offset.

I/Q Outputs for Up/Down Converter –
Fixed level ±1.5 V (peak).

LAYER 1 FUNCTIONS
Channels Supported – C0 channel with FCCH + SCH + BCCH + CCCH + SDCCH/4 + SACCH/C4 TCH/SDCCH channel with TCH + FACCH + SACCH or SDCCH/8 + SACCH/C8 (TCH is TCH/FS or TCH/F9.6, TCH/F4.8, TCH/F2.4, TCH/H4.8, TCH/H2.4.

Ciphering and Frequency Hopping –
With or without on all channels.

LAYER 2 FUNCTIONS
Signaling – All logical channels for SAPI 0 and 3.

User Data – Transparent mode.

LAYER 3 FUNCTIONS
Defined by user programs.

Programming Language – Borland C++.

Starter Programs – Included for key test runs.

GSM-SPECIFIC MEASUREMENTS
Bit Error Rate – Measurement of receiver sensitivity in loop-back mode.

Phase/Frequency Error, Peak Transmitter Carrier Power, Burst Delay, and Simulation of Delay in Downlink/Uplink – To GSM recommendations.

PRESENTATION OF RESULTS
GSM-specific Measurements –
Graphical or numerical.

Messages and Signaling (content of log memory) – Alphanumeric in mnemonic form.

GENERAL
ENVIRONMENTAL
Temperature –
Operating: 0 to +45°C;
Storage: –40°C to +70°C.

POWER
Line Voltage – 110/220 V ±10%.

Line Frequency – 47 to 63 Hz.

Power Consumption – 500 VA.

PHYSICAL CHARACTERISTICS

ANALOG UNIT

Dimensions	mm	in.
Height	236	9.1
Width	435	17.1
Depth	570	22.4
Weight	**kg**	**lb.**
Without options	Approx. 28	Approx. 61.7

DIGITAL UNIT

Dimensions	mm	in.
Height	192	7.6
Width	435	17.1
Depth	570	22.4
Weight	**kg**	**lb.**
Without options	Approx. 18	Approx. 39.7

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CRTC02
Mobile Station Radiocommunication Test Set for GSM, DCS 1800, and DCS 1900.
Includes: Analog Unit, Digital Unit, Keyboard, Monitor, Basic Software, Borland C Compiler, CRTP-K21 PCN (DCS 1800) Software.

CRTP02
Mobile Station Radiocommunication Test Set for GSM and DCS 1800.
Includes: Analog Unit, Digital Unit, Keyboard, Monitor, Basic Software, Borland C Compiler, CRTP-K21 PCN (DCS 1800) Software.

Opt. 01/CRTP-B1 – AF Measurement Unit.

Opt. 04/PS-B4 – Second IEC/IEEE Bus Interface.

Opt. 07/CRTP-B7 – I/Q Inputs/Outputs.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES
Test SIM Card – Order CRT-Z2.

GSM/DCS 1800 Phase 2 Basic Software – Order CR02 PH2.

SMS/TDS Phase 2 Basic Software for GSM/DCS 1800 – Order CR48 PH2.

Ciphering Software – Order CRTS-K1.

Ciphering Software (A5-2) – Order CRTS-K2.

DCS 1800 Phase 1 Test Case (A) – Order CRTP-K22.

DCS 1800 Phase 1 Test Case (B) – Order CRTP-K23.

DCS 1800 Phase 1 Test Case (C) – Order CRTP-K24.

DCS 1800 Phase 1 Audio Test Case – Order CRTP-K26.

GSM Phase 1 Test Case (A) – Order CRTS-K22.

GSM Phase 1 Test Case (B) – Order CRTS-K23.

GSM Phase 1 Test Case (C) – Order CRTS-K24.

GSM Phase 1 Audio Test Case – Order CRTS-K26.

GSM Phase 2 Test Case (A) – Order CRTP-K52.

GSM Phase 2 Test Case (B) – Order CRTP-K53.

GSM Phase 2 Test Case (C) – Order CRTP-K54.

GSM Phase 2 Supplementary Service Test Case – Order CRTP-K58.

GSM Phase 2 SMS Test Case – Order CRTP-K59.

DCS 1800 Phase 2 Test Case (A) – Order CRTP-K62.

DCS 1800 Phase 2 Test Case (B) – Order CRTP-K63.

DCS 1800 Phase 2 Test Case (C) – Order CRTP-K64.

DCS 1800 Supplementary Service Test Case – Order CRTP-K68.

DCS 1800 Phase 2 SMS Test Case – Order CRTP-K69.

ADDITIONAL ACCESSORIES – Also see page 434.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Signal Sources

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Introduction

A stimulus is an essential element in testing the wide range of components and assemblies that form a communications or navigation/guidance system and the various transmission line components, up to and including the antenna.

Stimulus of communications and navigation/guidance systems in use today and planned for the future require signal generators with precise frequency setting, stability, low phase noise, diversified forms of both analog and digital modulation, and frequency hopping capability.

The following signal generators have the necessary characteristics at affordable prices:

SIGNAL SOURCES OFFERED

SME 02/03 Signal Generator
5 kHz to 3 GHz with all common digital modulation modes.

SMHU58 Signal Generator
100 kHz to 4.32 GHz with high signal purity and frequency agility. For all types of digital and analog modulations.

IQSIM Software
Software tool for creating all types of digital modulations.

SMP 02/03/04/22 Signal Generator
10 MHz to 40 GHz with high signal purity and output power for microwave system testing.

SMT 02/03 Signal Generator
5 kHz to 3 GHz multifunction RF generator for receiver and EMS measurements.

SMY 01/02 Signal Generator
9 kHz to 2.05 GHz generator – versatility and low cost can go hand in hand.

Specifications for these signal generators are described in detail on the following pages.

Signal Sources
SME

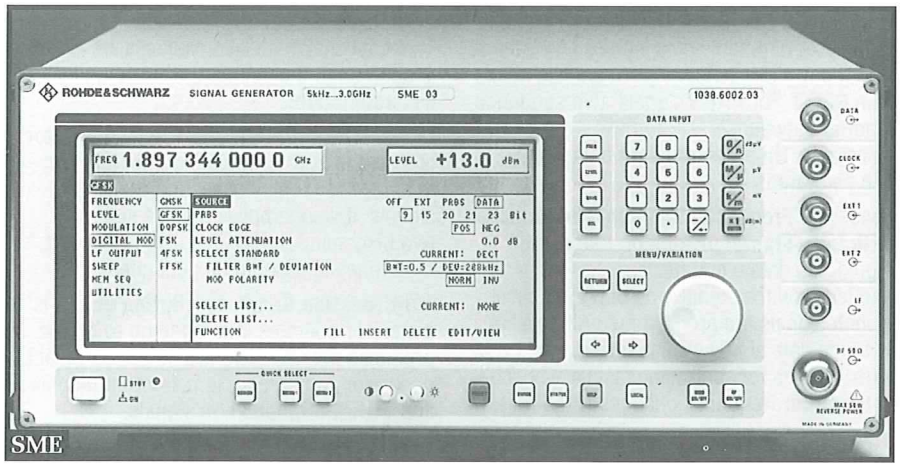
Features

SME

- Frequency Range
  5 kHz to 3 GHz, SME03
  5 kHz to 1.5 GHz, SME02
- All Common Digital Modulation Modes Provided in One Unit: GMSK, π/4-DQPSK, GFSK, FSK, 4FSK, FFSK, ...
- All Modulation Modes Usable over the Entire Frequency Range
- No External Modulation or Data Sources Required
- Internal Control of Frequency and Level Hopping Synchronous with the Data Signal
- Freely Programmable Data Sequences and Trigger Conditions
- Frequency Setting Time <0.5 ms for Frequency-agile Systems
- Broadband, Linear AM DC for Generation of Level Bursts with Predefined Shape
- Extremely High Spectral Purity for Out-of-channel Measurements
- Very High Level Accuracy; Resetting Error of Attenuator 0.01 dB
- RF, AF, and Level Sweep
- Programmable Measurement Sequence for up to 50 Complete Instrument Settings
- Ultra-low RF Leakage for Measurements on Highly Sensitive Paging Receivers
- Easy-to-operate Menu Concept

Applications

- Digital Radio Receivers
- Digital Radio Networks
- Analog Modulations



SME Signal Generator

The SME Signal Generator supplies the complex signals required for the development and testing of digital mobile radio receivers. It's capable of generating all signals used in the main digital radio networks in line with relevant standards regarding the type of modulation, data format, TDMA structure, and frequency hop patterns. The SME is also useful in the analog signal world of conventional signal generators.

The SME has a frequency range from 5 kHz to 1.5 GHz (SME02) or 5 kHz to 3 GHz (SME03). They can be tailored to your requirements by means of a wide variety of options with emphasis either on digital modulation, analog applications, or expansion into a universal signal generator.

DIGITAL MODULATION

With the optional DM Coder, Option 11, the SME provides a variety of network-specific digital modulation modes:

Modulation	Network
GMSK	GSM, DCS 1800/DCS 1900 (PCN), CDPD, DSRR, MC9, MOBILTEX
π/4-DQPSK	NADC, PDC, TFTS, TETRA, APCO25
GFSK	DECT, CT2, CT3
4FSK	ERMES, APCO25 FLEX, MODACOM
FSK, FFSK	POCSAG, FLEX, Cityraf

The SME has been designed to allow for the integration of future types of modulation and networks.

Frequency and phase changes are produced by DDS (direct digital synthesis). The frequency and phase response are therefore synthesizer-accurate. There is no drift at the carrier frequency.

The modulation spectrum stands out for its high spectral purity. Sidebands are well below permissible levels at the frequency spacing relevant for adjacent-channel measurements. Filters other than the standard ones may be used for varying the modulation spectrum (for GMS network: filters with BxT = 0.2, 0.3, 0.5). With GFSK modulation for DECT, non-standard deviations may be set to allow in-depth receiver tests.

The data signals for modulation are applied externally or supplied by the internal data generator. Bit rates are selectable with FSK; they are network-specific for other types of modulation.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488

Product(s) complies with IEEE Standard 488.2-1987 with SCPI conformance.

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Signal Sources
SME

Data Generator: The data generator supplies freely programmable data signals and Pseudo Random Bit Sequence (PRBS) signals in line with CCITT. For PRBS signals, five sequence lengths between $2^9 - 1$ and $2^{23} - 1$ are selectable. Up to ten different data signals can be stored.

Level and Frequency Hopping Synchronous with Data Signal: In addition to the data signal, the data generator supplies a burst and level switch signal. The burst and level switch signals are programmed bit-parallel with the data signal via list entries. The burst signal serves for controlling fast level changes (>80 dB) or frequency changes (<0.5 ms).

The internal level switch signal can be replaced by an external logic signal. The signal switches the level in selectable steps with a rise/fall time <10 µs and enables level variations of up to 20 dB (overrange up to 40 dB).

ANALOG MODULATION

Amplitude Modulation: The modulation frequency range is DC to 100 kHz. Particularly noteworthy is the extremely low incidental phase modulation with AM, which plays an important role in AM sensitivity tests on FM receivers.

Frequency Modulation (with Option 05): The modulation frequency range is DC to 2 MHz. The maximum selectable deviation for modulation frequencies above 500 kHz linearly decreases to 25% at 2 MHz. In the FM DC mode, there's virtually no drift. This allows the digital signaling of receivers by means of analog frequency modulation.

Phase Modulation (with Option 05): Phase modulation ranges from DC to 100 kHz. This wide span allows, for instance, tests on phase-sensitive circuits or the generation of PSK modulation with freely selectable phase deviation.

Pulse Modulation (SME02 Option 03 or SME03 Option 08): The pulse modulation capability featuring an on/off ratio better than 80 dB and a rise/fall time shorter than 10 ns makes the SME an ideal choice for radar applications. The optional pulse generator allows pulsed signals to be produced without an external source.

ANALOG MODULATION SOURCES

Three optional modulation sources are available in addition to the standard fixed-frequency LF generator source:

LF Generator (Option 02): The LF generator is a synthesizer up to 500 kHz. In addition to sinewave, squarewave, and triangular signals, it also supplies a noise signal. If two LF generators are installed in the unit, multitone signals can be generated.

Multifunction Generator (Option 06): This generator operates in a range up to 1 MHz. It produces the same signals as the optional LF generator and, in addition, stereo multiplex and VOR/ILS modulation signals.

Pulse Generator (Option 04): The pulse generator generates single and double pulses required for radar receiver testing. It can only be used in conjunction with the pulse modulator module, into which it's integrated.

SIMULTANEOUS MODULATION

Simultaneous modulation is required for simulating the complex signals used in modern communications and radar systems. The SME is capable of simultaneous DM, AM, FM (φM) and pulse modulation.

With AM and FM, multitone modulation can be affected either by means of the internal and an external modulation signal or, if two LF generators are provided, by means of two internal signals.

Convenient Sweeping in List Mode: Operation is extremely easy thanks to a well thought-out operating concept featuring a large LCD display and menu guidance. All parameters and conditions selectable for a specific function are logically arranged in a single display. Looking up functions in a manual is a thing of the past.

In the list mode, frequency and level settings are made by means of values stored in lists which may contain up to 4,096 pairs of frequency and level. This mode allows the frequency response of cable connections, amplifiers, TEM cells, etc., to be compensated in the signal generator, a particularly useful feature in EMC measurements.

The list mode may be executed either automatically with presettable dwell time, in single-step operation, or by means of external triggering (for frequency hopping applications).

Memory Sequence for Automatic Sequence Control: Up to 50 instrument settings can be stored in a non-volatile memory. After programming the sequence of measurements and the step time in a list, the sequence can be started.

External Triggering: In addition to automatic control, the list mode, memory sequence, RF, AF, and level sweep functions may also be triggered by an external signal. This facility enables synchronous operation with other units.

Compensation of External Frequency Response: The frequency response of external cables can be compensated by entering level correction values for up to 100 frequency points. The correction values for the frequencies between these points are determined by means of interpolation. The frequency response correction will be active in any operating mode as well as during sweeps.

CALIBRATION

Calibration of the unit is required every three years. Calibration values are loaded via the RS-232-C or the IEC/IEEE-bus interface to ensure frequency and level accuracy to specifications. The unit doesn't need to be opened, nor are there any mechanical adjustments to be made.

SELF-DIAGNOSTICS

For maintenance and calibration, precise data on the instrument status are needed. Using the built-in test equipment, the SME02/03 provides data without any extra equipment required. The signal generator status is continuously monitored. The SME signals malfunctions and deviations from nominal values by means of a message on the display screen.

See page 270 for characteristics.

Signal Sources
SMHU58

Features

SMHU58

- I/Q Modulator for Any Phase and Amplitude Modulation (PSK, QAM, ASK, etc.), Modulation Bandwidth DC to 200 MHz
- Second, Coherent Carrier for Simple I/Q Demodulation
- Broadband Amplitude Modulation for TV Applications
- Broadband Frequency Modulation for Satellite Communications, Radar, and Video Applications
- Optional Coders for Generating Modulating Signals for Digital Radio Networks to Relevant Standards (GSM, NADC, DECT, CDMA)
- Frequency Hopping – 4800 Stored Frequency and Level Settings
- Parallel Bus Interface for External Addressing of Memories
- Setting Time <1 ms for Frequency-agile Systems
- High Spectral Purity for Out-of-channel Measurements and LO Applications
- High Output Power (+19 dBm)
- High Carrier Frequency Accuracy and Drift-free FM DC for FSK and VCO Modes
- Fast AM DC for Generating Level Bursts
- RF, AF, Level, and Memory Sweeps for Automatic Test Runs

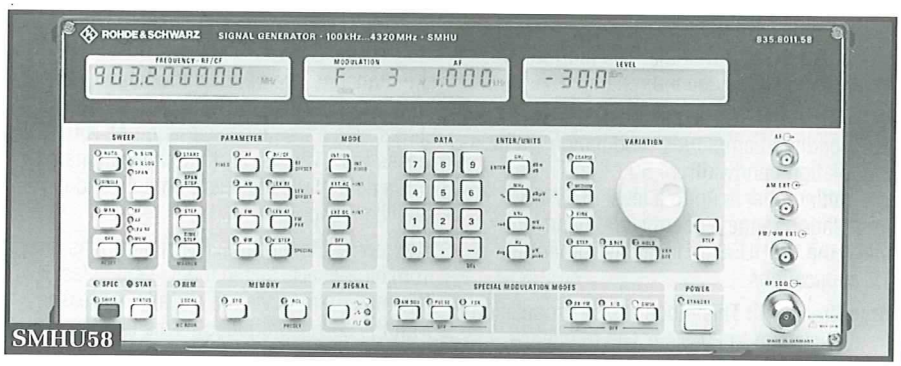
Applications

- Mobile Radio
- Radar Systems
- Directional Radio
- Satellite Communications Simulation
- Cellular and PCS

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GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



SMHU58 Signal Generator

The SMHU58 Signal Generator can generate complex test signals for modern communications and radar systems. Its high versatility is based upon the great variety of modulation capabilities in conjunction with high spectral purity and frequency hopping.

The I/Q and the broadband AM/FM modulators make all digital and analog modulation modes for directional radio and satellite communications possible. Modern radio networks use digital modulation methods, for which the SMHU58 is ideally suited due to the high accuracy of its I/Q modulator.

For modulation using serial data signals, coders can be integrated for the necessary signal processing and filtering to relevant standards. The optional coders produce filtered analog signals from a serial data stream for driving the I/Q modulator. The accuracy of the resulting phase modulation meets all requirements placed on a reference signal for NADC, DECT, PDC, and GSM testing. The CDMA coder uses Qualcomm chips to generate standard channels.

Broadband FM can be used for fast FSK, analog sweeping, video modulation, and for generating chirp signals.

MODULATION
Internal and external, or both internal modulation sources, can be combined for two-tone modulation.

Frequency Modulation: The maximum deviation depends upon the carrier frequency. Starting from a maximum deviation of 3.2 GHz in the frequency range 2.16 to 4.320 GHz, the maximum deviation decreases with the carrier frequency.

By selecting a special function, deviations of up to 800 kHz can be set even below 125 MHz. The FM modulation frequency range covers DC to 1 MHz. In FM DC mode, a high carrier-frequency accuracy is ensured. The frequency offset occurring with FM DC selected is extremely small.

Amplitude Modulation: The whole of the modulation frequency range can be used down to carrier frequencies of less than 100 kHz. The minimal phase shift at 30 Hz (AM DC) and a flat frequency response provide the precision amplitude modulation required for testing VOR/ILS navigation receivers.

Pulse Modulation: Rise/fall times of 20 ns (<10 ns typical for frequencies >200 MHz) and an on/off ratio of 80 dB open up a wide range of possibilities for testing telemetry, radio link, radar, and satellite communications systems.

I/Q Modulator: The I/Q modulator is adjusted for minimum amplitude and phase error in an automatic calibration routine. The settings can also be varied to simulate a non-ideal behavior of the modulator. With the aid of selectable defined modulation distortion, effects on bit error rates can be determined and demodulator maladjustments corrected.

Coder Options: The serial data signal may be derived from an external source or from a PRBS generator in the coder. By digital processing in the coder, the data signal is shaped as required for the prescribed filter function and split into I and Q signals. In addition to the standard filter functions provided, special filter functions for various bandwidths are programmed in the coder. They are used for specific variations of the modulation spectrum to enable investigations of non-standard signals. The extremely high modulation accuracy meets all the requirements placed on a reference signal for use in receiver testing. Separate coders are required for CDMA, GSM, DECT and NADC/PDC networks, since type of modulation, clock frequency, and baseband filtering are different

Signal Sources
SMHU58

in each network. The SMHU58 can accommodate one coder module. The plug-in coder modules can easily be interchanged.

Broadband AM: The I/Q modulator is also used for broadband amplitude modulation within a modulation bandwidth of 50 MHz. There are no limiting effects up to a level of +7 dBm. Modulation range, linearity, and bandwidth make the SMHU58 an ideal instrument for TV applications.

Broadband FM: This mode allows modulation frequencies up to 20 MHz. The frequency deviation can be adjusted in fine steps in the range from 1 kHz to 50 MHz. Through the simultaneous use of pulse modulation and Broadband FM, the SMHU58 can generate radar chirps with a frequency variation of 100 MHz in less than 100 ns. Further applications are in the field of video measurements and in satellite reception.

Frequency Modulation: FM applications range from high-quality stereo modulation to fast FSK. The maximum deviation usually decreases with the carrier frequency. This is different when FM is simultaneously used with I/Q or Broadband AM. The maximum deviation then has a constant value of 3.2 MHz in the range between 5 MHz and 1.95 GHz.

High carrier frequency accuracy is ensured in FM DC mode. When FM DC is selected, the frequency offset remains smaller than $10^{-7} \times f_c$ (f_c = carrier frequency) and smaller than 400 Hz for I/Q modulation and Broadband AM. There is practically no drift. This is particularly useful for receivers with digital signaling.

CHARACTERISTICS

	SME02	SME03	SMHU58
FREQUENCY			
Range	5 kHz to 1.5 GHz	5 kHz to 3 GHz	100 kHz to 4.32 GHz (usable to 1 kHz)
Resolution	0.1 Hz	0.1 Hz	0.1 Hz
Accuracy @ 1 GHz	1000 Hz based on reference aging rate per year	1000 Hz based on reference aging rate per year	100 Hz based on reference aging rate per year
Stability	±1 x 10^{-6}/year, ±1 x 10^{-9}/day with Opt. 01	±1 x 10^{-6}/year ±1 x 10^{-9}/day with Opt. 01	±1 x 10^{-7}/year ±1 x 10^{-9}/day
Setting Time	<10 ms after IEEE bus delimiter	<10 ms after IEEE bus delimiter	<10 ms after IEEE bus delimiter, <1 ms fast mode
OUTPUT LEVEL			
Range	+13 to –144 dBm	+13 to –144 dBm	+13 to –140 dBm
Overrange	+16 to –144 dBm	+16 to –144 dBm	+16 to –140 dBm
Resolution	0.1 dB	0.1 dB	0.1 dB
Accuracy	±1 dB	±1.5 dB	±1.5 dB, ±2.5 dB, ≥2.16 GHz
SPECTRAL PURITY			
Harmonics	≤–30 dBc	≤–30 dBc	≤–30 dBc
Spurious	≤–80 dBc, <–66 dBc for digital modulation	≤–74 dBc, <–60 dBc for digital modulation	–100 dBc ≤1 GHz, –94 dBc ≥1 GHz, –88 dBc ≥2.16 GHz
Residual FM (0.3 to 3 kHz BW)	1 Hz	1 Hz	≤1 Hz below 1 GHz, ≤2 Hz below 2.16 GHz ≤4 Hz above 2.16 GHz
SSB Phase Noise	–130 dBc/Hz @ 10 kHz offset and 1 GHz CF	–130 dBc/Hz @ 10 kHz offset and 1 GHz CF	–130 dBc/Hz @ 10 kHz offset and 1 GHz CF
MODULATION			
AM Rate	0.4/1/3/15 kHz internal, DC to 100 kHz external	0.4/1/3/15 kHz internal, DC to 100 kHz external	1 Hz to 50 kHz internal, DC to 50 kHz external
AM Depth	0 to 100%	0 to 100%	0 to 100%
FM Rate	0.4/1/3/15 kHz internal, DC to 500 kHz external	0.4/1/3/15 kHz internal, DC to 500 kHz external	10 Hz to 100 kHz internal/external
FM Max Deviation	±125 kHz @130 MHz, ±500 kHz @750 MHz ±1 MHz @ 1.5 GHz	±125 kHz @130 MHz ±500 kHz @750 MHz ±2 MHz @ 3 GHz	±100 kHz @125 MHz ±800 kHz @1 GHz ±3.2 MHz @ 4.3 GHz
Phase Modulation	YES with Opt. 05	YES with Opt. 05	YES
Phase Rate	0.4/1/3/15 kHz internal, DC to 100 kHz external	0.4/1/3/15 kHz internal, DC to 100 kHz external	10 Hz to 100 kHz internal/external
Phase Deviation (maximum)	10 radians	10 radians <1 GHz, 20 radians 1 to 3 GHz	320 radians
Pulse Modulation	YES with Opt. 03	YES with Opt. 08	YES, External
Pulse Width	20 ns to 1 s	20 ns to 1 s	–
Pulse Rate	100 ns to 85 s	100 ns to 85 s	–
Pulse Delay	20 ns to 1 s	20 ns to 1 s	–
On/Off Ratio	>80 dB	>80 dB	>80 dB
Rise/Fall Time	<10 ns	<10 ns	<20 ns

Signal Sources
SMHU58

MODULATION (CONT.)	SME02	SME03	SMHU58
Simultaneous Modulation	YES	YES	YES
Internal Modulation Generator	0.4/1/3/15 kHz	0.4/1/3/15 kHz	1 Hz to 100 kHz sine, 1 Hz to 2 kHz square or sawtooth
Digital Modulation	YES with Opt. 11	YES with Opt. 11	YES
FSK	YES	YES	YES
4FSK	YES	YES	YES with ADS and IQSM Software
FFSK	YES	YES	YES with ADS and IQSM Software
GFSK	YES	YES	YES with ADS and IQSM Software
GMSK	YES	YES	YES with ADS and IQSM Software
π/4-DQPSK	YES	YES	YES with ADS and IQSM Software
CDMA	NO	NO	YES with Opt. 06
SWEEP			
Functions	Digital, in discrete steps, linear or log	Digital, in discrete steps, linear or log	Digital, in discrete steps, linear or log
Modes	Automatic, manual, single-shot, and external triggered	Automatic, manual, single-shot, and external triggered	Automatic, manual, single-shot, and external triggered
Start/Stop	YES	YES	YES
Center Frequency/Delta Frequency	YES with Opt. 05 and 06	YES with Opt. 05 and 06	YES
Markers	3	3	User-selectable
OTHER FEATURES			
IEEE-488 Interface	YES	YES	YES
Self-diagnostics	YES	YES	YES
Overload Protection	50 W Max RF, 35 V Max DC	50 W Max RF, 35 V Max DC	30 W Max RF, 35 V Max DC
POWER REQUIREMENTS			
Line Voltage	90 to 132 V, 180 to 265 V	90 to 132 V, 180 to 265 V	100/120/220/240 V
Line Frequency	47 to 440 Hz	47 to 440 Hz	47 to 63 Hz
ENVIRONMENTAL			
Operating Temperature	0 to 50°C	0 to 50°C	0 to 50°C
Mechanical Stress	MIL-STD 810 D	MIL-STD 810 D	DIN 40046 (8)
Electromagnetic Compatibility	MIL-STD 461 B, RE02, CE03, CS01, CS02	MIL-STD 461 B, RE02, CE03, CS01, CS02	MIL-STD 461 B, CE03, RE02
PHYSICAL			
Dimensions	**mm / in.**	**mm / in.**	**mm / in.**
Height	192 / 7.89	192 / 7.89	192 / 7.89
Width	435 / 17.8	435 / 17.8	435 / 17.8
Depth	460 / 18.9	460 / 18.9	460 / 18.9
Weight	**kg / lbs.**	**kg / lbs.**	**kg / lbs.**
Net	25 / 55	25 / 55	26 / 57.2

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

SME02 – 1.5 GHz Signal Generator.
SME03 – 3 GHz Signal Generator.
Opt. 01/SM–B1 – Reference Oscillator OCXO.
Opt. 02/SM–B2 – LF Generator.
Opt. 03/SM–B3 (SME02) – Pulse Modulator.
Opt. 04/SM–B4 (Opt. 03 or Opt. 08 required) – Pulse Generator.
Opt. 05/SM–B5 – FM/φM Modulator.
Opt. 06/SM–B6 – Multifunction Generator.
Opt. 08/SM–B8 (SME03) – Pulse Modulator.
Opt. 11/SME–B11 – DM Coder.
Opt. 12/SME–B12 – Memory Expansion.
Opt. 19/SME–B19 – Rear Connectors for RF and AF.

SMHU58 – 4.32 GHz Signal Generator.
Opt. 01/SMHU–B2 – GMSK Coder for GSM, PCN Networks.
Opt. 02/SMHU–B3 – GFSK Coder for DECT Networks.
Opt. 03/SMHU–B4 – π/4 DQPSK. Coder for PHP, NADC, PDC Networks.
Opt. 04/SMHU–B5 – π/4 DQPSK Coder for PHP Networks.
Opt. 06/SMHU–B6 – CDMA Coder.
Opt. 10/SMGU–Z9 – Rear-panel Connectors.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES – Also see page 434.
Rear-panel Connectors for RF and AF – Order SMGU-Z9.
19 in. Rack Adapter – Order ZZA-94.
Service Kit – Order SMGU-Z2.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Signal Sources
IQSIM

Features

IQSIM

- Digital Modulation
- Superpositioning/Simulation of Interference Sources
- Power Ramping
- Data Transfer to Arbitrary Waveform Generator

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ROHDE&SCHWARZ

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IQSIM Software

IQSIM software for simulating I/Q signals allows the mathematical simulation of all digital modulations presently known, including CDMA. The simulated signals to be modulated are transferred to an arbitrary waveform generator whose output signals feed a signal generator with a built-in I/Q modulator.

Characteristics

System Features –
User Interface: Automatic adaptation to the graphic mode used, menus following SAA standard, context-sensitive help system, interactive dialog boxes, access to DOS.
Types of Modulation – 2PSK, 4PSK, 0-4PSK, 8PSK. 16QAM, 64QAM, 256QAM.
CFSK (m = 0.1 to 10). GFTM (b = 0 to 1).
4FSK (m = 0.1 to 20).

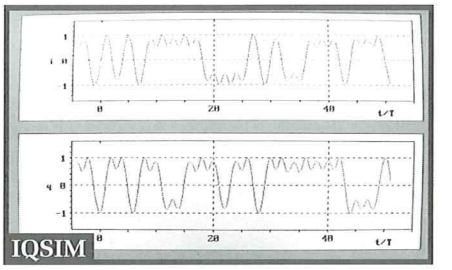
Filter Functions –
Digital Filters: No filter, Sinx/x filter, $\sqrt{\text{cosine}}$ filter, Roll-off factor r = 0.1 to 1, Cosine filter, roll-off factor r = 0 to 1, Gauss filter, bandwidth time product B x T = 0.1 to 1, User-specific FIR filters.
Window Function: Rectangular, Hanning window, Kaiser window. Parameter β = 0.1 to 20.
Pulse Length: 1 to 16-Bits/symbol.
Oversampling Factors: 4 to 32 in steps of 2.
Bit rate:

$$0 \text{ to } \frac{25 \text{ Mbits/s}}{(\text{oversampling factor})} \times \text{bit/symbol}$$

Coding – None, Gray coding, GSM coding (Groupe Spéciale Mobile), NADC-PDC coding (North American Digital Cellular, Pacific Digital Cellular), TFTS coding (Terrestrial Flight Telephone System).

Data Sources –
Pseudo-random Bit Sequences, Data Length: 127/511/2047/32767-Bits.
User-defined Data: Editor function, chaining, filling, saving.
Maximum Length: (16384/oversampling factor) x bit/symbol.

Simulation of Interference Sources –
Linear distortion effects – Carrier Leakage in I/Q: ±10%. IQ imbalance in I/Q: ±20%. Quadrature Offset: ±10%.



Nonlinear Distortion Effects – AM/AM Conversion (k2), (k3): ±10%. AM/PM Conversion (k1), (k2): ±10%.

Noise – Energy per Bit Related to Noise (energy Eb/noise): –36 to –3 dB. Normalized Noise Bandwidth: B x T_s = 0/0.5/1/2/4.

Co-channel interference – Simulation of interference source.

Amplitude shape/power ramping – Amplitude Control of the RF Signal: 0 to –60 dB.

Graphic Simulation –
Graphics: I(t), Q(t), r(t), φ(t), r(t), f(t), vector diagram, eye diagram, (r = amplitude function, φ = angle function, f = frequency function).
Scaling: User-selectable.

Transfer Interface – Setting Functions: IEC/IEEE-bus address of generator, choice of generator AMS or ADS, I/Q format or FM/AM format quantization maximum 12-Bit, interpolation between r = first and last bit.

REQUIRED HARDWARE
Controller –
Type: PSA controller family or AT-compatible.
Operating system: MS-DOS 3.00 and higher.
Main Memory: 350 KB RAM minimum.
Monitor and Graphics Adapter: Hercules graphic card and monochrome monitor, EGA/VGA with monochrome or color monitor.
IEC-bus Card (IEEE 488.1): Rohde & Schwarz IEC/IEEE-bus driver (PS-K2) or National Instruments GPIB-PC software.
Mouse: Rohde & Schwarz PS-B11, serial Microsoft mouse, or compatibles.

Generator –
SMHU58 Signal Generator: Signal generator with I/Q modulator 1 kHz to 4.32 GHz.
ADS Generator: 2-CH programmable ARB generator. AWG 2003: AWG 2020/21 with second channel option.

Extra – Clock Generator ADS-B1.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

IQSIM-K I/Q Simulation Software.
Includes: Manual.

Signal Sources
SMP

Features

SMP

- Frequency Range 2 to 40 GHz (SMP04), 2 to 26.5 GHz (SMP03), 10 MHz to 20 GHz (SMP02, SMP22 Opt. 11), 2 to 20 GHz (SMP02, SMP22)
- Maximum Output Level +3 dBm (SMP04), +6 dBm (SMP03), +10 dBm (SMP02), +20 dBm (SMP22)
- AM, FM, φM, and Pulse Modulation
- Ultra-low RF Leakage
- Large LCD Display
- Menu-guided Operation with All Menu Levels Shown at a Glance
- Two Menu Memories to Speed up Operation
- Non-volatile Storage for up to 50 Complete Instrument Setups
- Remote Control Interface IEC625/IEEE 488

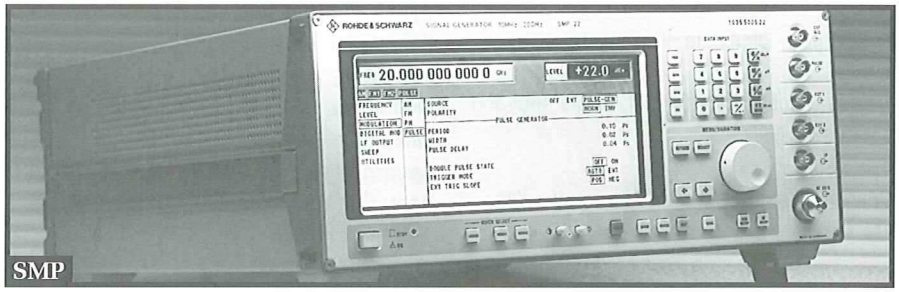
Applications

- Radar and Communications Receiver Testing
- Research and Development
- EMI Testing

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987 with SCPI conformance.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



SMP Signal Generator

The SMP Signal Generator is a high-frequency microwave signal source providing high output power with accurate level setting, high spectral purity, and excellent pulse modulation. The SMP can supply signals for radar and communications receiver tests. A wide range of extensions ensures universal use in research, production, EMC measurements, and material testing.

UNAMBIGUOUS RESULTS DUE TO HIGH SPECTRAL PURITY

The frequency range from 2 to 20 GHz is directly generated by YIG oscillators so that there are no subharmonics which may cause measurement errors. Non-harmonics of <–60 dBc and a specified SSB phase noise of >92 dBc/Hz at 10 GHz allow the user to concentrate on the device-under-test without wasting time in tracking down spurious signals of an inadequate signal source.

STABLE OUTPUT FREQUENCY

The built-in crystal reference ensures an accurate and low-drift output frequency. The SMP can also be fitted with an oven-controlled crystal oscillator (with OCXO, Option 01) to meet the most exacting requirements.

HIGH OUTPUT LEVEL ELIMINATES THE NEED FOR ADD-ON UNITS

A large number of microwave measurements requires mainly one thing: a high output level, which until now has only been possible with expensive add-on amplifiers. The SMP22 features a guaranteed level of 20 dBm (without attenuator) and thus sufficient reserves for compensating the attenuation of long cables as well as the losses of power splitters and directional couplers. The SMP22 is therefore ideal for the many applications that require a high output level.

Characteristics (Common)

FREQUENCY

Range – See chart page 274.

Resolution – 0.1 Hz.

Accuracy @ 1 GHz – 1000 Hz based on reference aging rate per year.

Stability – $\pm 1 \times 10^{-6}$/year, $\pm 1 \times 10^{-9}$/day, with Opt. 01.

Setting Time – <11 ms +10 ms/GHz after IEEE bus delimiter.

OUTPUT LEVEL

Range – See chart page 274.

Resolution – 0.1 dB.

Accuracy – ±0.6 to ±1.5 dB level dependent.

MODULATION

AM Rate – DC to 100 kHz.

AM Depth – 0 to 90%.

FM Rate – DC to 1 MHz.

FM Max Deviation – SMP02, SMP22: 10 MHz. SMP03, SMP04: 20 MHz (2 MHz with Option 5).

Phase Modulation – Yes with Opt. 02 and 05.

Phase Rate – 0.4/1/3/15 kHz internal, DC to 100 kHz external.

Phase Deviation (maximum) – 10 radians.

Pulse Modulation – Yes with Opt. 14.
Pulse width: 20 ns to 1 s.
Pulse rate: 100 ns to 85 s, 0 to 10 MHz.
Pulse delay: 20 ns to 1 s.

On/Off Ratio – >80 dB.

Rise/Fall Time – <10 ns.

Simultaneous Modulation – Yes

Internal Modulation Generator – 0.4/1/3/15 kHz.

Digital Modulation – Yes, external.

FSK Modulation – Yes, external.

Continued on next page

Signal Sources
SMP

SWEEP
Functions – Digital, in discrete steps, linear or log.
Modes – Automatic, manual, single-shot and external triggered.
Start/Stop – Yes.
Center Frequency/Delta Frequency – Yes.
Markers – 3.

OTHER FEATURES
IEEE-488 Interface – Yes.

POWER REQUIREMENTS
Line Voltage – 90 to 132 V, 180 to 265 V.
Line Frequency – 47 to 440 Hz.

ENVIRONMENTAL –
Operating Temperature – SMP02, SMP03, SMP04: 0 to 50°C. SMP22: 0 to 50°C.
Mechanical Stress – MIL-STD 810 D.
Electromagnetic Compatibility – MIL-STD 461 B, RE02, CE03, CS01, CS02.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	192	7.89
Width	435	17.8
Depth	570	23.42
Weight	**kg**	**lbs.**
Net	27	59.4

	SMP02	SMP03	SMP04	SMP22
FREQUENCY				
Range	2 to 20 GHz (10 MHz to 20 GHz with Opt. 11)	2 to 27 GHz (10 MHz to 27 GHz with Opt. 11)	2 to 40 GHz (10 MHz to 40 GHz with Opt. 11)	2 to 20 GHz (10 MHz to 20 GHz with Opt. 11)
OUTPUT LEVEL				
Range	–20 to +10 dBm to –130 dBm with Opt. 15	–20 to +20 dBm to –130 dBm with Opt. 15	–20 to +20 dBm to –130 dBm with Opt. 15	–20 to +20 dBm to –130 dBm with Opt. 15
SPECTRAL PURITY				
Harmonics	≤–30 dB, –50 dBc typical above 1.8 GHz	<–40 dBc, f>20 GHz	<–30 dBc, f>20 GHz	≤–25 dBc
Subharmonics	None f<20 GHz	<–40 dBc f>20 GHz	<–40 dBc f>20 GHz	None f<20 GHz
Nonharmonics at >10 kHz from carrier	<–60 dBc f<20 GHz	<–50 dBc f<2 GHz <–60 dBc f>2<20 GHz <–54 dBc f>20 GHz	<–50 dBc f<2 GHz <–60 dBc f >2<20 GHz <–54 dBc f<20 GHz	<–60 dBc f<20 GHz
Residual FM				
10 MHz to 10 GHz	<5 Hz	<5 Hz	<5 Hz	f<5 Hz
10 GHz to 20 GHz	<10 Hz	<10 Hz	<10 Hz	f<20 GHz
20 GHz to 27/40 GHz	–	–	–	–
Residual AM				
10 MHz to 2 GHz	<0.1%	<0.1%	<0.1%	<0.1%
2 GHz to 20/27/40 GHz	<0.05%	<0.05%	<0.05%	<0.05%
SSB Phase Noise	<–64 dBc f>10 MHz <10 GHz <–58 dBc f>10 MHz <20 GHz	<–64 dBc f>10 MHz <10 GHz <–58 dBc f>10 MHz <20 GHz <–52 dBc f>20 MHz <27 GHz	<–64 dBc f>10 MHz <10 GHz <–58 dBc f>10 MHz <20 GHz <–52 dBc f>20 MHz <40 GHz	<–64 dBc f>10 MHz <10 GHz <–58 dBc f>10 MHz <20 GHz

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

SMP02
20 GHz Signal Generator.

SMP03
26.5 GHz Signal Generator.

SMP04
40 GHz Signal Generator.

SMP22
20 GHz Signal Generator.
Includes: Power Cable, Operating Manual, 3.5 mm Female Adapter (SMP02, SMP03, SMP22), 2.9 mm Female Adapter (SMP04).
Opt. 01/SM–B1 – OCXO Reference Oscillator.
Opt. 02/SM–B2 – LF Generator.
Opt. 05/SM–B5 – FM/φM Modulator.
Opt. 11/SMP–B11 – Frequency Extension.
Opt. 12*1/SMP–B12 – Pulse Modulator, 2 to 40 GHz.
Opt. 13*1/SMP–B13 – Pulse Modulator, 0.01 to 20 GHz.
Opt. 14/SMP–B14 – Pulse Generator.
Opt. 15/SMP–B15 – RF Attenuator, 20 GHz.
Opt. 18/SMP–B18 – Auxiliary Interface.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

ADDITIONAL ACCESSORIES – Also see page 434.
**1 Option 12 and Option 13 cannot be installed at the same time.*

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Signal Sources
SMT

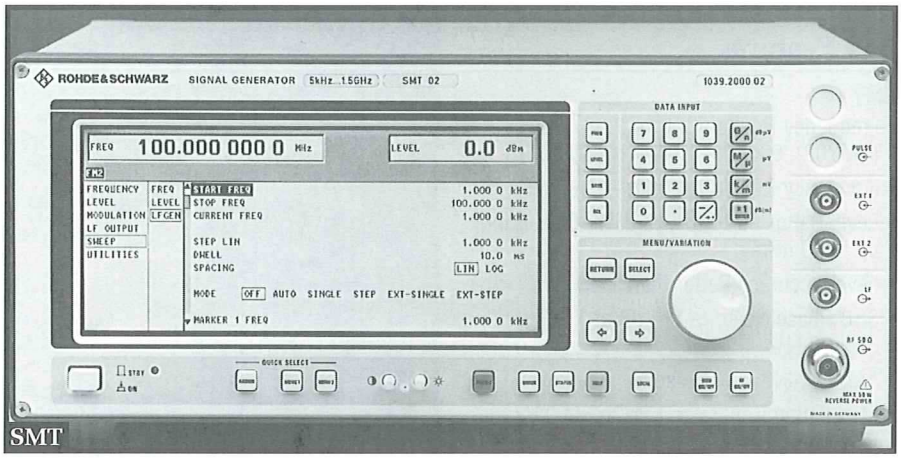
Features

SMT

- Frequency Range 5 kHz to 3 GHz (SMT03), 5 kHz to 1.5 GHz (SMT02)
- Broadband FM Modulation from DC to 8 MHz with Deviation Up to 20 MHz
- Amplitude Modulation
- Phase Modulation (φM) from DC to 2 MHz
- Convenient RF, LF, and Level Sweeps
- Memory Sequence Function for Automatic Measurements
- Programmable Level Correction for Compensation of External Frequency Response
- Optional LF Generator (Opt. 02)
- Optional Pulse Modulator (Opt. 03 or 08)
- Optional Pulse Generator (Opt. 04)
- Optional Multifunction Generator (Opt. 06)
- Large, Backlit LCD Display
- All Submenus and Current Instrument Status Clearly Displayed
- Remote Control Interface IEC625/IEEE 488

Applications

- Radar Applications (with Opt. 03 or Opt. 08)
- VOR/ILS Receiver Tests (with Opt. 06)
- FM Broadcast Transmitter and Receiver Test and Design (with Opt. 06)



SMT Signal Generator

The SMT Signal Generator covers the complete range of conventional analog receiver measurements up to 3 GHz. It provides exceptionally high signal quality, outstanding level accuracy, a wide variety of modulation and signal generation modes, a customizable configuration, and ease of operation.

THE IDEAL EMS SIGNAL SOURCE

With a specified lower frequency limit of 5 kHz (under-range down to 1 kHz), the SMT fully covers the frequency range for EMS measurements stipulated by IEC 801. The digital, step-by-step sweep function, with preselectable start and stop frequency, span, step width, and step time, enables the convenient testing of wide frequency ranges. During the frequency sweeps, no level overshoots will occur. The sweep function can also be used for the RF level and AF frequency.

The frequency response of cables, amplifiers, TEM cells, etc., can be compensated in the signal generator by means of a level-correction function. Complicated external level controls or test routines are not required.

EXCELLENT RF CHARACTERISTICS AT A REASONABLE PRICE

For high-frequency measurements on AM, FM, and SSB receivers, the signal source must be superior to the device-under-test. The low residual FM and SSB phase noise of the SMT make it suitable for in-channel and blocking measurements, even on high-end receivers. The small level error of <1 dB throughout the frequency range allows high-precision sensitivity measurements.

MINIMUM RF EMISSIONS FOR SENSITIVE DUTS

Measurements on highly sensitive receivers such as pagers not only require high signal quality, but also extremely high RF shielding of the signal source. Elaborate shielding measures keep RF emissions of the SMT to a minimum.

MEMORY SEQUENCE FUNCTION FOR AUTOMATIC MEASUREMENTS

For frequently repeated measurement series, the memory sequence function allows a sequence of measurements to be run without an external controller. Up to 50 instrument settings can be stored in non-volatile memory.

See page 277 for characteristics.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987 with SCPI conformance.*

ROHDE&SCHWARZ

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Signal Sources
SMY

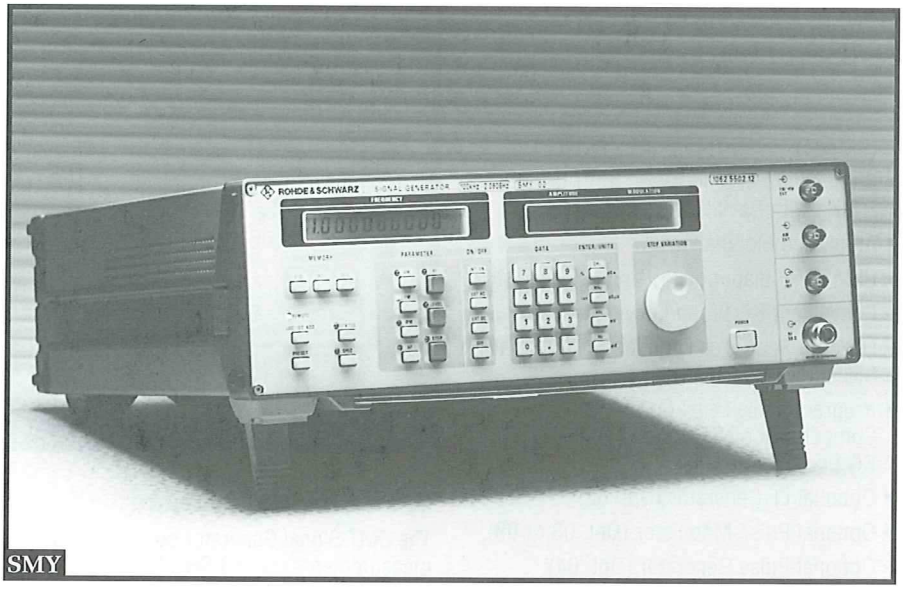
Features

SMY

- Frequency Range 9 kHz to 2.08 GHz (SMY02), 9 kHz to 1.04 GHz (SMY01)
- Frequency Resolution 1 Hz
- Level Range –140 to +13 dBm, Over Range up to 19 dBm
- Level Accuracy Better than 1 dB
- SSB Phase Noise <–114 dB at 1 GHz, Δf = 20 kHz
- AM, FM, φM, and Pulse Modulation
- Modulation Generator 1 Hz to 500 kHz
- RF Overload Protection 30 W (SMY01) or 50 W (SMY02)
- Low RF Leakage (<0.1 µV)
- Non-volatile Storage for up to 50 Complete Front-panel Setups
- Remote Control Interface IEC625/IEEE 488
- Calibration at 3-Year Interval

Applications

- Communications Receiver Testing
- General Component Measurements
- EMI



SMY

SMY Signal Generator

The SMY Signal Generator is a cost-effective instrument for testing AM, FM, and φM receivers and for component measurements. The SMY comes in two models: SMY01 for 9 kHz to 1.04 GHz and SMY02 for 9 kHz to 2.08 GHz.

The SMY Signal Generator is designed with a comprehensive set of basic signal generator capabilities. As a result, it's an economical solution for universal use in the lab, production, and servicing environments.

THE IDEAL GENERATOR FOR RECEIVER MEASUREMENTS...

Level range –140 dBm to +13 dBm (19 dBm over range) sufficient even for receivers of highest sensitivity.

High level accuracy and low RF leakage allowing accurate and undergraded sensitivity measurements.

FM DC with high accuracy of carrier frequency for testing pagers and receivers fitted with digital squelches.

Low SSB phase noise and high spurious rejection for all in-channel and blocking measurements.

Low residual FM affording ample margin for S/N measurements.

Modulation generator 1 Hz to 500 kHz for modulation frequency response measurements.

Stereo channel separation of 50 dB and low harmonic distortion for testing FM stereo receivers.

Non-interrupting level setting over a range of 20 dB for reproducible measurement of squelch hysteresis.

... PLUS THE PERFORMANCE FOR GENERAL-PURPOSE APPLICATIONS

Frequency resolution 1 Hz, also suitable for extremely narrowband tests.

FM DC deviation up to 20 MHz for VCO simulation.

FM bandwidth 2 MHz for fast FSK and telemetry applications.

High output level up to 19 dBm for component and overdrive testing.

AF synthesizer 1 Hz to 500 kHz, separate use as AF signal source possible for external applications (e.g., recording of AF frequency response).

Remote-control interface IEC625/IEEE 488 for use in automatic test systems.

Sequence function and SEQ input for semi-automatic use.

See page 277 for characteristics.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

ROHDE&SCHWARZ

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Signal Sources
SMT • SMY

CHARACTERISTICS

	SMT02	SMT03	SMY01	SMY02
FREQUENCY				
Range	5 kHz to 1.5 GHz	5 kHz to 3 GHz	9 kHz to 1.04 GHz	9 kHz to 2.08 GHz
Resolution	0.1 Hz	0.1 Hz	1 Hz	1 Hz
Accuracy @ 1 GHz	1000 Hz based on reference aging rate per year	1000 Hz based on reference aging rate per year	1000 Hz based on reference aging rate per year	1000 Hz based on reference aging rate per year
Stability	±1 x 10^{-6}/year ±1 x 10^{-9}/day with Opt. 01	±1 x 10^{-6}/year ±1 x 10^{-9}/day with Opt. 01	±1 x 10^{-6}/year ±1 x 10^{-9}/day with Opt. 01	±1 x 10^{-6}/year ±1 x 10^{-9}/day with Opt. 01
Setting Time	<25 ms after IEEE delimiter	<25 ms after IEEE delimiter	<60 ms after IEEE delimiter	<60 ms after IEEE delimiter
OUTPUT LEVEL				
Range	+16 to –144 dBm	+16 to –144 dBm	+19 to –140 dBm	+19 to –140 dBm
Resolution	0.1 dB	0.1 dB	0.1 dB	0.1 dB
Accuracy	±1 dB	±1 dB to 1.5 GHz ±1.5 dB, ≥1.5 GHz	±1 dB	±1 dB to 1.04 GHz ±1.5 dB, ≥1.04 GHz
SPECTRAL PURITY				
Harmonics	≤–30 dBc for levels ≤–10 dBm	≤–30 dBc for levels ≤–10 dBm	≤–30 dBc for levels <10 dBm	≤–30 dBc for levels <10 dBm
Spurious	≤–80 dBc	≤–80 dBc to 1.5 GHz ≤–74 dBc ≥1.5 GHz	≤–70 dBc	≤–70 dBc to 1.04 GHz ≤–64 dBc 1.04 to 2.08 GHz
Residual FM (0.3 to 3 kHz BW)	<8 Hz @ 1.5 GHz	<8 Hz to 1.5 GHz, <16 Hz 1.5 to 3 GHz	10 Hz	10 Hz
SSB Phase Noise	–116 dBc/Hz @ 10 kHz offset and 1 GHz CF	–116 dBc/Hz @ 10 kHz offset and 1 GHz CF	–114 dBc/Hz @ 10 kHz offset and 1 GHz CF	–114 dBc/Hz @ 10 kHz offset and 1 GHz CF
MODULATION				
AM Frequency Range	DC to 100 kHz	DC to 100 kHz	1 Hz to 500 kHz	1 Hz to 500 kHz
AM Depth	0 to 100%	0 to 100%	0 to 100%	0 to 100%
FM Frequency Range	DC to 100 kHz or DC to 8 MHz	DC to 100 kHz or DC to 8 MHz	DC to 2 MHz	DC to 2 MHz
FM Max Deviation	±10 MHz	±20 MHz	±10 MHz	±20 MHz
Phase Modulation	YES, dual channel, 100 kHz and 2 MHz BW	YES, dual channel, 100 kHz and 2 MHz BW	YES	YES
Phase Rate	0.4/1/3/15 kHz internal, DC to 2 MHz external	0.4/1/3/15 kHz internal, DC to 2 MHz external	1 Hz to 500 kHz	1 Hz to 500 kHz
Phase Deviation (maximum)	10 radians @ 100 kHz, 200 radians @ 2 MHz	10 radians @ 100 kHz, 200 radians @ 2 MHz	200 radians	200 radians
Pulse Modulation	YES, with Opt. 04	YES, with Opt. 04	YES, external	YES, external
Pulse Width	20 ns to 1 s	20 ns to 1 s	–	–
Pulse Rate	100 ns to 85 s 0 to 10 MHz	100 ns to 85 s 0 to 10 MHz	–	–
Pulse Delay	20 ns to 1 s	20 ns to 1 s	2.5 µs	2.5 µs
On/Off Ratio	>80 dB	>80 dB	>80 dB	>80 dB
Rise/Fall Time	<10 ns	10 ns	4 µs	4 µs
Simultaneous Modulation	YES	YES	YES	YES
Internal Modulation Generator	0.4/1/3/15 kHz	0.4/1/3/15 kHz	1 Hz to 500 kHz	1 Hz to 500 kHz
VOR Modulation Signal	YES, with Opt. 06	YES, with Opt. 06	NO	NO
ILS Modulation Signal	YES, with Opt. 06	YES, with Opt. 06	NO	NO
Stereo Multiplex Signal	YES, with Opt. 06	YES, with Opt. 06	NO	NO

Signal Sources
SMT • SMY

Characteristics (Continued)

	SMT02	SMT03	SMY01	SMY02
SWEEP				
Functions	Digital, in discrete steps, linear or log	Digital, in discrete steps, linear or log	Digital, in discrete steps, linear or log	Digital, in discrete steps, linear or log
Modes	Automatic, manual, single-shot and external triggered	Automatic, manual, single-shot and external triggered	Automatic, manual, single-shot and external triggered	Automatic, manual, single-shot and external triggered
Start/Stop	YES	YES	NO	NO
Center Frequency, Delta Frequency	YES	YES	NO	NO
Markers	3	3	NO	NO
OTHER FEATURES				
IEEE-488 Interface	YES	YES	YES	YES
Self-diagnostics	YES	YES	NO	NO
Overload Protection	50 W max RF, 35 V max DC	50 W max RF, 35 V max DC	30 W max RF, 35 V max DC	50 W max RF, 35 V max DC
POWER REQUIREMENTS				
Line Voltage	90 to 132 V, 180 to 265 V	90 to 132 V, 180 to 265 V	100 V/230 V	100 V/230 V
Line Frequency	47 to 440 Hz	47 to 440 Hz	47 to 440 Hz	47 to 440 Hz
ENVIRONMENTAL				
Operating Temperature	0 to 55°C	0 to 55°C	0 to 55°C	0 to 55°C
Mechanical Stress	MIL-STD 810D	MIL-STD 810D	MIL-STD-T 28800D Class 5	MIL-STD-T 28800D Class 5
Electromagnetic Compatibility	MIL-STD 461 B, RE02, CE03, CS01, CS02	MIL-STD 461 B, RE02, CE03, CS01, CS02	EN 50081-1, EN 50082-1 compliance	EN 50081-1, EN 50082-1 compliance
PHYSICAL				
Dimensions	**mm in.**	**mm in.**	**mm in.**	**mm in.**
Height	192 7.89	192 7.6	147 5.79	147 5.79
Width	435 17.8	435 17.8	435 17.12	435 17.12
Depth	480 18.9	365 14.38	350 13.8	460 18.1
Weight	**kg lb.**	**kg lb.**	**kg lb.**	**kg lb.**
Net	20 44	20 44	11 24	12 26

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

SMT02
Signal Generator (5 kHz to 1.5 GHz).

SMT03
Signal Generator (5 kHz to 3.0 GHz).
Includes: Power Cord, Operating Manual.

Opt. 01/SM–B1 – OCXO Reference Oscillator.

Opt. 02/SM–B2 – LF Generator.

Opt. 03/SM–B3 – Pulse Modulator for SME02 and SMT02.

Opt. 04/SM–B4 – Pulse Generator.

Opt. 06/SM–B6 – Multifunction Generator.

Opt. 08/SM–B8 – Pulse Modulator for SME03 and SMT03.

Opt. 20/SMT–B19 – Rear-panel Connectors for RF and AF.

SMY01
1.04 GHz Signal Generator.
Includes: Power Cord, Operating Manual.

SMY02
2.08 GHz Signal Generator.
Includes: Power Cord, Operating Manual.

Opt. 01/SMY–B1– OCXO Reference Oscillator.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

ADDITIONAL ACCESSORIES – Also see page 434.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

RF Meters

Electronic Voltmeters

RF MILLIVOLTMETERS

A diode rectifier in the probe changes the unknown RF signal into a DC voltage. This DC voltage is processed in the basic unit and indicated on the display. The non-linear rectifier characteristic is linearized by a control loop or by a calculated correction value.

Using the square weighting of a diode rectifier, RF millivoltmeters measure the RMS value of small voltages up to about 30 mV (or higher with a divider) and the peak or the peak-to-peak value (if a full-wave rectifier is used) of voltages above 1 V. Due to linearization, the meter reads the RMS value of a sine wave in the entire measurement range.

A probe incorporating a capacitively coupled diode is used for measurements on non-coaxial circuits. It features high input impedance and very low input capacitance.

Measurements in coaxial circuits are carried out with the aid of coaxial RF insertion units. They incorporate a diode inserted into the inner conductor or connected via a piston attenuator and permit broadband voltage measurements to be made up to 2 GHz with low SWR. Power sensors can be connected to RF millivoltmeters, so that they can also be used as RF power meters.

RF POWER MEASUREMENT

There are two general types of RF power meters:

- Terminating power meters absorb the test signal and indicate the power picked up
- Directional power meters separately measure the forward and reflected power in an RF line with practically no loss

Terminating power meters are often referred to simply as power meters. They typically have a resistive input impedance of 50 or 75 Ω. Depending upon the principle of operation, either the heat produced is measured, or the RF power at the termination is measured with the aid of a diode rectifier. Conventional power meters with diode probes have a limited dynamic range, since departures from linearity of the diode at as low as 10 µW cause considerable measurement errors. This range can be extended by microprocessor-controlled correction of the rectifier characteristics.

Directional power meters are inserted into an RF line and measure the forward and reflected power separately based upon a directional coupler. Directional power meters can thus be used for simultaneously checking the transmitter output power and the antenna or load matching. Minimum insertion loss is required for the measurement of higher power levels. The measuring instrument can thus remain connected to the transmitter output line for continuous monitoring. Special power sensors with peak weighting are available for measuring pulsed signals (e.g., in GSM/TDMA mobile radio).

MEASUREMENT ACCURACY

The most important characteristics of a voltmeter or power meter are high measurement accuracy and short measurement times. This requires the use of microprocessors and computed correction of factors such as frequency response, temperature effect, and linearity. This relieves the user of error-prone and time-consuming tasks such as recalibration of sensors before measurement, or reading, entering, and calculating correction factors.

STORED CALIBRATION DATA FOR EASE OF USE

The sensors offered for use with the URV and NRV meters are individually calibrated and their calibration data stored in memory. All relevant data required to produce accurate results are stored in calibration-data memory and are available to the meter when plugged in. Even sensor-specific data such as serial number, sensor type, and calibration date are known to the meter, in addition to the permissible measurement and frequency ranges. Only the frequency of the measurement is required; the meter automatically scans the data memory for the relevant calibration factors and interpolates if necessary.

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RF Meters
URV 5 • URV 35

Features

URV 5

- DC, 9 kHz to 2 GHz Frequency Range (26.5 GHz with NRV-Z Sensors)
- 200 µV to 1000 V Measurement Range
- Two Test Inputs
- Microprocessor Error Correction for Unexcelled Accuracy
- Wide Dynamic Range
- Readout in Standard Units with Selectable Reference Impedance
- Relative Measurements
- Individual, Frequency-dependent Calibration Factors Taken into Account
- Optional DC Output

URV 35

- DC to 26.5 GHz Frequency Range
- Compact, Handy, and Mobile
- Voltmeter and Power Meter in One Unit
- Combined Analog and Digital Display
- Menu-guided Operation
- DC Frequency Input for Tracking Frequency-response Correction
- Analog Output of YT Recorder
- Remote Control Interface
- Battery or AC Supply Operation
- Wide Choice of Probes and Sensors
- Rugged Design

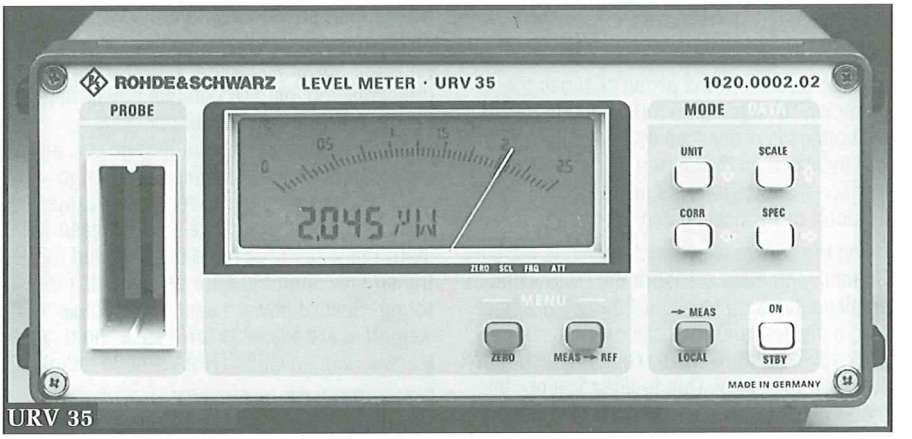
Applications

- Service
- Production
- Precision Measurements in RF and Microwave Labs

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *URV5 complies with IEEE Standard 488.1-1987.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



URV 35

URV 5 RF Millivoltmeter

The URV 5 RF Millivoltmeter is a broadband voltage, level, and power meter with high accuracy and sensitivity. It is suitable for both manual operation and use in systems. A great variety of probes, sensors, and accessories allows the URV 5 to be used for all kinds of measurements.

The values measured in the two channels can be displayed separately, set off against one another, or referred to any reference. For relative measurements, the difference, difference in percent, logarithmic difference, or ratio is indicated (ΔV, ΔW, Δ%, ΔdB, X/REF).

The URV 5 has a fast trend indication which follows the variations of the measured value.

URV 35 Level Meter

The URV 35 Level Meter is a precise voltage and power meter for a large variety of applications. It can be used in service and production, as well as for precision measurement in the RF and microwave lab.

The large variety of probes and sensors available opens up a wide level and frequency range. Excellent RF shielding provides precise measurements, even in the near field of antennas.

An intelligent operating concept in conjunction with an auto-range facility reduces the user's work to read the results in standard units, either as absolute or relative values. The appropriate scale is shown on the LCD display for convenient reading of the results.

Filtering, which is dependent upon the level and resolution, as well as the choice between 4 1/2- and 3 1/2-digit readout, optimizes the display of results. Each probe and sensor is calibrated individually. All relevant data of the probes are automatically evaluated in the URV 35.

Characteristics (URV 5)

Probes and Sensors – Compatible with all URV 5 probes and NRV sensors except NRV-Z51, NRV-Z52, NRV-Z53, NRV-Z54 and NRV-Z31.

Test Channels – 2 (A and B).
Dynamic range: >94 dB.
Absolute measurement: A, B.
Relative measurement: A/REF_A, B/REF_B, A/B, B/A.
Absolute readout: V, W, dBm, dBV.
Relative readout: ΔV, ΔW, Δ%, ΔdB, X/REF.
Resolution: 0.01% or dB.
Error limits (18 to 28°C): ±0.15% of reading per channel.
Filter: Reduces display noise in six steps (F0 to F5).
Zero adjustment: Via keyboard or remote control.
Measurement rate (manual): Approximately 1 measurement/second with filter F0, up to 30 measurements/second with filter F5.
Measurement time (IEC/IEEE bus): Approximately 0.05 second with filter F5, up to 20 seconds with filter F0.

PEP Measurement –
Pulse width: Approximately 200 µs to CW.
Minimum pulse repetition frequency:

Filter	F0	F1	F2	F3	F4	F5
f_{min}/Hz	0.05	0.25	1	5	25	100

RF Meters
URV 5 • URV 35

Optional DC Output (URV 5 with Option 01) – Output voltage range (EMF): –1.999 to +1.999 V into Z_{out} = 1 kΩ.
Resolution: 1 mV (10 digits).
Error: ±2 mV.

Remote Control –
Interface: IEC625-1 (IEEE 488) for control of all device functions.
Interface functions: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, PP1.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	110	4.3
Width	241	9.5
Depth	340	13.4
Weight	**kg**	**lb.**
Net	4.4	9.7

Characteristics (URV 35)

Probes and Sensors – Compatible with all URV 5-Z probes and NRV-Z sensors.

Frequency Range – DC to 26.5 GHz.

Display – Backlit LCD for display of measured value, units, and meter scale; additional moving-coil meter with short response time.

Absolute readout: dBm, dBµV, V, or W.

Relative readout: dB referred to stored reference value.

Resolution of digital display –
4 1/2 digits: 19,999 steps, 0.001 dB.
3 1/2 digits: 1,999 steps, 0.01 dB.

Analog display: Steps of 1/2.5/5 with readout in V, W, or dB; steps of 5 dB with readout in dBm and windows of 10 dB, manually or automatically selected; free scaling by entry of left-hand and right-hand scale limits.

Display filtering: Level-dependent digital averaging filter.
4 1/2-digit resolution: Averaging over 16 to 256 readings.
3 1/2-digit resolution: Averaging over 1 to 32 readings.

Error Limits (18 to 28°C) –
Digital display: ±0.02 dB ±1 digit.
Moving-coil meter: 1.5% of full scale.

Zero Adjustment – Via interface or manually, approximately 4 s.

HOLD Function – Displayed measurement result retained upon keystroke.

Measurement Rate – Five readouts per second in manual mode.

Frequency-response Correction – Specific calibration data of probe taken into account; frequency entry via keypad, interface, or equivalent DC voltage at rear-panel input.

Attenuation Correction – Attenuation or gain connected to input taken into account; input of attenuation value via serial interface or keypad, range ±199.99 dB.

Reference Value Entry – Measured value on keystroke or value entered via interface or keypad.

Reference Impedance – 50 Ω/75 Ω, automatic/selectable.

Input/Output –
DC frequency input:
Connector: BNC female.
Input impedance: 9 MΩ.
Input voltage range: ±12 V, freely selectable, linear, scaling.
Maximum input voltage: 50 V.

DC Voltage Output:
Connector: BNC female.
Source impedance: 1 kΩ.
Output voltage (EMF): Proportional to pointer deflection.
Left-hand scale limit: Corresponding to 0 V.
Right-hand scale limit: Corresponding to 0 V.
Settling time: 250 ms.
Error: ≤5 mV.
Ripple: 5 mV p-p typical.

Remote Control – All device functions controlled via serial interface (V.24, RS-232C).

POWER REQUIREMENTS (URV 5 AND URV 35)
Battery Operation (URV 35 Model 02) –
Battery type: 5 LR20 (1.5 V).
Operating time: Approximately 125 hours.
Charge time (with UZ-35 charger): Approximately 24 hours.

AC Operation (URV 5 and URV 35 Model 03) –
Line voltage: 100/120/220/240 V AC ±10%.
Line frequency: 47 to 63 Hz, 400 Hz.
Power consumption: 30 VA.

ENVIRONMENTAL CHARACTERISTICS (URV 5 AND URV 35)
Temperature Range –
Operating: 0 to +50°C (Class I to IEC 359, no condensation).
Storage: –40 to +70°C.

Humidity – 80% maximum (without condensation).

Mechanical Strength – To IEC 359, Class I.

RFI Suppression – VDE 0871, DBP approval number to regulations 527/1979.

EMC – To IEC 801.3, severity level 3; MIL-STD-461-B RS 03 and CS 02.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	103	4.1
Width	219	6.6
Depth	240	9.4
Weight	**kg**	**lb.**
Model 02		
With batteries	3.1	6.8
Without batteries	2.3	5.1
Model 03	2.4	5.3

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

URV 5
RF Millivoltmeter.
Includes: Power Cord, Manual.
Opt. 01 – DC Output.

URV 35 MODEL 02
RF Millivoltmeter (Battery Operated).

URV 35 MODEL 03
RF Millivoltmeter (AC Supply).
Includes: Power Cord, Manual.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES – Also see page 434.
Battery Charger – Order UZ-35.
Service Kit – Order URV 35-Z1.
Transit Case – Order UZ-22.
Carrying Strap – Order ZZT-96.
Rack Adapter – Order ZZA-97.
Plastic Hood – *1.
Probes and Sensors – See page 291.

*1 *Contact your local Tektronix representative.*

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

RF Meters
New NAS

Features

NAS

- Ideal for Measuring Power and SWR of All Kinds of Radio Equipment
- Plug-on Insertion Units for All Fields of Mobile Radio and for Power up to 1200 W
- Insertion Units for Digital Radio Networks (TDMA, GSM, DCS 1800, DCS 1900)
- Simultaneous Display of Forward and Reflected Power or of Forward Power and SWR
- Auto-ranging for Easy Operation
- Auto-calibration for Accurate Measurements
- Battery Operation for Measurements Anywhere
- Automatic Switchoff for Extended Battery Life
- Self-test for Reliable Operation

Applications

- TDMA
- GSM
- DCS 1800 (PCN)
- PCS 1900

NAS Directional Power Meter

With a frequency range from 1 MHz to 2000 MHz, the NAS Directional Power Meter covers from shortwaves to digital radio network frequencies. Six Insertion Units provide full coverage for the entire range.

NAS INSERTION UNITS

Insertion Units plug into the side of the NAS. They can also be connected via a 1.5-meter cable for measurements at test points that are difficult to reach. Specific calibration data is stored in each Insertion Unit. The NAS factors this data into measurements so the correct values at the measurement point are indicated on the front-panel meters. Selecting the appropriate Insertion Unit allows measurements from 1 MHz to 1800 MHz at power ratings from 0.01 to 1200 watts. This allows the NAS to make measurements on shortwave radios, police and fire radios, aircraft radios, TDMA transceivers, GSM, DCS 1800 (PCN), and cordless telephones.

TERMINATED POWER MEASUREMENTS

The NAS can also be used for terminated power measurements. For measurements of transmitters, a termination, which acts as a dummy antenna, is connected to the output of the Insertion Unit. Two termination units are available with load-handling capacity up to 30 watts.

MEASUREMENTS ON TDMA TRANSCEIVERS

The frequency range and circuit design of the NAS-Z6 and NAS-Z7 Insertion Units have been specifically tailored for measurements on GSM transceivers. TDMA signals call for special measurement techniques, since digital transmissions employ clocked signals and no CW signals are available for measurement. Conventional directional power meters indicate varying average power values depending upon the weighting method chosen. It's difficult to draw accurate conclusions regarding the true emitted power or on matching from these measurements. In order to obtain accurate results, the NAS makes a PEP (Peak, Envelope, Peak) measurement of the clocked signal, with due consideration of network timing. In addition, the NAS-Z6 and NAS-Z7 Insertion Units contain special circuitry to eliminate overshoots on signal bursts which make measurement impossible with conventional directional power meters.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

RF Meters
New NAS

Characteristics

BASIC UNIT

Display – Two moving-coil meters for forward and reflected power or forward power and SWR.

Power Measurement Ranges –
With NAS-Z7: 0.3/1/3/10/30 W.
With NAS-Z1, NAS-Z3, NAS-Z5, NAS-Z6: 0.3/1/3/10/30/100 W.
With NAS-Z2: 3/10/30/100/300 W.

Range Selection – Automatic or manual, separate for forward and reflected power.

Error Limits (18 to 28°C) – ±1.5% of selected range + error of insertion unit.

Additional Error at Temperatures >28°C or <18°C – ≤0.25% of reading/°C.

Automatic Switchoff – Approximately one hour after last keystroke.

ENVIRONMENTAL CHARACTERISTICS

Operating Temperature Range – 0 to 50°C.

POWER SUPPLY

Battery Type – Five dry batteries, IEC R20 (alkaline-manganese batteries).

Lifetime – >150 hours.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	210	8.3
Height	145	5.7
Depth	90	3.5
Weight	**kg**	**lb.**
(without Insertion Units)	2	4.4

FOR ALL INSERTION UNITS

Connector – N, female.

Characteristic Impedance – 50 Ω.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	55	2.2
Height	120	4.7
Depth	90	3.5
Weight	**kg**	**lb.**
Net	0.7	1.5

TERMINATIONS

Load-handling Capacity –
Continuous: NAZ10: 10 W; NAZ30: 30 W.
For 1 minute: NAZ10: 15 W; NAZ30: 50 W.

Impedance – 50 Ω.

Frequency Range –
NAZ10: 0 to 1 GHz.
NAZ30: 0 to 2 GHz.

SWR –
NAZ10: ≤1.15.
NAZ30: To 1 GHz: ≤1.1; To 2 GHz: ≤1.2.

Connector – N, male.

INSERTION UNITS

Model	NAS-Z1	NAS-Z2	NAS-Z3	NAS-Z5	NAS-Z6	NAS-Z7
Frequency Range	1 to 30 MHz	1 to 30 MHz	25 to 200 MHz	70 to 1000 MHz	890 to 960 MHz*1	890 to 960 MHz, 1710 to 1880 MHz*1
Measurement Range	0.01 to 120 W	0.1 to 1200 W	0.01 to 120 W	0.01 to 120 W	0.01 to 120 W	0.01 to 30 W*2
Error Limits	±4.5% of reading	±6.5% of reading	±5.5% of reading	–	±5.5% of reading	±6.0% or reading (≤20 W), ±7.0% of reading (20 to 30 W)
100 to 1000 MHz	–	–	–	±6.5% of reading	–	–
75 to 100 MHz	–	–	–	–11 to +5.5% of reading	–	–
70 to 75 MHz	–	–	–	–15 to +5.5% of reading	–	–
SWR	<1.07	<1.07	<1.07	–	<1.1	<1.15
<500 MHz	–	–	–	<1.07	–	–
≥500 MHz	–	–	–	<1.1	–	–
Directivity	>30 dB	>30 dB	>30 dB	–	>26 dB	>26 dB
<500 MHz	–	–	–	>30 dB	–	–
≥500 MHz	–	–	–	>26 dB	–	–
Insertion Loss	<0.2 dB	<0.1 dB	<0.2 dB	<0.3 dB	<0.3 dB	<0.3 dB

**1 Useful frequency range for CW signals: 100 to 1000 MHz for NAS-Z6, 850 to 2000 MHz for NAS-Z7 (with higher error limits).*

**2 Up to 100 W with higher error limits.*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

NAS
Directional Power Meter.
Includes: Instruction Manual.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES

See Power Sensors, Probes, and RF Insertion Units table, pages 293.

Connecting Cable – 1.5 m for detached operation of Insertion Units. Order NAS-Z9.

Carrying Bag – Order NAS-Z10.

10 W Termination – Order NAZ10.

30 W Termination – Order NAZ30.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

RF Meters
NRVD

Features

NRVD

- DC to 26.5 GHz Frequency Range
- Two Independent Channels for Simultaneous Measurement
- Power, Level, and Voltage Measurements
- LCD Display with Variable Backlighting, Separate Digital Readout for Each Channel, Bar Graph Indicator
- Intelligent Measuring Heads – Just Plug Them in and Measure
- Autoranging
- Entry of Reference Values for Level and Attenuation
- Menu-guided Operation via Softkeys
- Storage of 20 Complete Instrument Setups
- Rear Connectors for Rack Mounting
- Built-in Test Generator for Checking Sensors
- Remote Control of All Functions via IEC/IEEE Bus

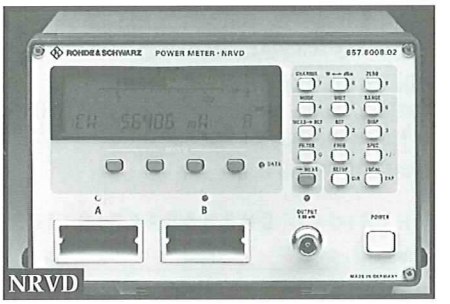
Applications

- Laboratory Test
- Production Test
- R & D

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987 with SCPI conformance.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



NRVD Dual-channel Power Meter

The NRVD Dual-channel Power Meter functions like two independent measuring instruments housed in one cabinet to perform measurements simultaneously and exchange data with one another. The two channels can be separately set so that two completely different measurements can be carried out at the same time. The two measured values can also be related to each other for direct indication of reflection coefficient, SWR and return loss, for instance, when an SWR bridge is connected to the meter.

READOUT OF RESULTS
Measurement results are displayed with selectable resolution on a large 5-digit LCD display with adjustable backlighting. The values measured in the two channels, or one measured value plus an additional item of information (e.g., the correction frequency) are displayed simultaneously.

All standard units of measurement or relative modes can be selected. Relative measurements are either referred to a stored reference value or to the value measured in the second channel. A high-resolution bar graph indicator with selectable scaling or autoscaling permits quasi-analog display of measured values with any unit or resolution.

If pulse-modulated signals are measured, the NRVD calculates the pulse peak power from the measured average value and the entered pulse duty factor, the result is directly displayed. In addition, the modulation depth of an amplitude-modulated signal can be determined from the power variation. After entering the SWR of the source, the measured value, together with its uncertainty, can be displayed.

MEASUREMENT RATE
The attainable measurement rate depends upon the type of measuring head used, as well as on the setting of the averaging filter, which must be matched to the measurement conditions. Taking into account the connected measuring head, the NRVD automatically selects the appropriate measurement rate by determining the optimum averaging time required for a steady readout as a function of level and selected resolution. This automatic selection may be disabled, and an averaging time of between 4 ms and 25 s may be set manually to measure more quickly than in automatic operation or to further reduce the noise.

POWER SENSORS
The range of probes and sensors includes thermocouple power sensors, as well as highly sensitive diode power sensors, probes, and insertion units. This allows the NRVD to cover a frequency range from DC to 26.5 GHz and a power span from 400 pW up to the kW range.

TEST GENERATOR
A test generator is included to check measuring heads and sensors for proper functioning. It generates a low-distortion, highly accurate 50-MHz signal of 1 mW power (0 dBm).

INPUT/OUTPUT WITH OPTION 01
Option 01 provides a number of inputs and outputs to extend the range of the NRVD.

Characteristics

Measurement Functions – Unmodulated and modulated power (average power, AM, pulse power), reflection, and DC voltage (depending upon measuring head).

Frequency Range – DC to 26.5 GHz (depending upon measuring head).

Level Range – 400 pW to 0.5 W (depending upon measuring head).

Measuring Heads – All NRV-Z and URV 5-Z voltage and power measuring heads.

Display – LCD with adjustable backlighting for figures, units, user prompting, and analog display.

Readout –
Absolute: W, dBm, V, dBV, dBµV.
Relative: dB, difference, %, ratio, referred to a stored reference value or to the second measurement channel; SWR, reflection coefficient, return loss in dB, modulation depth with AM; single-channel display; numeric readout of one channel and display of correction frequency or measurement error (not with all measuring heads) or dual-channel display, single-channel display, automatic, or with selectable scale.

RF Meters
NRVD

Resolution of Digital Display – 5 digits maximum, resolution adjustable in 3 modes.
HIGH: 12,000 steps or 0.001 dB.
MEDIUM: 1,200 steps or 0.01 dB.
LOW: 120 steps or 0.1 dB.

Display Filtering – Averaging over 1 to 512 readings for reducing the display noise; manual or automatic setting depending upon measurement range and resolution (see Table 1).

Display Noise – See measuring head specifications.

Measurement Rate – See Table 2.

Error Limits of Power Readout in W (without error of measuring head) –
18 to 28°C: 0.3% + 1 digit.
10 to 40°C: 0.8% + 1 digit.
0 to 50°C: 1.3% + 1 digit.

Zero Adjustment – Manual or via IEC/IEEE bus, duration approximately 4 s.

Frequency Response Correction – Stored frequency response of measuring head taken into account by numerical entry of test frequency (manually or via IEC/IEEE bus) or by applying a frequency-proportional DC voltage.

Attenuation Compensation – Attenuation or gain connected to input taken into account; entry of attenuation value (±200 dB) via keyboard or IEC/IEEE bus.

Reference Value – One reference value per channel for relative measurements; numeric entry via keyboard or IEC/IEEE bus, or use stored measured value or current value of second channel.

Reference Impedance – For conversion between voltage and power, automatic readout of reference impedance from data stored in the measuring head or numeric entry via keyboard or IEC/IEEE bus (for RF probe).

Remote Control – Control of all instrument functions via IEC 625/IEEE 488 interface. Interface functions: SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, PP0, PPI.

TABLE 1 – Automatic filter setting depending upon measurement rate.

Resolution	Filter Number						
HIGH 0.001 dB	11	9	7	7	7	7	7
MEDIUM 0.01 dB	9	7	3	3	3	3	3
LOW 0.1 dB	7	3	0	0	0	0	0
Sensors							
NRV-Z1, -Z3, -Z5, -Z6, -Z7	10 nW	100 nW	1 µW	10 µW	100 µW	1 mW	20 mW
NRV-Z2, -Z5, -Z8	1 µW	10 µW	100 µW	1 mW	10 mW	100 mW	500 mW
NRV-Z51, -Z52	10 µW	100 µW	1 mW	10 mW	100 mW	–	–
URV 5-Z2, -Z7	–	1 mV	10 mV	100 mV	1 V	10 V	–
URV 5-Z4	–	10 mV	100 mV	1 V	10 V	100 V	–

TABLE 2 – Measurement time in seconds (from trigger to output of first byte) depending upon filter setting.

Filter Number	0	1	2	3	4	5	6	7	8	9	10	11	12
NRV-Z1 to -Z8	0.045	0.05	0.06	0.08	0.15	0.27	0.49	0.95	1.85	3.6	7.2	14.5	28.5
NRV-Z51 to -Z52	0.115	0.12	0.13	0.15	0.21	0.32	0.52	0.92	1.75	3.4	6.6	13	26
URV 5-Z2, -Z4, -Z7	0.065	0.07	0.08	0.10	0.20	0.38	0.72	1.45	2.8	5.5	11	22	44

Test Generator –
Output power: 1.00 mW.
Frequency: 50 MHz.
Power measurement error: ≤0.7%.
SWR: ≤1.03.
RF connector: N female.

DC Control Input for Frequency Response Correction –
Connector: BNC female.
Input level: ±12 V, linear with selectable scale.
Input impedance: 9 MΩ.
Maximum input voltage: 50 V.

I/O with Option 01 –
Output: Two analog outputs for simultaneous output of measurement results of both channels.
Output impedance: 1 kΩ.
Voltage range: 0 to 3 V.
Resolution: 1 mV.
Error: ≤5 mV.

Input: DC input for analog frequency response correction.
Voltage range: ±12 V.
Input impedance: 1 MΩ.
Trigger input: TTL, active low.
Ready output: TTL, active high.

POWER REQUIREMENTS

Line Voltage – 110/120 V ±10%; 220 V ±10%, 230 V –6/+15%.

Line Frequency – 47 to 63 Hz.

Power Consumption – 25 VA.

ENVIRONMENTAL CHARACTERISTICS

Temperature Range –
Operating: 0 to +50°C, to IEC 359, Class I.
Storage: –40 to +70°C.

RFI Suppression – DBP approval number to regulations 527/1979, VDE 0871.

EMC – IEC 801-3, severity level 3; MIL-STD-461-B; RS 03 and CS 02.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	147	5.8
Width	219	8.6
Depth	350	13.8
Weight	**kg**	**lb.**
Net	4.5	9.9

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

NRVD
Dual-channel Power Meter.
Includes: Power Cable, Manual.

Opt. 01/NRVD-B2 – I/O Option.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES

Also see page 434.

See Probes and Sensors, page 293.

Rack Adapter – Order ZZA-98.

Accessory Bag – Order ZZT-92.

Carrying Straps – Order ZZT-96.

Transit Case – Order ZZK-983.

Service Kit – Order NRVD-S1.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

RF Meters
NRVS

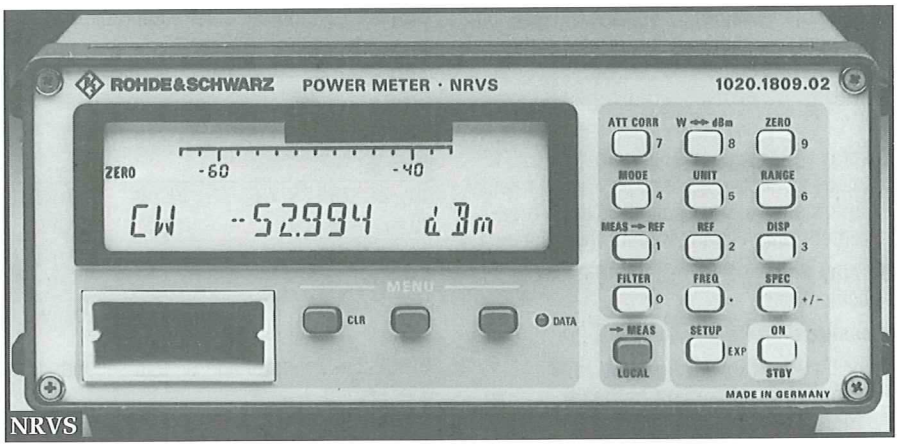
Features

NRVS

- DC to 26.5 GHz Frequency Range
- Power, Level, and Voltage Measurements
- Intelligent Measuring Heads – Just Plug Them in and Measure
- DC Frequency Input for Tracking Frequency-response Correction
- Analog Output
- Menu-guided Operation with Softkeys
- Storage of 20 Complete Instrument Setups
- 13 Digital Filters for Noise Suppression, Automatic or Manual Filter Selection
- Remote Control of All Functions via IEC/IEEE Bus

Applications

- Laboratory
- Production



NRVS

NRVS Power Meter

The NRVS Power Meter is the ideal instrument for any kind of power measurement in laboratory and system applications. Intelligent probes with calibration data memory and thermocouple sensors make user adjustments unnecessary. The NRVS provides high-precision measurements free of operator errors.

READOUT OF RESULTS
Measurement results, units, and various items of information are displayed on a large 4 1/2-digit LCD display in three steps of resolution. All standard units of measurement or relative modes can be selected. A high resolution bargraph indicator with selectable scaling or auto-scaling permits quasi-analog display of measured values with any unit of resolution.

If pulse-modulated signals are measured, the NRVS calculates the pulse peak power from the measured average value and the entered pulse duty factor; the result is directly displayed.

MEASUREMENT RATE
The attainable measurement rate depends upon the type of measuring head used as well as the setting of the averaging filter, which must be matched to the measurement conditions. Taking into account the connected measuring head, the NRVS automatically selects the appropriate measurement rate by determining the optimum averaging time required for a steady readout as a function of level and selected resolution. This automatic selection may be disabled and an averaging time of between 4 ms and 25 s set manually to measure more quickly than in automatic operation or to further reduce the noise.

POWER SENSORS
The range of probes and sensors includes thermocouple power sensors, as well as highly sensitive diode power sensors, probes, and insertion units. This allows the NRVS to cover a frequency range from DC to 26.5 GHz and a power span from 400 pW up to the kW range.

Characteristics

Measurement Functions – Average power, pulse power, DC voltage (depending upon measuring head).

Frequency Range – DC to 26.5 GHz (depending upon measuring head).

Level Range – 400 pW to 0.5 W (depending upon measuring head).

Measuring Heads – All NRV-Z and URV 5-Z voltage and power measuring heads.

Display – LCD for figures, units, user prompting, and analog display.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987.*

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

RF Meters
NRVS

Readout –
Absolute: W, dBm, V, dBµV.
Relative: dB, %W, or %V referred to a stored reference value, numeric readout with or without display of correction frequency.

Analog Display – Automatic or with selectable scale.

Resolution of Digital Display – 4 1/2 digits maximum, resolution adjustable in 3 modes.
HIGH: 12,000 steps or 0.001 dB.
MEDIUM: 1,200 steps or 0.01 dB.
LOW: 120 steps or 0.1 dB.

Averaging Filter – Over 1 to 512 readings for reducing the display noise; manual or automatic setting depending upon measurement range and resolution (see Table 1).

Display Noise – See measuring head specifications.

Measurement Rate – See Table 2.

Error Limits of Power Readout in W (without error of measuring head) –
18 to 28°C: 0.4% + 1 digit.
10 to 40°C: 0.9% + 1 digit.
0 to 50°C: 1.4% + 1 digit.

Zero Adjustment – Manual or via IEC/IEEE bus, duration approximately 4 s.

Frequency Response Correction – Stored frequency response of measuring head taken into account by numerical entry of test frequency (manually or via IEC/IEEE bus) or by applying a frequency-proportional DC voltage.

Attenuation Compensation – Attenuation or gain connected to input taken into account; entry of attenuation value (±200 dB) via keyboard or IEC/IEEE bus.

Reference Value – Numeric entry via keyboard or IEC/IEEE bus, or use stored measured value.

Reference Impedance – For conversion between voltage and power, automatic readout of reference impedance from data stored in the measuring head or numeric entry via keyboard or IEC/IEEE bus (for RF probe).

TABLE 1 – Automatic filter setting, depending upon measurement rate.

Resolution	Filter Number						
HIGH 0.001 dB	11	9	7	7	7	7	7
MEDIUM 0.01 dB	9	8	3	3	3	3	3
LOW 0.1 dB	7	3	0	0	0	0	0
Sensors							
NRV-Z1, -Z3, -Z4, -Z6, -Z7	10 nW	100 nW	1 µW	10 µW	100 µW	1 mW	20 mW
NRV-Z2, -Z5, -Z8	1 µW	10 µW	100 µW	1 mW	10 mW	100 mW	500 mW
NRV-Z51, -Z52	10 µW	100 µW	1 mW	10 mW	100 mW	–	–
URV 5-Z2, -Z7	–	1 mV	10 mV	100 mV	1 V	10 V	–
URV 5-Z4	–	10 mV	100 mV	1 V	10 V	100 V	–

TABLE 2 – Measurement time in seconds (from trigger to output of first byte), depending upon filter setting.

Filter Number	0	1	2	3	4	5	6	7	8	9	10	11	12
NRV-Z1 to -Z8	0.045	0.05	0.06	0.08	0.15	0.27	0.49	0.95	1.85	3.6	7.2	14.5	28.5
NRV-Z51 to -Z52	0.115	0.12	0.13	0.15	0.21	0.32	0.52	0.92	1.75	3.4	6.6	13	26
URV 5-Z2, -Z4, -Z7	0.065	0.07	0.08	0.10	0.20	0.38	0.72	1.45	2.8	5.5	11	22	44

Remote Control – Control of all instrument functions via IEC 625/IEEE 488 interface.
Interface functions: SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, PP0.

DC Control Input for Frequency Response Correction –
Connector: BNC female.
Input level: ±12 V, linear with selectable scale.
Input impedance: 9 MΩ.
Maximum input Voltage: 50 V.

DC Output –
Connector: BNC female.
Source impedance: 1 kΩ.
Output voltage (EMF): Proportional to deflection of analog display.
Full scale value: Left 0 V, right +3 V.
Additional settling time: 250 ms.

POWER REQUIREMENTS

Line Voltage – 115 V +15/–22%; 230 V +15/–22%.

Line Frequency – 47 to 63 (440) Hz.

Power Consumption – 13 VA.

Safety – Class I to VDE 0411 and IEC 348, transformer with thermal overload protection.

ENVIRONMENTAL CHARACTERISTICS

Temperature Range –
Operating: 0 to +50°C, for use in Class I to IEC 359.
Storage: –40 to +70°C.

Humidity – To 80% (without dewing).

Mechanical Stability – IEC 359, Class I.

RFI Suppression – DBP approval number to regulations 527/1979, VDE 0871.

EMC – IEC 801-3, severity level 3; MIL-STD-461-B; RS 03 and CS 02.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	103	4.1
Width	219	8.6
Depth	350	13.8
Weight	**kg**	**lb.**
Net	3.2	7.1

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

NRVS
Power Meter.
Includes: Power Cord, Manual.

RECOMMENDED ACCESSORIES
Also see page 434.
See Probes, Sensors, and Insertion Units, page 291.
Rack Adapter – Order ZZA-97.
Accessory Bag – Order ZZT-92.
Carrying Straps – Order ZZT-96.
Transit Case – Order ZZK-973.
Service Kit – Order NRVS-1.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

RF Meters

URE 2 • URE 3

Features

URE 2/URE 3

- True RMS Weighting for AC and AC + DC
- More Than 30 Measurements/Second
- Digital and Scalable Analog Displays
- Very High Measurement Accuracy
- Highpass and Lowpass Filters
- Relative Measurements, Maxima/Minima
- Convenient Menu-guided Operation
- Probe Division Factor Taken into Account in Displayed Result

URE 3 ONLY

- Peak-value Measurement Without Tilt and Overshoot
- Fast RMS Measurement Even for Very Low-frequency Signals
- Frequency Measurements to 30 MHz
- Automatic Frequency Response Error Correction
- In/Out Option with Dual-channel Analog Output, Ready Output, Trigger Input, TTL Frequency-counter Input

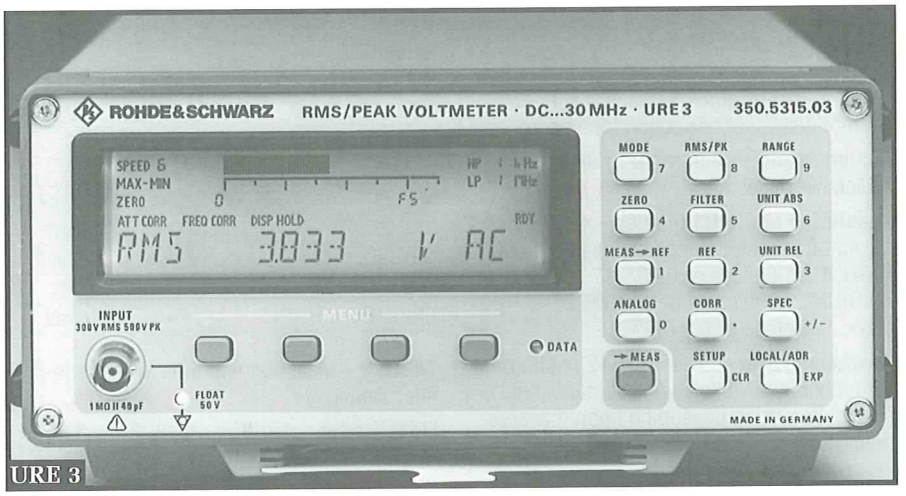
Applications

- Level Measurements in Audio Range
- Interference Measurements on Switch-mode Power Supplies
- Measurement of Extremely Fast Dialing Signals and Detection of Simultaneously Transmitted Supply Voltages in Radiotelephony
- Automatic Quality Control of Audio and Videotapes
- High-frequency Measurements in Digital Magnetic Storage and Optical Data Storage
- Peak Weighting in Video Measurements (Sync Signals)
- Secondary Calibration Standard

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



URE 3

URE 2/URE 3 RMS Voltmeter

The URE 2 RMS Voltmeter is a broadband RMS voltmeter unrivaled for accuracy and speed. A patented rectifier circuit allows signals with a crest factor up to 7 and bandwidth of 25 MHz to be measured.

The URE 3 RMS/Peak Voltmeter further enhances the range of applications due to its greater bandwidth, built-in frequency counter, additional peak-responding rectifier, and extremely high accuracy.

ACCURATE MEASUREMENTS

The patented rectifier circuit with microprocessor-controlled autocalibration provides unparalleled measurement capability. In order to further enhance accuracy, correction factors for each measurement range are determined during initial test of each instrument and stored in non-volatile memory.

A zero function allows spurious voltages and inherent noise to be compensated for, thus increasing the measurement accuracy, particularly at low levels.

The measured frequency value is used by the URE 3 for an internal frequency-response error correction. This method increases the accuracy, mainly at higher frequencies. Measurement of signals without distortion is ensured by:

- High input impedance
- Low input capacitance
- Highpass and lowpass filters that can be switched in to suppress hum or high-frequency spurious voltages

MEASUREMENT SPEED

Measurement speed is an important criterion for a voltmeter's usability in system applications. With more than 30 measurements/second in the fastest mode, the URE satisfies even the most exacting requirements.

DISPLAY OF RESULTS

The measured value is read out in 4 1/2 digits (URE 3, 5 digits for frequency measurements) with unit additional information on a large LCD. Readout in V, W, dBV, dBµV, dBu or dBm can be referenced to any impedance value.

Relative display is possible in dB or % as a ratio of measured value, or as a difference. Reference values can be entered or measured values can be used as reference values. Minimum and maximum values, as well as tolerance limits, can be determined automatically.

A high-resolution bar graph indicator is provided on the display for quick informative measurements and precise adjustments. The selectable scale is set automatically. It can also be adjusted manually.

RF Meters
URE 2 • URE 3

Characteristics

Measurement Functions –
URE 2: DC, AC, AC + DC voltages.
URE 3: RMS value, peak value, DC voltage, frequency.

Frequency Range –
URE 2: DC, 10 Hz to 25 MHz.
URE 3: DC, 20 MHz to 30 MHz; PEAK, 20 MHz to 10 MHz.

Voltage Measurement Range –
DC: 0 to ±300 V.
AC, AC + DC: 50 µV to 300 V.

Range Selection – AUTO, HOLD, FIX.

Input –
Connector – URE 2: BNC female, floating.
URE 3: BNC female, either floating or grounded, switch-selectable.
Input impedance: 1 MΩ, 40 pF.
Maximum input voltage: 300 V_{RMS}, 500 V_{pk} (1 x 10^8 V x Hz maximum).

Display –
URE 2: LCD, 4 1/2-digit readout, digital and analog in V, W, dBV, dBm, dBµV, or dBu; difference, deviation in % or dB, and ratio to a reference value.

URE 3: Illuminated LCD, 4 1/2-digit level display, 5-digit frequency display, digital and analog in V, W, dBV, dBm, dBµV, dBu, or Hz; difference, deviation in % or dB, and ratio to a reference value.

I/O Option (Option 01, URE 3 only) –
Two simultaneous analog outputs (level and frequency).
Voltage range: 0 to 3 V (EMF, Z_{out} = 1 kΩ, resolution 1 mV, error ≤3 mV).
Frequency input: TTL, 0.1 Hz to 30 MHz.
Trigger input: TTL, active low.
Ready output: TTL, active high.

Remote Control – Functions to IEC-625-2/IEEE 488.

AC VOLTAGE MEASUREMENT (URE 2 ONLY)
Voltage Measurement Range –
50 µV to 300 V.

Ranges and Resolution – 1 mV to 300 V, 10 dB steps.
Maximum reading: 3,800 or 12,000 counts.
Maximum resolution: 1 µV.

Selectable Lowpass Filters – 20 kHz, 100 kHz Butterworth (3 dB cutoff frequency, 40 dB/decade).

Selectable Highpass Filters – 10 Hz, 100 Hz, 1 kHz (lower measurement limit, AC component in AC + DC).

Measurement Speed and Lower Frequency Limit –

Measurement Speed	Time of Triggered Measurement	Readout Rate	Minimum Test Frequency
Speed 4	1.3 s	10/s	10 Hz
Speed 5	250 ms	10/s	100 Hz
Speed 6	32 ms	20/s	1 kHz

Maximum Crest Factor (S) – Seven for nominal range.

Weighting Error (for spectral components up to 25 MHz) –
Crest factor <3: Included in basic error.
Crest factor <5: 1%.
Crest factor <7: 3%.

Temperature Effect –

% of reading/°C	Frequency	Frequency for Vin <3 mV
≤0.1	<10 MHz	<10 MHz
≤0.15	<20 MHz	<12 MHz
≤0.3	<25 MHz	<15 MHz
≤0.8	–	<20 MHz

RMS MEASUREMENT (URE 3 ONLY)
Voltage Measurement Range –
50 µV to 300 V.

Ranges – 1 mV to 300 V, 10 dB steps.
Maximum reading: 3,800 to 12,000 counts.
Maximum resolution: 1 µV.

Frequency Range –
AC coupling: 0.02 Hz to 30 MHz.
AC + DC: DC to 30 MHz.

Selectable Lowpass Filters – 20 kHz, 100 kHz Butterworth (3 dB cutoff frequency, 40 dB/decade), 1 MHz Bessel.

Selectable Highpass Filters – 10 Hz, 100 Hz, 1 kHz (lower measurement limit, AC component in AC + DC).

Measurement Speed and Lower Frequency Limit (AC component in AC + DC) –
Speed 0, 1: Selectable time 10 ms to 60 s.
Speed 2, 3: Fixed time 10 s, 1 s.
Speed 1, 2, and 3: Automatic synchronization to whole number of signal periods; due to synchronization, measurement takes 2 or 3 times the time selected.

Measurement Speed	Time of Triggered Measurement	Readout Rate	Minimum Test Frequency
Speed 4	1.3 s	10/s	10 Hz
Speed 5	250 ms	10/s	100 Hz
Speed 6	32 ms	20/s	1 kHz

Maximum Crest Factor –
Seven for nominal range.

Weighting Error (for spectral components up to 30 MHz) –
Crest Factor <3: Included in basic error.
Crest Factor <5: 1%.
Crest Factor <7: 3%.

Temperature Effect –

% of reading/°C	Frequency	Frequency for Vin <3 mV
≤0.1	<10 MHz	<10 MHz
≤0.15	<20 MHz	<12 MHz
≤0.3	<25 MHz	<15 MHz
≤0.8	<30 MHz	<20 MHz

RF Meters
URE 2 • URE 3

PEAK MEASUREMENT (URE 3 ONLY)
Voltage Measurement Range – 0.1 mV to 500 V.

Ranges – 3 mV to 1000 V, 10 dB steps. Maximum reading: 1,200 to 3,800 counts. Maximum resolution: 1 µV.

Frequency Range –
AC coupling: 10 Hz to 10 MHz.
AC + DC: DC to 10 MHz.

Selectable Lowpass Filters – 20 kHz, 100 kHz Butterworth (3 dB cutoff frequency, 40 dB/decade), 1 MHz Bessel.

Selectable Highpass Filters – 10 Hz, 100 Hz, 1 kHz (lower measurement limit, AC component in AC + DC).

Measurement Speed and Lower Frequency Limit for AC Coupling –

Measurement Speed	Time of Triggered Measurement	Readout Rate	Minimum Test Frequency
Speed 1 to 3	Depends on measurement time		10 Hz
Speed 4	1.3 s	5/s	10 Hz
Speed 5	315 ms	10/s	100 Hz
Speed 6	65 ms	20/s	1 kHz

Measurement Speed and Lower Frequency Limit for DC Coupling –

Measurement Speed	Time of Triggered Measurement	Readout Rate	Minimum Test Frequency
Speed 1 to 3	Depends on measurement time*1		0.02 Hz
Speed 4	215 ms	5/s	10 Hz
Speed 5	95 ms	10/s	100 Hz
Speed 6	65 ms	20/s	1 kHz

*1 *Measurement time for speed 1 to 3 similar to RMS, but without synchronization.*

Temperature Effect – 0.1% of reading/°C.

FREQUENCY MEASUREMENT (URE 3 ONLY)
Frequency Range – 0.02 Hz to 30 MHz.

Display – 5 digits, maximum resolution 0.1 MHz.

Measurement Speed and Lower Frequency Limit –

Measurement Speed	Time of Triggered Measurement with feeding on		Readout Rate	Minimum Test Frequency
	Front	Rear		
Speed 1 to 3	Depends on measurement time			0.02 Hz
Speed 4	2.4 s	1.4 s	2/s	10 Hz
Speed 5	430 ms	330 ms	5/s	100 Hz
Speed 6	80 ms	75 ms	30/s	1 kHz

Error Limits – ±(0.005% + 1 digit) plus 100 µs/0.75 x measurement time for RMS measurement, f <10 Hz (HP off).

Sensitivity – >10 dB below nominal range.

DC VOLTAGE MEASUREMENT
Voltage Measurement Range – 0 to ±300 V.

Ranges – 10 mV to 1000 V, 20 dB steps. Maximum reading: 12,000 counts. Maximum resolution: 1 µV.

Measurement Speed and Lower Frequency Limit –

Measurement Speed	Time of Triggered Measurement	Readout Rate
Speed 4	1.3 s	10/s
Speed 5	250 ms	10/s
Speed 6	32 ms	20/s

Error Limits – ±(0.1% of reading + 10 counts).

Temperature Effect – <(0.01% of reading + 1 count)/°C.

POWER REQUIREMENTS
Line Voltage – 100/120/220/240 V ±10%.

Line Frequency – 47 to 440 Hz.

Power Consumption – 25 VA.

Safety – Class I to VDE 0411 and IEC 348.

ENVIRONMENTAL CHARACTERISTICS
Temperature Range –
Operating: 0 to +50°C, for use in Class I to IEC 359.
Storage: –40 to +70°C.

Humidity – 20 to 80% (no dewing).

Mechanical Resistance – To IEC 359 Class I.

RFI Suppression – DBP approval number to regulations 1046/1984.

EMC – To VDE 0843 part 1 to 4, IEC 801 part 1 to severity 4, NAMUR recommendations part 1.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	103	4.1
Width	219	8.6
Depth	350	13.8
Weight	**kg**	**lb.**
Net	4.5	9.9

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

URE 2
RMS Voltmeter.

URE 3
RMS/Peak Voltmeter.
Includes: Power Cord, Manual.
Opt. 01/URE 3-B2 (URE 3 only) – In/Out Option.

RECOMMENDED ACCESSORIES
Also see page 434.
See Probes, Sensors, and Insertion Units, page 293.
Carrying Strap Set – Order ZZT-96.
Transport Case – Order ZZK-973.
19 in. Rack Adapter – Order ZZA-97.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987.*

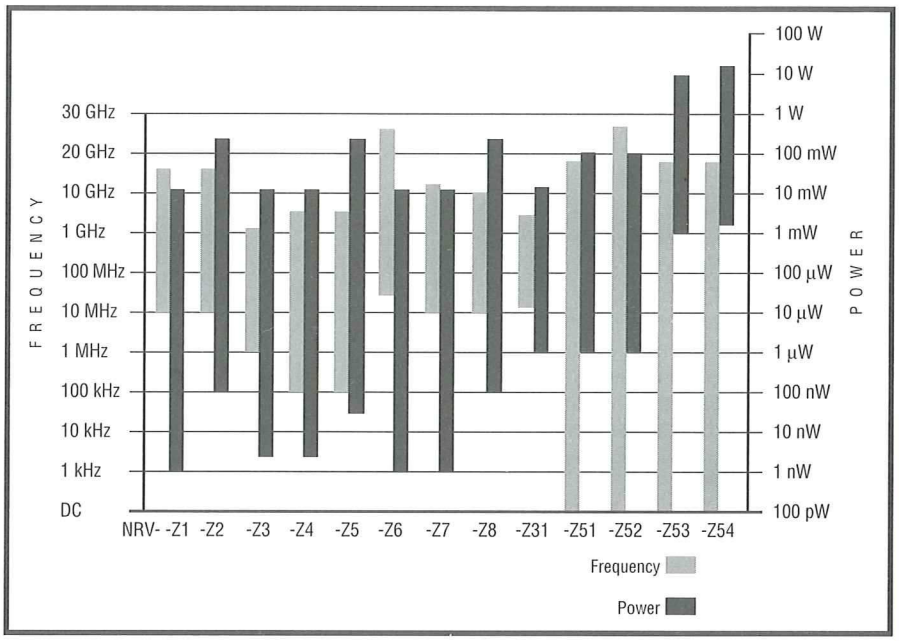
ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

RF Meters

Power Sensors • Probes • RF Insertion Units

Features

- Thermocouple Sensors
- Diode Sensors
- Diode Sensors with an Integral 20-dB Attenuator
- Peak Power Sensors
- RF Probes
- RF Insertion Units



Voltage probes for URV/NRV family.

A Full Range of Probes, Insertion Units, and Power Sensors

These probes, insertion units, and power sensors extend the measurement range and offer added measurement capability.

THE RIGHT SENSOR FOR EVERY APPLICATION

Power sensors absorb the power applied and provide an equivalent DC voltage at their output. To cover the complete power range from less than 1 nW to more than 100 mW, two different types of power sensors are required: thermocouple sensors based on the Seebeck effect, and semiconductor detectors using zero-bias Schottky diodes. Both types of transducers are available for the entire frequency spectrum.

THERMOCOUPLE SENSORS

Thermocouple sensors open up a wide power range from 1 µW to 100 mW. Regardless of the waveform, they always indicate the RMS power over the full range, giving precise results, even for modulated or complex signals.

DIODE SENSORS

Diode sensors feature a higher sensitivity. They are able to measure power to as low as 100 pW. Since they measure true RMS power down to 10 µW, they can even be used for signals with harmonic contents, noisy, or modulated signals.

DIODE SENSORS WITH AN INTEGRAL 20-DB ATTENUATOR

Diode sensors with an integral 20-dB attenuator fill the gap between pure diode sensors and thermocouples. They provide true RMS measurements in a range up to 1 mW and satisfy the most exacting requirements on measurement speed, even for levels between ten and 100 µW, where the use of thermocouple sensors is limited.

PEAK POWER SENSORS

Peak power sensors contain rectifiers for measuring the peak modulation. They enable direct measurement of the TV sync pulse peak power, the power of TDMA signals, as well as of other pulsed signals with a pulse width from 2 µs. In the frequency range from 1 µW to 20 mW, these sensors are a value-for-money alternative to special peak power meters.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ

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RF Meters

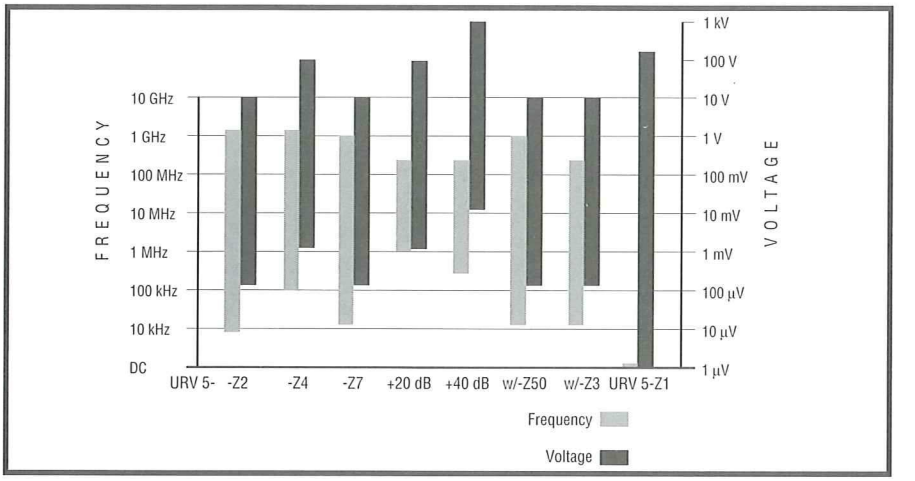
Power Sensors • Probes • RF Insertion Units

RF PROBES

RF probes are indispensable for measurements on non-coaxial circuits and components. Small input capacitance and low loss enable low-load measurements directly in the circuit. Dividers increase the voltage measurement range and minimize the loading of the device under test.

RF INSERTION UNITS

RF insertion units are used for voltage measurements in coaxial circuits. They incorporate a diode inserted in the inner conductor or connected via a piston attenuator and permit broadband measurements to be made up to 2 GHz with low reflection coefficient. Given matched conditions, these insertion units can also be used for practically no-loss measurements of RF power.



Power Sensors for the URV/NRV family.

MEASURING HEADS

Probes

URV 5-Z1	DC Probe 0 to 400 V, 9 MΩ, 3 pF	For low-capacitance DC voltage measurements in RF circuits at minimum load
URV 5-Z702, 4 ft. cable URV 5-Z703, 16 ft. cable	RF Probe 200 µV to 10 V, 20 kHz to 1 GHz	For measurements in open RF circuits at low capacitance and resistive load
URV-Z6 with 20 dB plug-on divider*[1] URV-Z6 with 40 dB plug-on divider*[1]	2 mV to 100 V, 1 to 500 MHz 20 mV to 1000 V, 500 kHz to 500 MHz	The 20 dB and 40 dB plug-on dividers increase the voltage measuring range of the RF probe; the high Q factor of the capacitive divider makes the resistive loading negligible, the capacitive loading goes down to 0.5 pF (40 dB divider)
URV-Z50 with 50 Ω Adapter	200 µV to 10 V, 20 kHz to 1 GHz	With integrated termination for power or level measurements on test items, with a source impedance of 50 Ω in the frequency range up to 1 GHz (BNC female/male)
URV-Z3 with 75 Ω Adapter	200 µV to 10 V, 20 kHz to 500 MHz	With integrated termination for power or level measurements in 75 Ω systems, such as antenna or video assemblies (BNC male)

[1] Included in accessory URV-Z6.

RF Insertion Units (unless otherwise specified, all insertion units with N male/female; all power sensors with N male connectors)

URV 5-Z25, 4 ft. cable URV 5-Z26, 16 ft. cable	10 V Insertion Unit 50 Ω 200 µV to 10 V, 9 kHz to 2 GHz	Low-load RF voltage measurements in coaxial 50 Ω systems, low-loss power measurements on well-matched RF lines
URV 5-Z44, 4 ft. cable URV 5-Z45, 16 ft. cable	100 V Insertion Unit 50 Ω 2 mV to 100 V, 100 kHz to 2 GHz	Virtually no-load RF voltage measurements in coaxial 50 Ω systems even at higher voltages. Due to minimum insertion loss and reflection coefficient, this unit causes practically no interference on a 50 Ω line.
URV 5-Z46, 4 ft. cable URV 5-Z47, 16 ft. cable	100 V Insertion Unit 75 Ω 2 mV to 100 V, 100 kHz to 2 GHz	RF voltage measurements in coaxial 75 Ω systems, same performance as Insertion Unit URV 5-Z4/50 Ω
NAS-Z1	120 W Insertion Unit, 1 to 30 MHz	
NAS-Z2	1200 W Insertion Unit, 1 to 30 MHz	
NAS-Z3	120 W Insertion Unit, 25 to 200 MHz	
NAS-Z5	120 W Insertion Unit, 70 to 1000 MHz	
NAS-Z6	120 W Insertion Unit, 890 to 960 MHz	
NAS-Z7	30 W Insertion Unit, 890 to 960 MHz, 1710 to 1880 MHz	For GSM, DCS 1800

RF Meters

Power Sensors • Probes • RF Insertion Units

Power Sensors

NRV-Z1 02, 4 ft. cable NRV-Z1 03, 16 ft. cable	Diode Power Sensor 50 Ω 10 MHz to 18 GHz, 1 nW to 20 mW	Power measurements of highest sensitivity up to 18 GHz in 50 Ω systems
NRV-Z2 02, 4 ft. cable NRV-Z2 03, 16 ft. cable	Diode Power Sensor 50 Ω 10 MHz to 18 GHz, 100 nW to 500 mW	Power measurements with minimum mismatch, for high powers in 50 Ω systems
NRV-Z3 02, 4 ft. cable NRV-Z3 03, 16 ft. cable	Diode Power Sensor 75 Ω 1 MHz to 2.5 GHz, 400 pW to 13 mW	Power measurements in 75 Ω systems
NRV-Z4 02, 4 ft. cable NRV-Z4 03, 16 ft. cable	Diode Power Sensor 50 Ω 100 kHz to 6 GHz, 500 pW to 20 mW	Power measurements of highest sensitivity in the frequency range 100 kHz to 6 GHz, very large dynamic range
NRV-Z5 02, 4 ft. cable NRV-Z5 03, 16 ft. cable	Diode Power Sensor 50 Ω 100 kHz to 6 GHz, 50 nW to 500 mW	Like NRV-Z4, but for high powers and minimum mismatch
NRV-Z6	Diode Power Sensor 50 Ω 50 MHz to 26.5 GHz, 1 nW to 20 mW	Power measurements up to 26.5 GHz with high sensitivity in 50 Ω systems (PC 3.5 male)
NRV-Z7	Diode Power Sensor 50 Ω 10 MHz to 13 GHz, 1 nW to 20 mW	Like NRV-Z1, but only up to 13 GHz
NRV-Z8	Diode Power Sensor 50 Ω 10 MHz to 13 GHz, 100 nW to 500 mW	Like NRV-Z2, but only up to 13 GHz
NRV-Z31	Peak Power Sensor 50 Ω 30 MHz to 6 GHz, 1 µW to 20 mW	Peak power measurements, pulse width ≥2 (200) µs, pulse repetition rate ≥10 (100) Hz, 3 models
NRV-Z51	Thermocouple Sensor 50 Ω DC to 18 GHz, 1 µW to 100 mW	High-precision power measurements also with non-sinusoidal signals
NRV-Z52	Thermocouple Sensor 50 Ω DC to 26.5 GHz, 1 µW to 100 mW	Like NRV-Z51, but with PC 3.5 connector for measurements up to 26.5 GHz
NRV-Z53	Thermocouple Sensor 50 Ω DC to 18 GHz, 100 µW to 10 W	High-power measurements up to 10 W also with non-sinusoidal signals
NRV-Z54	Thermocouple Sensor 50 Ω DC to 18 GHz, 300 µW to 30 W	High-power measurements up to 30 W also with non-sinusoidal signals

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

PROBES

DC Probe – Order URV 5-Z1.

RF Probe – Order URV 5-Z7.

RF Probe with 20 dB and 40 dB Plug-on Divider – Order URV-Z6.

RF Probe with 50 Ω Adapter – Order URV-Z50.

RF Probe with 75 Ω Adapter – Order URV-Z3.

RF INSERTION UNITS

10 V Insertion Unit, 50 Ω – Order URV 5-Z2.

100 V Insertion Unit, 50 Ω – Order URV 5-Z44.

100 V Insertion Unit, 75 Ω – Order URV 5-Z47.

120 W Insertion Unit, 1 to 30 MHz – Order NAS-Z1.

1200 W Insertion Unit, 1 to 30 MHz – Order NAS-Z2.

120 W Insertion Unit, 25 to 200 MHz – Order NAS-Z3.

120 W Insertion Unit, 70 to 1000 MHz – Order NAS-Z5.

120 W Insertion Unit, 890 to 960 MHz – Order NAS-Z6.

30 W Insertion Unit, 890 to 960 MHz, 1710 to 1880 MHz – Order NAS-Z7.

POWER SENSORS

Diode Power Sensor, 50 Ω – Order NRV-Z1.

Diode Power Sensor, 50 Ω – Order NRV-Z2.

Diode Power Sensor, 75 Ω – Order NRV-Z3.

Diode Power Sensor, 50 Ω – Order NRV-Z4.

Diode Power Sensor, 50 Ω – Order NRV-Z5.

Diode Power Sensor, 50 Ω – Order NRV-Z6.

Diode Power Sensor, 50 Ω – Order NRV-Z7.

Diode Power Sensor, 50 Ω – Order NRV-Z8.

Peak Power Sensor, 50 Ω – Order NRV-Z31.

Thermocouple Power Sensor, 50 Ω – Order NRV-Z51.

Thermocouple Power Sensor, 50 Ω – 1 µW to 100 mW, DC to 26.5 GHz. Order NRV-Z52.

Thermocouple Power Sensor, 50 Ω – Order NRV-Z53.

Thermocouple Power Sensor, 50 Ω – Order NRV-Z54.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ

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Telecommunications Products

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Tektronix Understands Your Needs

Until recently, telecommunications consisted largely of voice traffic traveling over dedicated and public lines at rates in megabits per second – satisfactory, but relatively slow compared to speeds possible today. Today, a range of technological changes has revolutionized the industry. Digital technology and gigabit transmission have expanded your service options – and your traffic load. And while telecommunications is an increasingly important strategic asset, most professionals in the industry are being asked to provide more service on tighter budgets.

Tektronix provides advanced test and measurement tools to network operators as well as designers and manufacturers of high-speed network transmission equipment.

If you're a network operator, Tektronix understands your need to reduce maintenance costs through lower cost equipment that's so easy to use it will lower your training and overall personnel costs, too. At the same time, the increasing amount of business-critical traffic on most networks means you need tools to help increase network uptime and integrity.

If you're a designer, manufacturer or evaluator of telecommunications equipment, Tektronix is aware of your need to boost your competitiveness, too. We're ready to help with equipment that can shorten your design cycle test times and contribute to efficient manufacturing test procedures.

The Customers We Serve

With over 40 years of leadership in test and measurement, Tektronix has unmatched expertise in telecommunications, video and high-speed networking that uniquely position us to meet your new, evolving requirements for test equipment. Our telecommunications products bring this expertise together to offer powerful, state-of-the-art technology and features to meet your budget and application needs.

For network operators, we provide innovative physical layer and transmission test equipment so you can install metallic, fiber and wireless networks with maximum efficiency, while reducing maintenance costs and improving network uptime. Our range of customers include local exchange telephone companies, independents and co-ops, interexchange carriers, cellular service providers, and local- and wide-area network providers.

If you're an equipment supplier, we can help too. Tektronix offers a line of products to help design, manufacture and test equipment for high-speed telecommunications transmission, data communications, opto-electronic components and sub-assemblies and microwave transmission. As standards proliferate, Tektronix is ready to help with equipment to test compliance with the growing range of specifications, including FDDI, SDH/SONET, fiber channel and HPPI.

Telecommunications Products

Products and Technologies

Tektronix offers a broad range of products that are grouped into eight categories:

- Optical time domain reflectometers (OTDRs) and optical fault finders measure and display the condition of fiber optic cable media. They locate faults over long distances and offer distance resolution down to the order of centimeters. These instruments are used in data communications networks, telephony networks, and cable television distribution system installation and maintenance.
- Metallic time domain reflectometers (TDRs) measure and display the condition of metallic cable media. They locate and characterize cable breaks and faults quickly and accurately. These testers are used in local area networks, as well as telephone networks and cable television networks.
- A handheld digital interface and protocol test set for Integrated Services Digital Network (ISDN)-compliant equipment is used by crafts-level telephony service personnel. The small, battery-powered unit is optimized for field use and is continually enhanced to meet customers' changing needs.
- SDH and SONET analyzers, either in a VXI configuration or as a standalone portable instrument, provide a broadband test platform that combines bit error rate testing, overhead testing and payload analysis.
- High-performance oscilloscopes acquire, display and measure repetitive telecommunications electrical and optical waveforms. They are optimized for eye pattern analysis and optical transmitter evaluation.
- Opto-electronic products include optical-to-electronic converters, optical attenuators, optical impulse generators and SDH/SONET optical reference receivers. These modular products are used with Tektronix high-performance oscilloscopes for a variety of complex fiber optic tests and measurements.
- Bit error rate testers provide digital stimulus generation and error response measurements up to 12 gigabits. They are used for design and evaluation of components and product sub-assemblies.
- Optical spectrum analyzers measure wavelength and spectral width of fiber optic sources. They are used to assure compliance of communications standards in the design of high-speed network transmission equipment.

Tektronix Support for Telecommunications

In addition to industry-leading products for telecommunications, Tektronix offers industry-leading support. Application guides and complete training support is available from the Tektronix worldwide sales and support organization. And all products are covered by our one- to three-year warranties. Any questions? Just contact your local Tektronix representative listed in the back of this catalog; inside the U.S. call 1-800-426-2200.

At Tektronix, we're committed to our telecommunications products customers. Whether you design, manufacture, install or maintain telecommunications equipment, we understand your needs and we'll always provide the best support tools available.

Fault Finder, Optical Sources, Power Meter

TOP130, TOP140, TOP150, TOP200, TOP300

Features

TOP130

- Dual Wavelength (850 nm and 1300 nm)
- Excellent Long Term Stability
- Selectable Output (CW or Modulated)
- Three Modulation Frequencies (270 Hz, 1 kHz, 2 kHz)
- >20 Hours Battery Life
- Universal (SOC) Interface

TOP140/TOP150

- Stabilized Calibrated Output
- Hermetically Sealed Laser Diode for Longevity
- Selectable Modulation Frequencies (270 Hz, 1 kHz, 2 kHz)
- Universal (UCI) Connector Interface
- >80 Hours Battery Life

TOP200

- Relative dB Mode for Direct Attenuation and Insertion Loss Measurement
- 0.01 dB Resolution
- Set Reference for Different Wavelengths
- Save References for Each Wavelength
- Universal (SOC) Interface
- >100 Hours Battery Life

TOP300

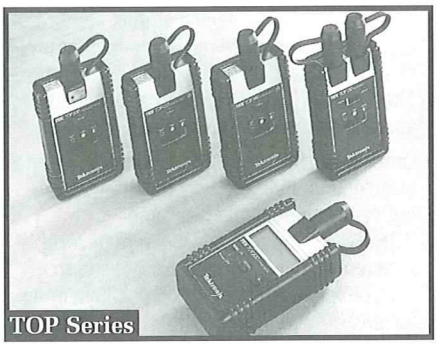
- High Brightness
- Universal (UCI) Connector Interface
- Fiber Tracing
- Fault Location to Millimeter Accuracy
- Long Battery Life
- Solid State Substitute for HeNe Laser

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.



TOP130 Optical LED Source

The Tektronix TOP130 Optical LED Source is a small, rugged LED source designed for use in installing, maintaining and researching telephony, datacom, CATV, FDDI and other fiber optic links.

The instrument provides two calibrated outputs: at 850 nm and 1300 nm. Providing both CW and modulated outputs, the user can set the modulation frequency to match the frequency signatures (270/1000/2000 Hz) required by fiber identifiers and signal tracers. The TOP130 comes standard with two removable ST universal (SOC) interface adapters.

TOP140/TOP150 Optical Laser Source

The TOP140 and TOP150 Optical Laser Source answer the request from the industry for small, rugged and truly versatile laser sources for use in installation, maintenance and testing of fiber optic systems. These two laser source models cover the most used single-mode transmission windows: 1310 nm and 1550 nm. The TOP140 and TOP150 feature both CW and modulated output modes. In CW mode these instruments feature extremely stabilized output power (–10 dBm). In the modulated mode the frequency may be set to 270 Hz, 1 kHz or 2 kHz by the user.

All laser sources feature the Universal Connector Interface which adapts to all standard fiber optic connectors via a complete line of simple, screw-on/screw-off UCI adapters.

TOP200 Optical Power Meter

The TOP200 handheld optical power meter covers the full range of optical fiber applications. This instrument is quality engineered for field and lab personnel requiring a high performance, cost effective, compact and rugged optical power meter.

The TOP200 utilizes the Snap-On Connector (SOC) interface. Most industry standard fiber optic connectors can be accommodated, including FC, ST and SC.

The extraordinary design combines a state-of-the-art signal processor and microcomputer electronics to provide superb performance as well as simple and elegant operation with just three controls: ON/OFF, dBm/dB and λ. A reference value can be set and also saved for each wavelength.

TOP300 Visual Fault Finder

The TOP300 Visual Fault Finder is specifically designed for field personnel who need an efficient and economical tool to visually check continuity and integrity of fiber installations, during and after installation. The highly efficient laser diode operates at short wavelengths which makes the emitted light even more visible to the human eye.

Difficult-to-locate fiber breaks are easily detected when using the TOP300 visual fault finder. Whenever the fiber is interrupted, the light escapes the fiber and becomes visible to the operator. Precise pinpointing of problems is immediate and intuitive to the user.

The optical connection is via the precision Universal Connector Interface (UCI) which offers superior repeatability, longevity, and ease of maintenance.

Characteristics

TOP130

Center Wavelength – 850 nm (830-870 nm), 1300 nm (1270-1330 nm).

Spectral Width (FWHM) – 850 nm: ≤55 nm. 1300 nm: ≤140 nm.

Stability (1hour) – ±0.05 dB.

Power Output (into 62.5/125GI MM fiber) – 850 nm: –13 dBm (50 µW). 1300 nm: –20 dBm (10 µW).

Power Output Uncertainty – ±1.0 dB (Calibrated launch level into 62.5/125 GI MM fiber).

Functions – Mod: Modulated output mode. CW: Continuous Wave DC output mode. FREQ: Frequency is user selectable to 270 Hz, 1 kHz or 2 kHz.

Connector Interface – Universal (SOC) Interface – ST adapter standard. See ordering information for other available SOC adapters.

Fault Finder, Optical Sources, Power Meter

TOP130, TOP140, TOP150, TOP200, TOP300

Power – Requires two AA alkaline batteries (>20 hours battery life).

Environmental –
Operating: –15°C to +55°C, 0-95% RH (non-condensing).
Storage: –35°C to +70°C, 0-95% RH (non-condensing).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	72	2.8
Height	142	5.6
Depth	36	1.4
Weight	**g**	**oz.**
Net	240	8.4

TOP140 AND TOP150

Center Wavelength –
TOP140: 1310 nm (1280-1340 nm).
TOP150: 1550 nm (1520-1570 nm).

Spectral Width RMS – <3 nm.

Stability*1 –
1 hour max. deviation: ±0.05 dB.
24 hours max. deviation: ±0.15 dB.

Power Output*1 (into SM-28/9 µm core) – –13 dBm (100 µW).

Power Output Uncertainty*2 – (Calibrated launch level into SM-28/9 µm core) ±0.5 dB.

Functions –
Mod: Modulated output mode.
CW: Continuous Wave DC output mode.
FREQ: Frequency is user selectable to 270 Hz, 1 kHz or 2 kHz.

Connector Interface – Universal (UCI) Connector Interface – FC adapter standard. See ordering information for other available UCI adapters.

Power – Requires two AA alkaline batteries (>80 hours battery life).

Environmental –
Operating: –15°C to +55°C, 0-95% RH (non-condensing).
Storage: –35°C to +70°C, 0-95% RH (non-condensing).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	72	2.8
Height	142	5.6
Depth	36	1.4
Weight	**g**	**oz.**
Net	230	8

**1 Within specified ambient temperature of +20°C to +25°C.*

**2 Specified with properly terminated FC-PC, ST, SC, DIN, HMS-10/HP (2.5 mm) connectors. Uncertainty for other connectors may be higher.*

TOP200

Sensor Type – InGaAs (1 mm).

Power Range – +3 to –60 dBm.

Cal Wavelengths – 850/1300/1550 nm.

Absolute Accuracy – ±0.25 dB at calibration conditions.

Display – Custom tri-plexed liquid crystal display with 4-digit data field (0.01 dB resolution) and simultaneous display of cal wavelength. Display incorporates the following distinct annunciators: 850, 1300, 1550, dB, dBm, B (low Bat) and C (CAL).

Functions –
dBm: absolute power.
dB: Relative power; Also used to save/recall reference values.
λ: select CAL wavelength; also used to set default/CAL wavelength.
CAL: Calibrate unit.

Calibration Data – Data stored in non-volatile memory.

Connector Interface – Universal (SOC) Interface – ST adapter standard.
See ordering information for other available SOC adapters.

Power – Requires two AA alkaline batteries (>100 hours battery life).

Environmental –
Operating: –15°C to +55°C, 0-95% RH (non-condensing).
Storage: –35°C to +70°C, 0-95% RH (non-condensing).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	72	2.8
Height	142	5.6
Depth	36	1.4
Weight	**g**	**oz.**
Net	250	8.9

TOP300

Center Wavelength – 635 nm (615-660 nm).

Spectral Width (FWHM) – <1.2 nm RMS.

Stability – 1 hour max. deviation: ±0.15 dB.
24 hours max. deviation: ±0.25 dB.

Power Output (into SMF-28 fiber) – –6 dB ± 2 dBm (Class II).

Connector Interface – Universal (UCI) Connector Interface – FC adapter standard. See ordering information for other available UCI adapters.

Power – Requires two AA alkaline batteries (>20 hours battery life).

Environmental –
Operating: –15°C to +40°C, 0-95% RH (non-condensing).
Storage: –35°C to +70°C, 0-95% RH (non-condensing).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	72	2.8
Height	142	5.6
Depth	36	1.4
Weight	**g**	**oz.**
Net	230	8

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TOP130
LED Optical Source (850/1300 nm).

TOP200
Optical Power Meter (850/1300/1550 nm).
Both Include: User Manual (070-9372-00); Protective Rubber Jacket with Stand (348-1480-00); Universal ST (SOC) Adapters (119-5144-00).

Additional Universal (SOC) Connector Adapters – Biconic (119-5168-00); D4 (119-5167-00); Diamond 2.5 (119-5171-00); Diamond 3.5 (119-5172-00); DIN (119-5166-00); E-2000 (119-5165-00); FC (119-5146-00); SC (119-5145-00); SMA (119-5169-00); SMA 2.5 (119-5170-00); ST (119-5144-00).

TOP140/TOP150
Laser Optical Source (1310/1550 nm).

TOP300
Visual Fault Finder (635 nm).

Both Include: User Manual (070-9372-00); Protective Rubber Jacket with Stand (348-1480-00); Universal FC (UCI) Adapter (119-4516-00).

Additional Universal (UCI) Connector Adapters – Biconic (119-4515-00); D4 (119-4514-00); Diamond 2.5 (119-4556-00); Diamond 3.5 (119-4558-00); DIN (119-4546-00); E-2000 (119-5164-00); FC (119-4516-00); SC (119-4518-00); SMA (119-4557-00); SMA 2.5 (119-4517-00); ST (119-4513-00).

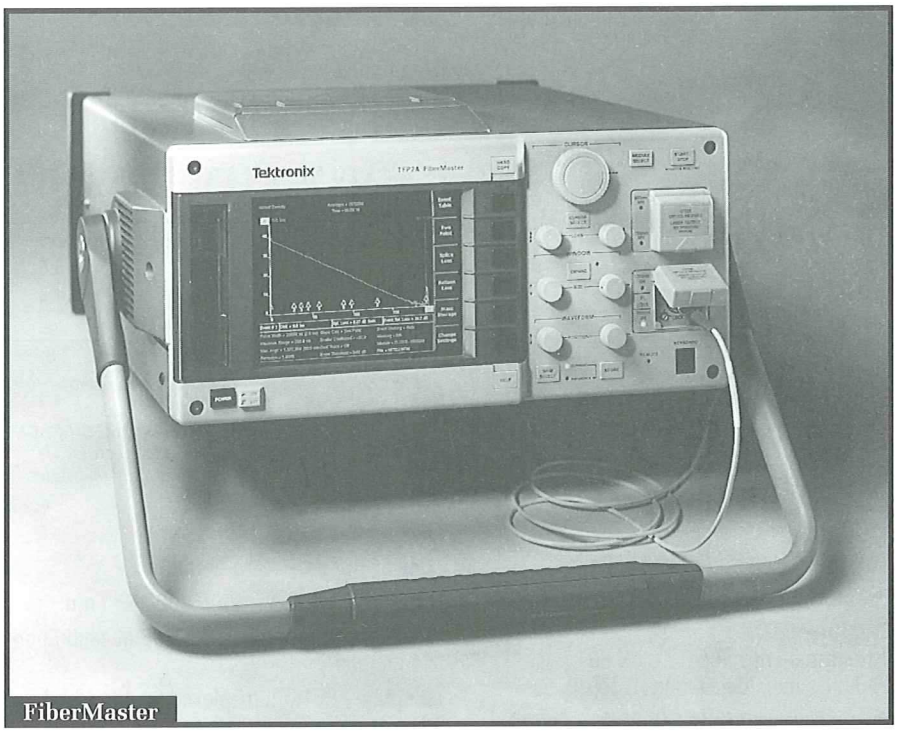
Optical Time Domain Reflectometer

TFP2A FiberMaster®

Features

FiberMaster

- High-speed Processing
- User-friendly
- High-resolution Color Display System
- Custom Configurable Design
- Dual Optical Plug-in Capacity Mainframe
- High-resolution and Long-range Performance
- Expandable Overview/Window Design
- Dual Trace Display Capability
- Automatic or Manual Mark Events
- Event Tables
- Pop-up Menus
- Automatic/Manual Masking
- Cleanable/Interchangeable Optical Connector Adapter
- High-resolution Internal Printer (Optional)
- Link and Event Return Loss Capability
- MS-DOS File Compatible
- Floppy Disk Drive
- Internal RAM (Optional)
- AT Compatible Keyboard Interface
- GPIB and RS-232C Interfaces
- PC Trace Analysis Software, FMTAP
- Remote Operation
- Language Options



FiberMaster

FiberMaster OTDR

Unlike any other OTDR on the market, the TFP2A FiberMaster sets a new level of performance and flexibility, providing faster, easier, more efficient solutions to fiber optic network testing requirements.

FiberMaster is the only OTDR equipped to accommodate two dual-wavelength optical plug-in modules at the same time. Fully utilized, this feature gives you dual-wavelength multimode and dual-wavelength singlemode optical cable testing at the touch of a button. This allows testing of virtually any communications network, Telco, CATV or LAN without switching modules.

FiberMaster is driven by a high-speed 32-Bit processor that delivers clear, concise, accurate waveforms in a fraction of the averaging time taken by other OTDR systems which are based on traditional PC technology.

Characteristics

CRT DISPLAY

Size – 16.5 cm (6.5 in.) diagonal.

Resolution – 640 x 480 pixels.

Type (color) – CRT with Liquid Crystal Color Shutter.

Cursors – Selectable, dual independent.

Module Capacity – Maximum 2 plug-ins providing 4 wavelengths.

HARDCOPY OUTPUT

Internal Printer – High-speed/resolution dot matrix, thermal.

Resolution – 150 dots/in. vertical and horizontal (1.1 ratio to CRT Display).

Print Dimensions – 10.2 cm x 12.7 cm (4 in. x 5 in.).

GPIB to External – HPGL Plotter and HP ThinkJet.

RS-232C to External – HPGL Plotter, HP ThinkJet, Epson, Postscript.

Defaults – Factory and User Selectable.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*

Optical Time Domain Reflectometer

TFP2A FiberMaster®

NON-VOLATILE MEMORY
Mass Storage – MS-DOS Compatible.

Internal Floppy Disk Drive – Size: 8.9 cm (3.5 in.); 1.44 MB or 720 KB.

Internal RAM – Capacity: 1 MB, non-volatile.

Keyboard Interface – AT compatible, 6-Pin modular.

DISPLAY RANGE
Vertical System – Vertical Display Range (one way): 1.0 dB to 100 dB. Loss Readout Resolution Range: 0.001 dB to 0.01 dB.

Mainframe Horizontal System – Distance Display Range: 1 m to 320 km. Distance Measurement Cursor Resolution 850 nm MM: 5 cm normal density; 1 cm high density. 1300 nm MM, 1310 nm SM, 1550 nm SM: 20 cm normal density, 10 cm high density.

Index of Refraction Range – 1.4000 to 1.6000.

Distance Measurement Accuracy – ±0.001%, ± min. cursor resolution, ± uncertainty in fiber cal. factor.

Number of Stored Waveform Points – 16 K max. (Normal), 32 K max. (High Density).

PHYSICAL CHARACTERISTICS

Dimensions*1	cm	in.
Length	60.7	23.9
Width	45.2	17.8
Height	19.8	7.8
Weight *2	**kg**	**lb.**
Net	15	33

**1 Includes front cover, handle and feet.*
**2 Includes mainframe optics module, internal printer, disk drive.*

Power Requirements – AC Operation: 90-130 V AC, 47-440 Hz, 180-253 V AC, 47-73 Hz. Optional 10-32 V DC.

Laser Product Safety Classification – Class I.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

FiberMaster with Color Display
Order TFP2A.
FiberMaster with MonoChrome Display
Order TFP2AM.
Includes: Operator's Manual (070-7906-05); Soft Carrying Case (016-1037-01); Front Panel Cover (200-3566-00); Power Cord (161-0104-00).

OPTICS PLUG-IN OPTIONS – MULTIMODE
Opt. 01 – 850 nm MM.
Opt. 02 – 1300 nm MM.
Opt. 03 – 850 nm/1300 nm MM.

OPTICS PLUG-IN OPTIONS – SINGLEMODE
Opt. 04 – 1310 nm SM.
Opt. 05 – 1550 nm SM.
Opt. 06 – 1310 nm/1550 nm SM.
Opt. 07 – 1310 nm SM Long Range.
Opt. 08 – 1310/1550 nm SM Long Range.
Opt. 09 – 1550 nm SM Long Range.
Opt. 10 – 1310 nm SM.
Opt. 11 – 1310/1550 nm SM.
For Options 01–11 select one connector per option at no charge.

CONNECTOR OPTIONS – MULTIMODE
Opt. 20 – Biconic (119-4515-00).
Opt. 21 – FCPC (119-4516-00).
Opt. 22 – D4PC (119-4514-00).
Opt. 23 – SMA906 (119-4517-00).
Opt. 24 – STPC (119-4513-00).
Opt. 25 – DIN 47256 (119-4556-00).
Opt. 26 – Diamond 3.5 (119-4558-00).
Opt. 27 – Diamond 2.5 (119-4546-00).
Opt. 28 – SCPC (119-4518-00).
Opt. 29 – SMA 2.5 (119-4517-00).

CONNECTOR OPTIONS – SINGLEMODE
Opt. 30 – Biconic (119-4515-00).
Opt. 31 – FCPC (119-4516-00).
Opt. 32 – D4PC (119-4514-00).
Opt. 33 – SMA 905/906 (119-4557-00).
Opt. 34 – STPC (119-4513-00).
Opt. 35 – DIN 47256 (119-4556-00).
Opt. 36 – Diamond 3.5 (119-4558-00).
Opt. 37 – Diamond 2.5 (119-4546-00).
Opt. 38 – SCPC (119-4518-00).
Opt. 39 – SMA 2.5 (119-4517-00).

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz.
Opt. A2 – United Kingdom 240 V, 50 Hz.
Opt. A3 – Australian 240 V, 50 Hz.
Opt. A4 – North American 240 V, 60 Hz.
Opt. A5 – Switzerland 220 V, 50 Hz.

SERVICE ASSURANCE OPTIONS
REP4500 – Provides one year of post-warranty Repair Protection for TFP2A/TFP2AM and FM8500.
REP4600 – Provides one year of post-warranty Repair Protection for FM8513/FM1300, FS1300/FS1500/FS1315, and FL1300/FL1315/1500.
CAL4500 – Provides one year of Calibration Services for TFP2A/TFP2AM and FM8500.
CAL4600 – Provides one year of Calibration Services for FM8513/FM1300, FS1300/FS1500/FS1315, and FL1300/FL1315/FL1500.

ADDITIONAL ACCESSORIES
Also see page 434.

FACTORY INSTALLED OPTIONS –
Opt. 14 – Internal RAM, 1 MB.
Opt. 16 – Internal High Speed Thermal Printer.
Opt. 17 – DC Power Input (10-32 V DC).

FIELD INSTALLED OPTIONS
Trace Analysis Package PC Software – Order FMTAP.
Opt. 19 – AT Compatible Keyboard. Order 118-7637-00 and 174-2356-00.
Opt. 1R – Rackmount Kits (fits 19 in. racks).
Opt. 1T – Hard Shell Transit Case. Order 016-1036-00.

OPTICS MODULES/CONNECTOR
When ordering Optics Modules for previously purchased mainframes, use the following numbers plus connector option:
FG1300 – 1310 nm Singlemode.
FG1315 – 1310/1550 nm Singlemode.
FM8500 – 850 nm Multimode, 62.5 µm.
FM1300 – 1300 nm Multimode, 62.5 µm.
FM8513 – 850 nm/1300 nm Multimode, 62.5 µm.
FS1300 – 1310 nm Singlemode.
FS1500 – 1550 nm Singlemode.
FS1315 – 1310 nm/1550 nm Singlemode.
FL1300 – 1310 nm SM Long Range.
FL1315 – 1310/1550 nm SM Long Range.
FL1500 – 1550 nm SM Long Range.

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GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

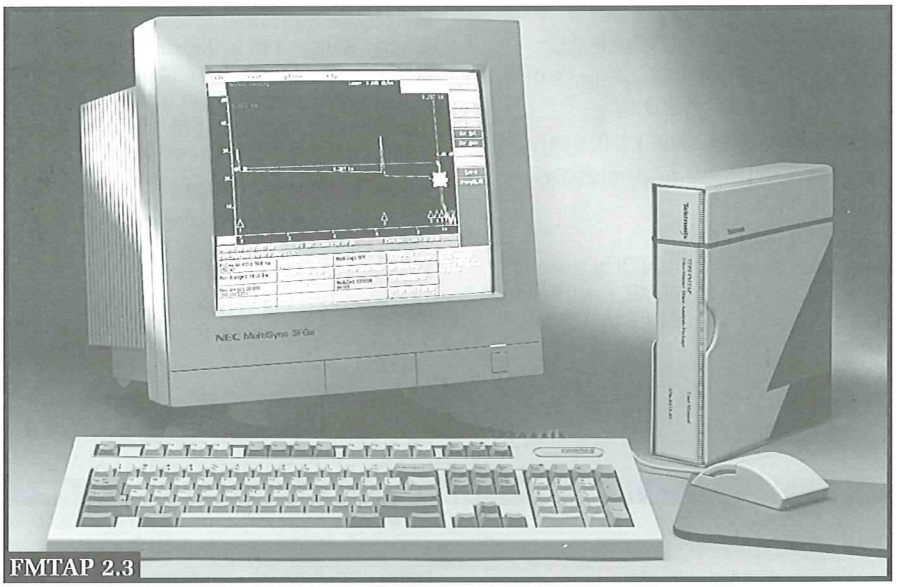
ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*

Trace Analysis Package 2.3
FMTAP

Features

FMTAP

- Link Return Loss
- Event Return Loss
- High Density Data
- Automatic and Manual Event Marking
- Event Table
- Waveform Subtraction
- Waveform Averaging
- Two-way Event Averaging
- Batch Printing of Waveforms
- Screen-dump for Printing on a Variety of Printers, or for Importing into a Word Processor Document
- Export of Waveform Data for Use with Spreadsheet or Word Processor
- Data Base Searches with Selectable Tolerances for All Event Table Measurements
- Copy Established Event Markers for Documenting Redundant Fibers



FMTAP™ Trace Analysis Package

Trace Analysis Software for the TFP2A FiberMaster® OTDR, and TFS3031 TekRanger, FMTAP, allows you to use an IBM PC or compatible to display and analyze waveforms created by a TFP2A FiberMaster and TFS3031 TekRanger.

Use the FiberMaster or TekRanger to acquire the waveform data and save it on a floppy disk file. Then use the PC to manipulate the waveforms and perform many of the same kinds of measurements that are possible on the FiberMaster and TekRanger.

- Preview the complete waveform
- Automatic and manual two-point and splice-loss measurements
- Display distance and loss axes, measurements and settings
- Dual-trace
- Event Marking
- Expanded view of events

By using a Microsoft compatible two- or three-button mouse you can access front measurement controls.

Extensive pull down menus are available for file management and printing functions to a number of popular printing devices. On-line help is available with a push of a button.

THE MEASUREMENT SCREEN

Once loaded into your PC, the measurement screen appears, displaying a menu bar, status bar and the waveform display area, which includes a horizontal distance scale and vertical loss scale. After you load a waveform, the distance and loss cursors and the expansion window are positioned where they were located at the time the waveform was written into mass storage on the FiberMaster or TekRanger.

The waveform area of the measurement screen is color coded for easier interpretation of the data.

- Waveform data is green.
- Measurement values, such as two-point distance and loss, splice-loss and fiber-loss are shown in yellow.
- The user adjustable elements (distance and loss cursors) are displayed red.
- Cursor adjustment handles and the handles on the expansion window are magenta.

The control panel on the screen allows you to select the waveform to display, the measurement mode, expanded view, and cursor functions. You can also choose various waveform settings:

- Single- or dual-trace
- Slope calculation
- Units (Meters or Feet)
- Index of refraction
- Fiber identification, Notes, Operator

Other settings, which are not selectable but are displayed, include the pulse width, range, number of averages, and masking type.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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Trace Analysis Package 2.3
FMTAP

System Requirements

Processor – 80286-, 80386-, or 80486-based IBM*3 PC or PS/2*3 (or 100% compatible).

Operating System – MS-DOS*8 or PC-DOS*3 3.30 or later.

Base Memory – 640 K RAM minimum. 580 K available.

Extended or Expanded Memory – At least 1 MB required.

Graphics Adapter – Color VGA.

Monitor – Color VGA.

Floppy Disk Drive – 3.5 in., 1.44 MB, IBM compatible*1.

Fixed Disk Drive – 2 MB minimum.

RS-232 Serial Port – For transferring stored tests from the TFS3030 to the PC. Is not necessary to run the FMTAP Software.

Mouse – Two- or three-button Microsoft-compatible serial mouse.

Compatibility – A math coprocessor (80287 or 80387) is required and a FiberMaster®-compatible printer or an IBM graphics printer are highly recommended.

Compatible printers include:

- IBM*3 Graphics Printer
- Epson*2 MX and FX
- Epson LQ 24-Pin
- Hewlett-Packard ThinkJet*4
- Hewlett-Packard LaserJet*4
- Hewlett-Packard DeskJet*4
- Hewlett-Packard DeskJet 500C*4
- Apple LaserWriter*6 (PostScript*5)
- Tek Phaser®*7 (Color PostScript)

**1 A 3.5 in. disk drive is required to read the FiberMaster floppy disk directly, but is not necessary to run the FMTAP software.*

**2 Epson is a registered trademark of EPSON, Shinshu Seiko Co., Ltd.*

**3 IBM, IBM PS/2 and PC-DOS are registered trademarks of IBM, Inc.*

**4 Hewlett-Packard ThinkJet, LaserJet and DeskJet are registered trademarks of Hewlett-Packard Company.*

**5 PostScript is a registered trademark of Adobe Systems, Inc.*

**6 Apple LaserWriter is a registered trademark of Apple Computer, Inc.*

**7 Tek and Phaser are registered trademarks of Tektronix, Inc.*

**8 MS-DOS is a registered trademark of Microsoft, Inc.*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

FMTAP
FiberMaster Trace Analysis Package.

Includes: Disk Pack (063-0971-01), FMTAP User's Manual (070-8433-01), FMTAP Quick Reference Card (063-0828-01), FiberMaster Utilities Disk Pack (063-1493-00).

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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Mini Optical Time Domain Reflectometer

TFS3031 TekRanger™

Features

TFS3031 TekRanger™

- One-button Automatic Fiber Analysis
- Large, High-resolution Display
- "Real Time" Testing
- Easy-to-change Wavelengths
- 5 Meter Singlemode Dead Zone
- 8 Meter Multimode Dead Zone
- 0.02 dB Loss Threshold
- 32 dB Singlemode Dynamic Range
- 28 dB Multimode Dynamic Range
- 15 to 60 dB Selectable Reflectance Threshold
- Shock, Water, and Dust Resistant
- Echo Detection
- Compatible with FiberMaster FMTAP PC Spreadsheets
- Internal Memory for 200 Waveforms
- Software Upgradeable in the Field
- 4 Hour Battery Charge Time
- RS-232 and Parallel Ports
- 3.5 Inch Internal Floppy-disk Drive (Optional)
- Multimode/Singlemode in One Unit (Optional)

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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Tektronix Measurement products are manufactured in ISO registered facilities.



TFS3031 TekRanger™

Tektronix Communications Test Business Unit provides a broad range of products in cable tests, transmission tests, and RF and wireless applications.

The TFS3031 TekRanger™ mini-OTDR with IntelliTrace™ Automated Fiber Analysis System is a rugged, easy-to-use mini-optical time domain reflectometer (OTDR) built to stand the rigors of field work while providing precise measurements on singlemode or multimode optical fiber systems.

The location, reflectance and loss of every splice in a system appears quickly and clearly on the large 7-inch display screen. The TFS3031 is the only mini-OTDR that can report a splice 5 meters away while also finding splices 100 kilometers away at the push of a single button.

THE IntelliTrace ADVANTAGE
IntelliTrace technology automatically adjusts acquisition parameters to provide the best possible resolution, while maintaining the necessary dynamic range for accurate measurements. The various pulse widths used during the acquisition result in a much more accurate waveform.

EASY TO OPERATE
Operation of the TFS3031 with IntelliTrace Automated Fiber Analysis System is simple and quickly learned. One-button operation brings up easy to read traces on the display screen along with event table, indicating everything about a splice.

EDITING VERSATILITY
A flexible user interface provides the ability to edit tables, add markers to traces, measure reflectance and splice loss with a single cursor, and even customize your data tables. Singlemode and multimode operation in the same instrument enhances the utility and efficiency of the TekRanger mini-OTDR.

OPTIONAL FLOPPY DISK
Test results are stored in the TFS3031's ample internal memory or collected on the optional floppy disk. The data, uploaded to a PC, provides for further analysis with FMTAP Trace Analysis Software. The data can also be used in the full-sized Tektronix FiberMaster OTDR.

The TekRanger mini-OTDR disk drive also permits updating of the unit's software in the field, keeping it current with network changes.

Characteristics

Optical*1 –
850 nm optical output: 850 ± 20 nm.
1300 nm optical output: 1300 ± 20 nm.
1310 nm optical output: 1310 ± 5 nm.
1550 nm optical output: 1550 ± 10 nm.

Loss threshold: 0.02 dB minimum.
Loss resolution: 0.001 dB.

Dynamic and Measurement Range*1 –

	Dynamic Range	Measurement Range
850 nm (Opt. 01)	28 dB	21 dB
850/1300 nm (Opt. 03)	28/25 dB	21/18 dB
1310 nm (Opt. 04)	27 dB	21 dB
1310/1550 nm (Opt. 06)	26/24 dB	20/18 dB
1310/1550 nm (Opt. 08)	32/29 dB	26/23 dB
1550 nm (Opt. 09)	31 dB	25 dB

**1 Typical performance @ 25°C.*

Readout Resolution – 25 cm minimum.

OTDR Distance Range Settings –
Singlemode: 1 to 160 km.
Multimode: 1 to 40 km.

Distance Resolution (IntelliTrace) – 25 cm to 20 m.

Measurement Time (Auto) – Less than 3 minutes (20 dB accumulated loss).

Field Usage – Shock, water and dust resistant. Tested to Bellcore Mini-OTDR TR Environmental Specifications (i.e., 30-inch drop, shock, etc.).

ENVIRONMENTAL
(Without internal disk drive)

Operation Temperature Range – –15°C to +40°C.

Storage Temperature – –20°C to +60°C.

Relative Humidity – 5% to 80% ± 5% (non-condensing).

Mini Optical Time Domain Reflectometer

TFS3031 TekRanger™

PHYSICAL CHARACTERISTICS

Dimensions	cm	in.
Width	29.2	11.5
Height	11.4	4.5
Depth	4.1	9.5
Weight	**kg**	**lb.**
Net	4.2	9.2

Dead Zone (Options 01, 03, 04, 06, 08) –

	Event Detection	Loss Measurement
Singlemode	5 m	25 m
Multimode	8 m	15 m

Display – High resolution 640 x 480; 7 inch, high contrast; Operator switchable backlight.

Selectable Pulse Widths –
Multimode:
850 nm: 1 m, 5 m, 10 m.
1300 nm: 1 m, 5 m, 10 m, 20 m, 50 m, 100 m.
Singlemode: 1 m, 5 m, 10 m, 20 m, 50 m, 100 m, 500 m, 1000 m, 2000 m.

Memory Capacity – 200 traces in internal memory (typical). 3.5 in. floppy disk drive (optional).

Output Ports – RS-232; Centronix parallel printer.

Power Options – AC (100 to 240 V, 50 to 60 Hz). 9 to 16 V DC. Internal NiCad rechargeable battery (8 hours of operation). Standard "C" Cell (adapter required).

Safety – UL 3111-1. Listed certified to CSA C22.2 No. 1010.1-92.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TFS3031
TekRanger Base Unit.
Includes: Operator Manual (070-9027-00); Quick Reference Card (063-2096-00); NiCad Battery Pack (146-0095-00); Power/Charger Adapter (119-4545-00); Power Cord (161-0228-00); Soft Carrying Case (016-1215-01).

OUTPUT PORT OPTIONS
Multimode Options –
Opt. 01 – Single wavelength 850 nm.
Opt. 03 – Dual wavelength 850/1300 nm.
Singlemode Options –
Opt. 04 – Single wavelength 1310 nm.
Opt. 06 – Dual wavelength 1310/1550 nm.
Opt. 08 – Dual wavelength 1310/1550 nm extended range.
Opt. 09 – Single wavelength 1550 nm extended range.

MULTIMODE/SINGLEMODE OPTION PACKAGES
Opt. 03 and 06; Opt. 03 and 04; Opt. 01 and 04; Opt. 01 and 06; Opt. 03 and 08.

CONNECTOR OPTIONS

Multimode Option	Singlemode Option	Connector Type	Part Number
20	30	Biconic	119-4515-00
21	31	FCPC	119-4516-00
22	32	D4PC	119-4514-00
24	34	STPC	119-4513-00
25	35	DINPC 47256	119-4546-00
26	36	DIAMOND 3.5	119-4558-00
28	38	SCPC	119-4518-00
	41	FC/APC	119-5115-00
	42	SC/APC	119-5116-00

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V. Order 161-0066-09.
Opt. A2 – United Kingdom 240. Order 161-0066-10.
Opt. A3 – Australia 240 V. Order 161-0066-11.
Opt. A5 – Switzerland 220 V. Order 161-0154-00.
Opt. A6 – Japan 110 V. Order 161-0288-00.
See Customer Information Section for additional description.

LANGUAGE OPTIONS
Opt. L1 – French.
Opt. L2 – Italian.
Opt. L4 – Spanish.
Opt. L5 – Japanese.
Opt. L6 – Portuguese.
Opt. L7 – Chinese.

OPTIONAL ACCESSORIES
Opt. 11 – Disk drive.
Opt. 1S – FMTAP software.
Opt. 1T – Transit case.
Hard Travel Case – Order 016-1210-00.
Thermal Printer – Order HC411.
Thermal Printer Paper – Order 006-7840-00.
RS-232 PC Interface Cable – Order 012-1379-00.
FMTAP Trace Analysis Package – Order FMTAP.
Cigarette Lighter Power Adapter – Order 198-5810-00.
Centronix Parallel Printer Cable – Order 012-1214-00.
Standard "C" Cell Adaptor – *1.
*1 Contact your local Tektronix representative.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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Handheld Optical Fault Finder

TFS2020 FiberScout®

Features

FiberScout

- Simple Symbolic Display
  - Graphics
  - Event Descriptions
- Fast Restoration Capability
- Small, Lightweight, Easy to Handle
- Easy One-button Operation
- Low Cost – High Performance
- Long Range
- Multimode Short Range
- Dual Port Capability
- High Distance Accuracy
- User-selectable Fault Thresholds
- Internal Battery Operation
- Internal Test Result Storage
- RS-232C Output Port: PC Interface, Seiko DPU-201G Printer, Seiko DPU-411 Printer
- PC Interface Software
- Rackmount Available



FiberScout Handheld Optical Fault Finder

Weighing just five pounds (2.3 kg), the battery-operated Tektronix TFS2020 FiberScout reports the status of the fiber through four easy-to-understand symbols.

Designed to locate events and faults in optical cable, the FiberScout is priced for widespread use in the cable restoration environment.

No waveform interpretation is necessary – making the FiberScout so simple to use, it allows fault finding by virtually any user, regardless of the person's level of training.

The FiberScout gives you faster restoration capability and greater service staff effectiveness, since it can be deployed in far greater numbers than the more complex, more expensive OTDRs.

Documentation is fast and simple when using either of the lightweight, portable Seiko thermal printers. FiberScout comes standard with non-volatile memory for internal storage of test results which can later be transferred to a PC.

For advanced documentation and storage needs, we also offer the FSTIP test interface package. Files are saved to the PC in ASCII form, which allows easy analysis of the representative trace and annotations of the results through virtually any word processor.

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Handheld Optical Fault Finder

TFS2021 FiberScout®

CHARACTERISTICS

OPERATING PERFORMANCE*1

	Multimode Short Range	Long Range
Operating Distance Range*2	≥3.0 km @ 3.5 dB/km	≥40.0 km @ 0.4 dB/km
Fault Detection Range (one way)	≥10.5 dB @ 62.5 µm	≥16 dB*3
Distance Measurement Accuracy*4		
To Reflective Event	±2 meters	±5 meters
To Non-reflective Event	±2 meters	±5 to 20 meters*5
Distance Readout Resolution	1 meter or 1 foot	1 meter or 1 foot
Two Event Resolution*6		
Distance to Detect 2nd Reflection	≤10 meters	≤40 meters
Loss Measurement Repeatability	±0.2 dB	±0.3 dB
Loss Readout Resolution	±0.1 dB	±0.1 dB
Fault Threshold Selections	1, 2, 3, or 4 dB	1, 2, 3, or 4 dB*7
Optical Output		
Wavelength	835 nm ±35 nm	1300 nm ±25 nm
Output Core Size	50 or 62.5 microns	8 to 10 microns
Display	Backlit LCD, Graphics and Text	
Laser Safety	Complies with Class I, 21 CFR 1040.10/1040.11	
Power	Internal Rechargeable NiCad Battery Pack. Typical operation life between charges: 6 hours. Typical shelf life between charges: 6 months. External AC/DC External Power/Charger Adapter.	

**1 In some cases, varying test conditions may affect measurement performance.*

**2 With no events present.*

**3 At the 4 dB fault threshold setting.*

**4 Actual distance accuracy includes: timebase accuracy (±0.005%) quantization error in the Index of Refraction setting.*

**5 With extended averaging invoked.*

**6 The FiberScout automatically uses the optimal pulse width to separate the loss measurements between two adjacent events.*

**7 For singlemode fiber, the FiberScout will report any loss ≥1 dB. For multimode fiber, the FiberScout will report any significant fault.*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

FiberScout
Handheld Optical Fault Finder. Order TFS2020.
Includes: Battery Pack (146-1000-01); 110 V AC/DC, Power Supply – USA/Canada (119-2731-00); Travel Case (016-1024-00); Accessory Pouch (016-0993-00); Operator Manual and Supplement (070-7167-04); Reference Label (062-9360-01).

With each FiberScout ordered, select one of the option groups listed below:

Opt. 02 – Equip with Long Range Port.

Opt. 09 – Equip with Multimode (62.5 µm) Short Range Port.

Opt. MC – Equip with Multimode (50 µm) Short Range Port.

Opt. MM – Equip with Long Range and Multimode (62.5 µm) Short Range Ports.

Opt. MN – Equip with Long Range and Multimode (50 µm) Short Range Ports.

With each FiberScout ordered, select one of the connector options:

CONNECTOR OPTIONS – LONG RANGE
Opt. 20 – Biconic.
Opt. 21 – FC.
Opt. 22 – D4.
Opt. 24 – ST.
Opt. 25 – DIN.
Opt. 28 – SC.

CONNECTOR OPTIONS – MULTIMODE SHORT RANGE
Opt. 40 – Biconic.
Opt. 41 – FC.
Opt. 42 – D4.
Opt. 44 – ST.
Opt. 45 – DIN.
Opt. 46 – SMA 905/906.
Opt. 48 – SC.

AC/DC POWER SUPPLY OPTIONS
The FiberScout is equipped for use in the U.S.A. and Canada. If use is for other than in the U.S.A. or Canada, order one of the following options:

Opt. 1C – 220 V AC/DC Power Supply (Europe).

Opt. 2C – 240 V AC/DC Power Supply (UK).

SERVICE ASSURANCE OPTIONS
REP4400 – Provides one year of post-warranty Repair Protection.

CAL4400 – Provides one year of Calibration Services.

Note: Units are not modular or customer modifiable. Any change in capability from originally ordered configuration, if available, must be performed by the factory or authorized Tektronix service center. Additional charges will apply.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

Optical Power Meter

TFC200 FiberChamp®

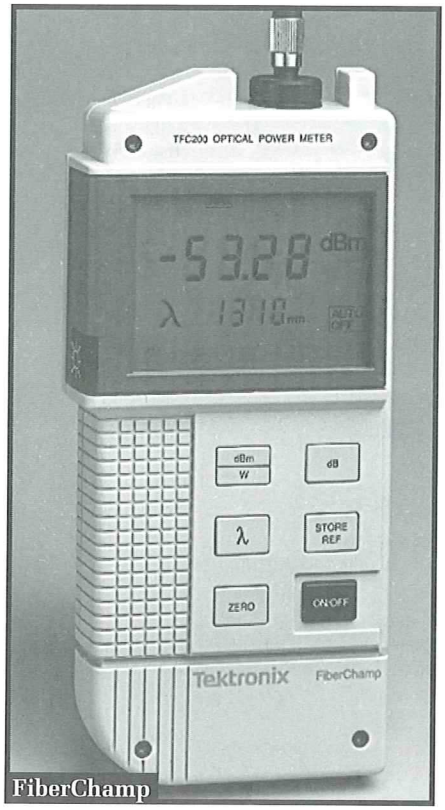
Features

FIBERCHAMP

- 3% Accuracy
- Selectable dB Threshold Audio Indicator
- Readouts in dBm, dB and Watts
- Multiple Calibrated Wavelengths: 780, 820, 850, 1060, 1300, 1310 and 1550
- Non-volatile Storage of Reference Power Level for Each Wavelength
- Averaging
- Analog Output Port
- Easy-to-use, Intuitive User Interface
- Large, Backlit LCD Display Is Easy to Read in Direct Sunlight or Total Darkness
- Battery or AC/DC Operation
- Wide Selection of Connector Adapters
- Interfaces to Multimode and Singlemode Fiber

Applications

- Absolute Power Measurements
- Link Loss
- Threshold Testing
- Monitoring Power Levels
- Telco
- CATV
- LAN
- R&D



FiberChamp

FiberChamp Optical Power Meter Characteristics

These specifications apply for use with all singlemode and multimode fibers up to 200 µm, 0.3 NA core with all connector options.

Spectral Range – 750 nm to 1700 nm.

Calibrated Wavelengths – 780, 820, 850, 1060, 1300, 1310, 1550 nm.

Dynamic Range – +10 dBm to –70 dBm.

Accuracy – ±3% (±0.1 dB). Note: At –20 dBm at 20°C at calibrated wavelengths.

Readout Resolution – 4 digits, 0.01 dBm.

Display – Backlit LCD 6.98 x 5.08 cm (2.78 x 2.00 in.).

ENVIRONMENTAL

Temperature – Operating: –5°C to +45°C; Storage: –30°C to +75°C.

Humidity – 5 to 95% Relative Humidity (non-condensing).

Altitude – Operating: 4,500 meters (15,000 ft.); Storage: 15,000 meters (50,000 ft.).

POWER REQUIREMENTS

Internal – 9 V Alkaline (non-rechargeable) or 7.2 V, 6 cell NiCad (rechargeable).

Battery Life – Alkaline 28 hours, NiCad 8 hours.

External – 12 to 20 V DC (AC/DC converter) at 100 mA minimum.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Length	9.5	3.74
Width	3.3	1.3
Height	20.1	7.91
Weight	**kg**	**lb.**
Net	0.45	1

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ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

FiberChamp
Optical Power Meter. Order TFC200.

Includes: Operator Manual (070-7913-00); User Guide (063-0809-00); Carrying Case (016-1078-00); Alkaline Battery (146-0094-00).

Connector Adapters, Rechargeable Power Options, and additional accessories are available.

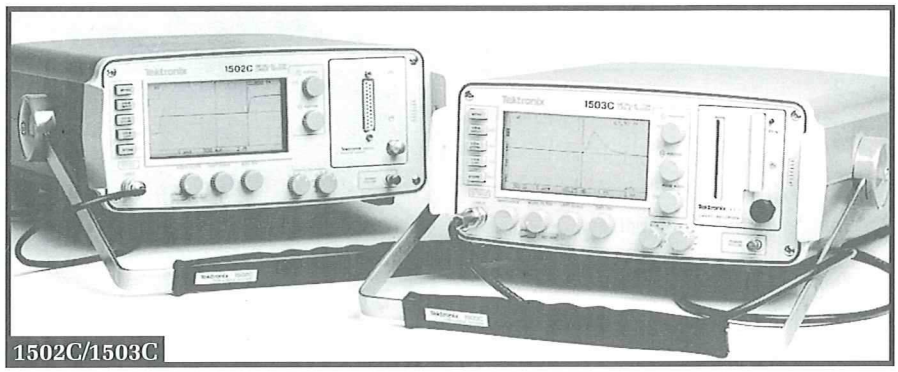
Metallic Cable Testers

1503C • 1503B • 1502C • 1502B

Features

1502C/1503C
1502B/1503B

- Direct Distance Readout – Accurate to Better Than 1%
- Intermittent Fault Monitor Mode
- High-resolution LCD Display With Zoom
- Menu-driven Setup
- Help Mode
- Rugged Portability
- Calibrated Vertical Scale
- Optional Serial Interface
- Optional Internal Printer
- Noise Filtering



The 1502C/1503C MTDR Cable Testers combine portability and ease of use with the ability to test most dual conductor metallic cable under virtually any condition.

1503B/1503C
GENERAL PURPOSE CABLE TESTERS
These products generate a 1/2 sine pulse, with selectable pulse widths of 2, 10, 100, or 1000 ns. The high-resolution 2 ns pulse permits the identification of multiple faults as close together as one foot. The 1000 ns pulse gives the 1503C a range of 5,000 to 50,000 feet (depending on cable type and condition).

For most TDR applications, where determining distance to an impedance change is the key measurement, the 1503C/1503B are the best choices.

1502C/1502B ULTRA-HIGH-RESOLUTION TDRS
The 1502C and 1502B generate a 200 ps rise time step pulse and have an output impedance of 50 Ω. The fast rise time permits the identification of multiple faults as close together as 0.6 inches.

Sample Applications

LOCAL AREA NETWORKS
Cable and connector problems can be the biggest headache for the LAN installer. The 1503C's high-resolution 2 ns pulse will precisely identify problems in seconds. The calibrated vertical scale can help identify marginal components before they cause problems and a return call.

ON-BOARD SYSTEMS
The ultra-high resolution of the 1502C or 1502B are perfectly adapted for testing critical wiring on board aircraft and ships.

MANUFACTURING QUALITY CONTROL
Manufacturers of circuit boards or precision cabling can quickly and accurately determine or verify the impedance characteristics of their products in a matter of seconds with the 1502C or 1502B.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

1503C – Metallic TDR.
1503B – Metallic TDR.
1502C – Metallic TDR.
1502B – Metallic TDR.
Includes: AC Power Cord; 50 Ω BNC Terminator; Precision 50 Ω Cable (1502); 93 Ω Cable (1503); BNC-Cliplead (1503); Female-to-Female BNC Connector; Spare Fuse; Operator's Manual; Accessory Pouch; Option Port Cover; Calculator Slide Rule.

Opt. 03 – Battery Pack.
1500C Series products meet environmental requirements of MIL-STD-28800C for Type III, Class 3, Style C, and utilize a high-performance internal gel-cell battery. 1500B Series products meet environmental requirements for Style A, and utilize a removable NiCad battery pack.

Opt. 04 – YT1 Chart Recorder.
Records all information displayed on LCD, including waveform and settings for a permanent record.

Opt. 06 – (1503 only) Live Ethernet testing capability.

Opt. 08 – (1503 only) Token Ring TDR Adapter.

Opt. 09 – (1503 only) USOC Adapter.

Opt. 10 – (1503 only) Token Ring Interface.
SP232 Serial Interface Module. Provides a serial link to a host PC for remote control, waveform storage, and automated fault finding. Includes host software for IBM-compatible PCs.

SERVICE ASSURANCE OPTIONS
REP4400 – Provides one year of post-warranty Repair Protection.
CAL4400 – Provides one year of Calibration Services.
A wide range of other options and connectors is available.

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 to A5.
See Customer Information Section for additional description.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

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TDR for Telephony Cable Tester, Software

TS100 TelScout® • MCTAP

Features

TS100

- One-step Setup
- Automatic Instrument Control Mode
- Manual Instrument Control Mode
- 15 km Fault Location Capability
- Rugged (Survives 2 m Drop) and Splash-proof
- Powered from AC Mains or Battery
- 10 x 12 x 3.5 in., 6.4 lb.
- Single Button Zoom
- Pair Comparison Mode
- Crosstalk Mode
- Measures Distance to Fault in Feet, Meters, or Time
- Configurable for any Cable Type and Vp (0.300 to 1.000)
- Internal Memory for 20 Waveforms and Notes
- Serial Printer Output for Stored or Displayed Waveforms
- Accurate (±3 ft. at 10,000 ft.)
- Short-pulse/Coaxtest Option
- Intermittent Fault Location
- Optional PC Software (MCTAP)

MCTAP

- Uploading/Downloading to and/or from the TS100
- Cursor Movement
- Help Screens
- DOS Program. Runs Under Windows
- Screen-dumps for Printing or Importing into Word Processor Documents
- Screen-dumps to a File in TIFF Format
- Export of Waveform Data for Use with Spreadsheet or Word Processor



TelScout TDR

If your job is to find faults on telephone twisted pair cable, the Tektronix TS100 TelScout is built for you. Designed specifically for twisted pair telephony applications, TelScout applies the newest technology to provide both ease of use and performance that cannot be found in any other TDR. With the TS100, you'll spend less time operating the TDR, and more time repairing faults.

Simply select the cable type to be tested and TelScout does the rest. Impedance, Vp, gain, pulse width and vertical position are automatically selected and adjusted as you scan the cable. Just move the cursor to the fault to pinpoint its location.

On the performance side, TelScout employs optimized pulsing and sampling, coupled with advanced filtering and signal processing techniques, to insure the maximum measurement range. That way, you'll always have a clean waveform for easier fault interpretation.

Best of all, you get all this performance in the industry's most rugged TDR package. Come snow, rain, heat and humidity, TelScout keeps working, because you have to.

TelScout MEASUREMENT MODES

The TS100 has connectors for two pairs, the test pair and the reference pair. There are four basic modes of operation:

1. **Test pair only.** Conventional TDR operation with one displayed waveform for the test pair.
2. **Test pair and reference pair.** This mode is used to visually compare the test and reference pairs. Pulsing occurs on both pairs and two waveforms are displayed. A stored waveform can also be selected for comparison.
3. **Test pair – reference pair.** Similar to the mode described above, pulsing occurs on both test pair and the reference pair (a single displayed waveform) to simplify the comparison. A stored waveform can also be selected for comparison.
4. **Crosstalk test.** A single waveform mode in which TelScout pulses on the test pair and samples on the reference pair for returning signal. This mode is typically used to determine the distance to the point where a split pair is occurring.

Characteristics

Test Signal (Std. Opt.) – 1/2 Sine, balanced.

Amplitude (Std. Opt.) – 20 V into 100 Ω.

Output Impedance (Std. Opt.) – 100 Ω.

Pulse Widths (Std. Opt.) – 20 to 3000 ns; 5 ns optional.

Test Signal (Opt. 01) – 1/2 Sine.

Amplitude (Opt. 01) – 5 ns + 2.5 V into 100 Ω, 20 ns to 3000 ns ±4 V into 100 Ω.

Output Impedance (Opt. 01) – 100 Ω.

Pulse Widths (Opt. 01) – 5 ns to 3000 ns.

Input Protection – ±400 V, DC + peak AC, to a maximum of 440 Hz.

Maximum Range – 15,000 m/45,000 ft., depending on cable type and condition.

Display Resolution – 0.33% of selected range, 4.5 cm/0.15 ft. minimum, on 640 x 200 high resolution LCD.

Display Ranges – Eleven display ranges plus single button expand window. (Ranges are user definable in manual mode.)

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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TDR for Telephony Cable Tester, Software

TS100 TelScout® • MCTAP

Filter – High pass, cutoff frequency 150 kHz, user selectable.

Amplifier – A 5 mV reflection produces a full-screen vertical deflection.

Gain – 0 to 63 dB.

Waveform Storage – Up to 20 waveforms with notes.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	300	12
Height	250	10
Depth	90	3.5
Weight ≈	**kg**	**lb.**
Net	3	6.4

Horizontal Accuracy – 0 to 5000 m = ±1 m, 5000 to 15,000 m = ±2 m ±uncertainty in Vp. 0 to 2000 ft. = ±2 ft., 2000 to 10,000 ft. = ±3 ft., 10,000 to 20,000 ft. = ±4 ft., ±uncertainty in Vp.

Mains Operation – 110 V, 220 V, or 240 V, with appropriate AC to DC adapter.

Battery Operation – 8 hours, continuous.

Battery Saver – 5 to 30 minutes or disabled, selectable.

Printer Interface – Serial 9-Pin D-type connector.

ENVIRONMENTAL

Operating Temperature – –15° to +60°C.

Nonoperating Temperature – –20° to +65°C.

Humidity – 95% RH (non-condensing).

Shock – Survives drop of two meters to concrete in standard soft case.

EMI Emissions – FCC part 15, subpart J, class A; VFG243 and EN55022.

MCTAP Trace Analysis Software

MCTAP, Trace Analysis Software for the TS100 TelScout TDR, allows you to use an IBM PC or compatible to display and analyze waveforms created by the TelScout.

THE MEASUREMENT SCREEN

Once loaded into your PC, the measurement screen appears, displaying a menu bar, a status bar and the waveform display area, which includes a horizontal distance scale. The distance and marker are positioned where they were located at the time the waveform was written into mass storage on the TelScout.

The waveform area of the measurement screen is color coded for easier interpretation of the data.

The control panel allows you to select the waveform to display, the measurement mode and cursor functions. You can also choose various waveform settings:

- Single- or dual-trace, or difference
- Units (Meters or Feet)
- V.p.

Other settings, which are not selectable but are displayed, include the pulse width, range, the cable identification and waveform notes.

System Requirements

Processor – 80386- or 80486-based IBM PC or PS/2 (or 100% compatible).

Operating System – MS-DOS or PC-DOS 5.0 or later. Windows 3.1.

Base Memory – 640 Kb RAM minimum, 580 K available.

Extended or Expanded Memory – At least 1 MB required (DOS not required).

Graphics Adapter – Color EGA or VGA.

Monitor – Color EGA or VGA.

Fixed Disk Drive – One MB minimum.

Floppy Disk Drive – 3.5 in., 1.44 MB or 5.25 in., 1.2 MB capacity. IBM compatible.

Mouse – Not required. (Two- or three-button Microsoft-compatible serial mouse possible to use.)

Math Coprocessor – (80287 or 80387) Not required.

Compatible Printers – IBM Pro Printer, Epson MX and FX, Hewlett-Packard ThinkJet, Hewlett-Packard LaserJet, Hewlett-Packard DeskJet, PostScript.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TelScout
Basic Configuration. Order TS100.
Includes: Test Leads (two sets), Soft Carrying Case with Shoulder Strap, U.S. AC Adapter/Charger, 120 V AC, 60 Hz, 9 V @ 1 A, Cigarette Lighter Charger Cable, User Manual, Quick Reference Card. The rechargeable internal battery is a standard feature.

Opt. 01 – Adds 5 ns Pulse Width.

Opt. 1C – Universal Euro Adapter/Charger, 220 V AC, 6 A, 50 Hz (119-4240-00).

Opt. 2C – United Kingdom Adapter/Charger, 240 V AC, 5 A, 50 Hz (119-4239-00).

Opt. 3C – Australian Adapter/Charger, 240 V AC, 5 A, 50 Hz (119-4238-00).

Opt. 6C – Japanese Adapter/Charger, 110 V, 1 A, 60 Hz (119-4241-00).

SERVICE ASSURANCE OPTIONS

REP4300 – Provides one year of post-warranty Repair Protection.

CAL4300 – Provides one year of Calibration Services.

OPTIONAL ACCESSORIES

Cigarette Lighter Charger Cable – Order 174-1734-00.

General Printer Cable – Order 012-1313-00.

Seiko DPU-411 Printer Cable – Order 012-1462-00.

Printer, Seiko DPU-411 – Order 119-4594-00.

Thermal Paper for Seiko Printer – Order 006-7840-00.

AC Adapter/Charger, 220 V AC for Seiko Printer – Order 119-4648-00.

MCTAP
Metallic Cable Trace Analysis Package.
Includes: Disk Pack: Contains one 3.5 in. and one 5.25 in. Floppy Disk; MCTAP User Manual (070-9306-00); RS-232C Cable (012-1379-00).

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

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TDR Cable Tester for CATV

TV110 CableScout™

Features

TV110 CABLESCOUT

- One-step Setup and Acquisition
- Exclusive One Button Zoom/Overview Function
- Fully Automatic and Manual Control Modes
- Context Sensitive Help (Help Screens Available for All Functions)
- Internal Memory for 20 Waveforms with Notes
- Large, High-resolution Display (2.5 in. x 6 in.)
- Intermittent Fault Location
- Noise Reducing Digital Trace Smoothing
- Marker Function Measures Relative Distance Between Any Two Points
- Serial RS-232 Printer Output
- Rain, Dust, and Shock Proof Packaging (2 meter (6 ft.) Drop Tested)

Applications

THE TV110 CableScout IS DESIGNED SPECIFICALLY FOR CATV/COAXIAL CABLE APPLICATIONS

- Dedicated 75 Ω F Connector
- Pulsewidths Optimized for CATV/Coaxial Cable Runs
- Return Loss Measurement
- Sample Waveforms, Cable Types and Vps Stored in Memory



TV110 CableScout

CableScout TDR

If your job is to find faults on coaxial cable, the new Tektronix TV110 CableScout is built for you. Designed specifically for CATV and other coaxial cable applications, CableScout applies the newest technology to provide both ease of use and coaxial cable testing performance that cannot be found in any other TDR.

With the TV110, you'll spend less time operating the TDR and more time repairing faults. Simply select the cable type to be tested and CableScout does the rest. Pulse width, Vp, gain, and vertical position are automatically selected and adjusted as you scan the cable. Finding the fault couldn't be faster; just move the cursor to the fault and use the one button zoom function to pinpoint its location. Identifying the fault is easy: just activate the dual trace display to compare your waveform to the stored sample CATV waveforms. Then use the TV110's standard waveform memory to store and document your results.

On the performance side, CableScout employs optimized pulsing and sampling, coupled with advanced filtering and signal processing techniques. That way, you'll always have a clean waveform for easier event identification.

Best of all, you get all this performance and ease of use in the industry's most rugged TDR package. Come snow, rain, heat and humidity, CableScout keeps working, because you have to.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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TDR Cable Tester for CATV

TV110 CableScout™

Characteristics

Test Signal – 1/2 Sine.

Amplitude – 15 V into 75 Ω.

Output Impedance – 75 Ω.

Pulse Widths – 6 and 12 ns.

Input Protection – ±400 V, DC and ±400 V, peak AC, to 440 Hz.

Maximum Range – 1830 m (6000 ft.) depending on cable type and condition.

Display Resolution – 0.33% of selected range, 4.5 cm (0.15 ft.) minimum, on 640 x 200 pixel high resolution reflective liquid crystal display 6.35 x 15.24 cm (2.5 x 6 in.).

Display Ranges – Eight display ranges plus single button expand window.

Filter – High pass, cutoff frequency 150 kHz, user selectable.

Amplifier – A 5 mV reflection produces a fullscreen vertical deflection.

Gain – 0 to 63 dB.

Waveform Storage – Up to 20 waveforms with notes.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	300	12
Height	250	10
Depth	90	3.5
Weight	**kg**	**lb.**
Net	3	6.4

Horizontal Accuracy – 0 to 600 m = ±0.6 m, ±uncertainty in Vp. 601 m to 1,830 m = ±1 m, ±uncertainty in Vp. 0 to 2,000 ft. = ±2 ft., ±uncertainty in Vp. 2,001 ft. to 6,000 ft. = ±3 ft., ±uncertainty in Vp. Horizontal measurements in feet, meters, or time.

Mains Operation – 110 V, 220 V, or 240 V, with appropriate AC to DC adapter.

Battery Operation – 8 hours, continuous operation (4.6 A hours).

Battery Saver – 5 to 30 minutes or disabled, selectable.

Printer Interface – Serial 9-Pin D-type connector.

ENVIRONMENTAL

Operating Temperature – –15°C to +60°C (5°F to 140°F).

Nonoperating Temperature – –20°C to +65°C (–5°F to 150°F).

Humidity – 95% RH (non-condensing).

Shock – Survives drop of two meters (6 ft.) to concrete in standard soft case.

EMI Emissions – FCC part 15, subpart J, class A; VFG243 and EN55022.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TV110 CABLESCOUT
TDR Cable Tester for CATV.
Includes: BNC to Alligator Clips (F to BNC, and F to F Barrel Adapters), Coaxial Jumper Cable, Soft Carrying Case with Shoulder Strap, U.S. AC Adapter/Charger (120 V AC, 60 Hz, 9 V @ 1A), User's Manual, Quick Reference Card, Rechargeable Internal Lead Acid Battery, Standard 1 Year Warranty.

Opt. 1C – Changes U.S. AC Adapter/Charger to 119-4240-00 Universal Euro Adapter/Charger, 220 V AC, 6 A, 50 Hz.

Opt. 2C – Changes U.S. AC Adapter/Charger to 119-4239-00 United Kingdom Adapter/Charger, 240 V AC, 5 A, 50 Hz.

Opt. 3C – Changes U.S. AC Adapter/Charger to 119-4238-00 Australian Adapter/Charger, 240 V AC, 6 A, 50 Hz.

Opt. 6C – Japanese Adapter/Charger, 110 V, 1 A, 60 Hz (119-4241-00).

SERVICE ASSURANCE OPTIONS

REP4300 – Provides one year of post-warranty Repair Protection.

CAL4300 – Provides one year of Calibration Services.

OPTIONAL ACCESSORIES

Cigarette Lighter Charger Cable – Order 174-1734-00.

General Printer Cable – Order 012-1313-00.

Seiko DPU-411 Printer Cable – Order 012-1462-00.

Printer, Seiko DPU-411 – Order 119-4594-00.

Thermal Paper for Seiko Printer – Order 006-7840-00.

AC Adapter/Charger, 220 V AC for Seiko Printer – Order 119-4648-00.

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ISDN
CT100 CrafTek™

Features

CT100 CrafTek™

- Craft Tool for Subscriber Loop Installation and Maintenance:
  - ISDN Basic Rate
  - EBS (P-Phone)
- Highly Flexible Architecture for Easy Upgrading
- Rugged, Lightweight, Battery Operation
- ISDN Service Verification
  - EOC and Cause Messages
  - BERT
  - NEBE/FEBE Tests
  - Loopback
  - Info, LAP-D, and Call States
  - Local Power
  - Sealing Current
- EBS P-Phone Verification
  - Call Appearance and Feature Verification
  - DC Voltage
  - Signaling Channel



CT100 CrafTek Subscriber Loop Portable Test Set.

CT100 CrafTek™ Subscriber Loop Portable Test Set

The CrafTek Subscriber Loop Test Set is designed to meet the changing needs of the telephone craftsperson, with flexibility to handle rapidly evolving and increasingly sophisticated digital technologies. The platform is built to support multiple loop technologies from multiple vendors, allowing each unit to be custom-configured.

The CrafTek's ruggedness, portability and multiple power options assure use in any environment, minimizing customer downtime. Extensive ease of use features, like self-prompting, plain-English menu displays, speed dialing, and stored settings assure users are productive from the start.

THE CrafTek: PUT IT TO WORK

Each CrafTek comes equipped for 2B1Q ISDN service and can perform the fundamental tests required for installation and maintenance of ISDN lines. These tests include BERT, NEBEs, FEBEs, B-channel loopback, and D-channel packet.

For EBS P-Phone, the CrafTek goes much beyond a simple butt-in, allowing service verification and trouble-shooting of EBS lines. A variety of operating modes and measurements are ideally suited to craft needs.

THE INTEGRATED CRAFT SOLUTION

During installation, the CrafTek allows you to turn up services even before customer premises equipment is delivered. Once the system is up and running, the CrafTek becomes the first line of defense, allowing location and repair of service problems on the first call. There's no longer the need to escalate the problem or to rely on expensive protocol analyzers or on multiple test equipment.

Characteristics

CrafTek™ PLATFORM

Display – Supertwist Liquid Crystal (LCD), Backlit.

User Interface – Easy-to-use menus with extensive user prompts and error messages via 4-line x 20 character LCD.

Power Supply – Rechargeable NiCad battery pack. Alkaline "C" cells, or 120 V AC with adapter. "Low Battery" and "Charging" indicators via LCD. Automatic shut-off.

Interface Ports – Four RJ45-type jacks (LINE, S/T(NT1), S/T(TE), AUXiliary).

Speed Dial – Storage for ten numbers (up to 22 digits per number) plus last number redial.

PHYSICAL ENVIRONMENT

Weather, moisture, dust and shock resistant. Designed for rugged field use.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

ISDN

CT100 CrafTek™

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	84	3.30
Length	273	10.75
Depth	83	3.25
Weight ≈	**kg**	**lb.**
Net	1.5	3.35

Safety – UL 1244, CSA C22.2 No. 223.

ISDN TE

TE Compatibility – AT&T terminal equipment; NORTEL terminal equipment; National ISDN equipment.

Software Generics – Currently compatible with AT&T software generics up to and including 5E9; NORTEL DMS-100 up to and including BCS-36; National ISDN-1.

TE Functions – Provides basic voice and circuit-switched data services plus redirect. Supports B-Channel loopbacks using BRITL (Basic Rate Interface Test Line). Supports D-Channel X.25 Packet Data testing (calling and answering).

S/T Interface – Complies with T1.605-1991 ISDN Basic Rate Interface Specifications.

TE Terminations – User selectable: Bridged, 100 Ω.

"T" Pad Attenuation – Range: 0 to 15 dB; Resolution: 1 dB.

"T" Synchronization – LED: Red = No Sync; Orange = Sync, not Activated; Green = Sync and Activated.

Hook LED – Red = Awaiting Dial Tone; Orange = Negative Acknowledgment; Green = Dial Tone/Active Call.

ISDN NT1

2B1Q Interface (Opt. 2B) – Meets specifications defined in ANSI T1.601-1992 Standard. Complies with all 15 defined ANSI "U" loops. Supports Quiet and Insertion Loss Modes (AC/DC Triggers).

NT Terminations – User selectable: Bridged, 100 Ω, 50 Ω.

"U" Pad Attenuation – Range: 0 to 42 dB; Resolution: 1 dB.

"U" Synchronization – LED: Red = No Sync; Orange = Sync, not Transparent; Green = Sync and Transparent.

ISDN MEASUREMENTS AND INDICATORS

BER Testing – Provides BER testing on either B-Channel (56 kbps, 64 kbps).

Near End Block Errors (NEBE) – Total errors, errored seconds, selectable elapsed time.

Far End Block Errors (FEBE) – Total errors, errored seconds, selectable elapsed time.

Sealing Current –
Presence with polarity indication.

2B1Q Battery –
Presence with polarity indication.

Local Power –
Presence with polarity indication.

S/T Power Sources 1, 2 and 3 –
Presence with polarity indication.

TE Receive Level – Range: –9 dB to +3 dB; Resolution: 0.5 dB.

Indicators via LCD – INFO ("F" and "G") States, LAPD and CALL States, B-Channel Assignment, TEI Number, ANI Number, CAUSE messages, and NT1 EOC messages.

EBS (P-PHONE)

P-Phone Interface (Opt. 3B) – Provides support for NORTEL "Electronic Business Service," including phone emulation for primary set, add-on sets, and Monitor mode (allows passive monitoring of voice and signaling channels); 2x16 message display.

P-Phone Measurements – DC Voltage and Polarity; Peak signal level of 8 kHz signaling channel; Signaling Message elements (Hex and decoded displays, with buffer).

RS-232 SERIAL PORT

RS-232 Interface (Opt. 2A) – Provides an RS-232 interface for data logging to a printer or PC (ISDN signaling, measurements, EBS signaling, CLASS messages) and D-channel data sourcing.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CRAFTEK™ SUBSCRIBER LOOP PORTABLE TEST SET

Order CT-100.

Includes: ANSI 2B1Q "U" Interface; Soft Padded Carrying Case (016-1073-00); User Manual (070-7895-06); Reference Card (070-7921-06); Rechargeable Battery Pack (016-1072-00); AC Adapter/Charger (119-2731-00); RJ11 to RJ11 Cord (012-1363-00); RJ45 to RJ45 Cords (012-1364-00); RJ11 to Bed-of-Nails Clips (012-1365-01); CLEI Number: TETQ3006AA.

Opt. 2A – RS-232 Interface.

Opt. 3B – EBS (P-Phone) Interface.

Opt. 46 – RJ45 to Bed-of-Nails Clips. Order 012-1366-01.

ADDITIONAL ACCESSORIES

Soft Padded Carrying Case – Order 016-1073-00.

Rechargeable Battery Pack – Order 016-1072-00.

Portable RS-232 Printer – Order 119-4594-00.

WARRANTY

One Year Warranty.

Rep 4200 – Provides one year of post-warranty Repair Protection.

UPGRADES

For ordering information to upgrade existing CrafTek test sets with new interface options or the latest operating firmware, please contact your local Tektronix representative or call the TeleBusiness Center at 1-800-426-2200.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

SDH/SONET Test Sets

CTS 710 • CTS 750

Features

CTS 710/CTS 750

- 52 Mb/s, 155 Mb/s, and 622 Mb/s Transmit and Receive
- DS1 and DS3 Testing (Optional)
- 2 MB, 34 MB and 140 MB Testing (Optional)
- Bit Error Rate Testing Including BIP Error Monitoring and Analysis
- Payload Mapping and Demapping
- Tributary Add, Drop and Test
- Pointer Generation and Analysis
- Alarms Generation and Analysis
- DCC and User Channel Access
- APS Testing
- Simple User Interface
- Automatic Setup
- Pass/Fail Testing
- Rugged Modular Design, Customer Configurable
- Disk Drive
- IEEE 488.2 and RS-232C

Applications

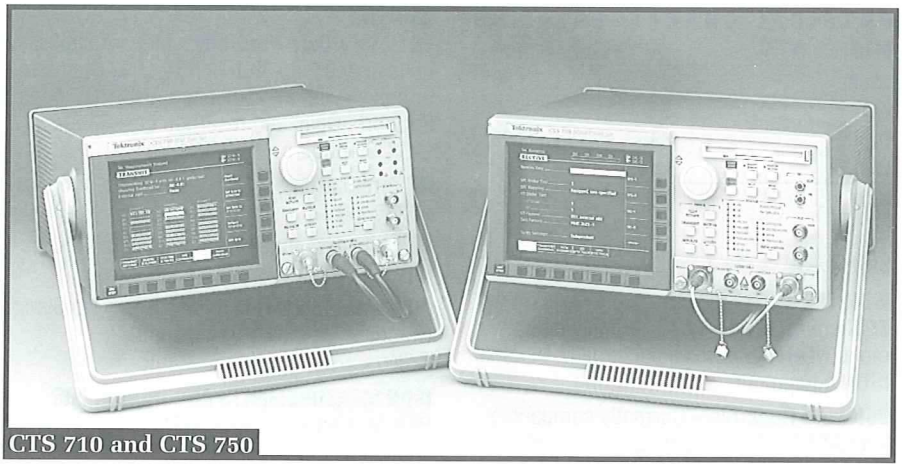
- Network Integrity Testing
- In-service Performance Monitoring
- Overhead Testing
- Tributary Mapping and Demapping
- Tributary Testing
- Stimulus and Response Testing
- Stress Testing

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, RS-232C, and with Tektronix Standard Codes and Formats.*

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ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*



CTS 710 and CTS 750

CTS 700 Series

The ITU-T and ANSI standards for SDH/SONET specify requirements for the network element (ADM, multiplexers, terminals, etc.) interfaces. Installation, commissioning, maintenance and repair of the SDH/SONET network involves the challenge of testing to ITU-T and ANSI standards. The CTS 700 Series is ready for the challenge to assist with these and other testing needs. In one configurable, expandable and upgradable instrument you will find everything required to do your testing.

CONFIGURABLE

The CTS 700 Series is a rugged portable test set designed not only for your current tasks; through its unique architecture, it will grow with you as SDH and SONET grows. When you require additional capabilities such as optical interfaces, jitter analysis, ATM testing, etc., you can add such functionality to your CTS 700. This upgradability is important due to evolving nature of the standards, test requirements and equipment capabilities.

The CTS 700 Series is part of a new generation of test sets combining various different functions in one instrument with the power to go beyond basic testing. The modular nature of the test set allows you to configure the instrument to your needs, without the cost of unwanted built-in capabilities. Starting with a low cost platform which addresses your basic SDH or SONET testing needs, you can expand its capabilities as desired with a growing number of options.

EASY TO USE

The CTS 700 Series incorporates a number of new productivity features:

- AutoScan – Graphically presents the incoming signal structure and allows easy instrument setup
- Pass/Fail Testing – Automates following a written test procedure
- TroubleScan – Highlights error, alarms, and defects
- Graphical Displays – For historical trend analysis
- Online Help – For quick assistance with operation
- Disk Drive – For easy storage of instrument setups, Pass/Fail Test and results

These instruments employ innovative hardware technology which reprograms itself, depending on the operational mode. Future demands regarding access and control of particular bytes are easily reprogrammed. Upgrades are distributed on disks.

Please refer to the data sheet for more technical specifications.

SDH/SONET Test Sets

CTS 710 • CTS 750

CTS 710 SONET/DS3/DS1 Test Set

TRANSMIT AND RECEIVE RATES

- STS-1, STS-3 (electrical)
- STS-3c and OC-3c
- OC-1, OC-3, OC-12 (optical)
- DS1, DS3 (Opt. 22)
- Compliance to ANSI T1-105

GENERATION AND ANALYSIS

- Testing of Bit Error Rates including B1, B2, B3, VT BIP, Line FEBE, Path FEBE and Payload
- Complete alarm monitoring and generation
- Measurements: 1 sec to 99 days
- Histograms: 72 hours with 1 minute resolution. 45 days with 15 minute resolution
- Measurements with ANSI T1M1.3 analysis

OVERHEAD MANAGEMENT

Transport Overhead, Path Overhead and VT Overhead

- Set and View Byte Value: All
- Set and View Byte Trace Message: J1
- Add/Drop: DCCs, F1, F2

CTS 750 SDH/PDH Test Set

TRANSMIT AND RECEIVE RATES

- STM-0E, STM-1E (electrical)
- STM-0, STM-1, STM-4 (optical)
- 2 Mb/s, 34 Mb/s, 140 Mb/s (Opt. 36)
- Compliance to ITU-T G.707, G.708, G.709

GENERATION AND ANALYSIS

- Testing of Bit Error Rates including B1, B2, B3, TU BIP, MS FEBE, Path FEBE and Payload
- Complete alarm monitoring and generation
- Measurements: 1 sec to 99 days
- Histograms: 72 Hours with 1 minute resolution. 45 days with 15 minutes resolution.
- Measurements with ITU-T analysis according to G.826, G.821, M.2100

OVERHEAD MANAGEMENT

Section Overhead, Path Overhead and TU Overhead

- Set and View Byte Value: All
- Set and View Byte Trace Message : J1, J2
- Add/Drop: DCCs, F1, F2

CTS 710/CTS 750

OTHER

- APS Control
- Pointer movement control
- Complete Pointer Sequence selection in accordance with ITU-T G.783 and ANSI T1X1.6
- Timing offset up to ±100 ppm
- DS1 and DS3 T-carrier testing (Opt. 22)
- 2 Mb/s, 34 Mb/s, 140 Mb/s (Opt. 36) PDH testing
- Disk storage: 200 instrument setups, or 400 hours of results including histories, or 200 Pass/Fail tests on each disk (DOS compatible)

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	164	6.4
Width	491	14.25
Depth	1362	19.25
Weight	**kg**	**lb.**
Net	10	22.5

Please refer to the data sheet for more technical specifications.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CTS 710
SONET DS3/DS1 Test Set.
Includes: User Manual, Reference Manual, Performance Verification, Front Cover, Accessory Pouch, 75 Ω Cable, Power Cord.

CTS 750
SDH/PDH Test Set.
Includes: User Manual, Reference Manual, Performance Verification, Front Cover, Accessory Pouch, 75 Ω Cable, Power Cord.

OPTIONS FOR CTS 710 AND CTS 750

Opt. 03 – Optical/Electrical Interface, 52 Mb/s, 155 Mb/s, 1310 nm.
Includes: Two Optical Connector Kits 020-1885-00 for FC-PC, ST, DIN, SC.

Opt. 04 – Optical/Electrical Interface, 52 Mb/s, 155 Mb/s, 622 Mb/s, 1310 nm.
Includes: Two Optical Connector Kits 020-1885-00 for FC-PC, ST, DIN, SC.

Opt. 05 – Optical/Electrical Interface, 52 Mb/s, 155 Mb/s, 622 Mb/s, 1550 nm, 0 dBm Power.
Includes: Two Optical Connector Kits 020-1885-00 for FC-PC, ST, DIN, SC.

Opt. 06 – Optical/Electrical Interface, 52 Mb/s, 155 Mb/s, 622 Mb/s, 1310/1550 nm.
Includes: Two Optical Connector Kits 020-1885-00 for FC-PC, ST, DIN, SC.

Opt. 11 – 1.6/5.6 Connector Adapter Kit for CTS 750.

OPTIONS FOR CTS 710 ONLY

Opt. 22 – DS1 and DS3 Testing.
Includes: Standalone, Map/Demap and Add/Drop.

OPTIONS FOR CTS 750 ONLY

Opt. 36 – 2 Mb/s, 34 Mb/s and 140 Mb/s Testing.
Includes: Standalone, Map/Demap and Add/Drop.

SERVICE ASSURANCE OPTIONS
3 Year Warranty Standard.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.
Opt. A2 – United Kingdom 240 V, 50 Hz.
Opt. A3 – Australian 240 V, 50 Hz.
Opt. A4 – North American 240 V, 60 Hz.
Opt. A5 – Switzerland 220 V, 50 Hz.

FIELD UPGRADE KITS

CTS7F01 – Electrical Interface 52 Mb/s, 155 Mb/s, 75 Ω BNC.
CTS7F03 – Optical/Electrical Interface, 52 Mb/s, 155 Mb/s, 1310 nm.
CTS7F04 – Optical/Electrical Interface, 52 Mb/s, 155 Mb/s, 622 Mb/s, 1310 nm.
CTS7F05 – Optical/Electrical Interface, 52 Mb/s, 155 Mb/s, 622 Mb/s, 1550 nm.
CTS7F22 – DS1 and DS3 Testing.
Includes: Standalone, Map/Demap and Add/Drop.
CTS7F36 – 2 Mb/s , 34 Mb/s and 140 Mb/s Testing.
Includes: Standalone, Map/Demap and Add/Drop.

ACCESSORIES

Rackmount – Order 016-0819-1x.
Optical Connector Kit – **Includes:** FC-PC, ST, DIN, SC. Order 020-1885-00.
Battery Powered Printer – HC411 Opt. 04.
Hard Transit Case – Order 016-1157-00.
Soft Carrying Bag – Order 016-1158-00.

CART
Order K212.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, RS-232C, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*

SDH/SONET Test Sets

New ST112 SONET Test Set

Features

ST112

- OC-1/3/3c/12 Framing and Payload per Bellcore, ITU, and ANSI Specifications
- Complete Overhead and Bit Error Rate Testing (BERT)
- Extended Control and Measurement Display via VT100 and RS-232 Support
- STS-3c, DS3, and VT1.5 Payload Mappings
- User-upgradeable Software
- Unique VT1.5 Channel Scan and SONET Trouble Scan
- Standalone DS1/3 Test Capability
- Six DSX-3 or Six STSX-1 and Four DSX-1 Outputs
- LabVIEW*[1] Driver Compatibility
- Quick Setup for Automatic Configuration of Standard Test Modes
- AutoSeek (Automatic Detection of Receive Signal) and AutoLink (Receiver Follows Transmitter)
- Full SPE and VT pointer control
- Multiple Electrical Outputs for Four DS1, Six DS3/STSX-1
- Access to All SONET Overhead Bytes
- Data Communications Channel (DCC) Add/Drop
- Multiple Simultaneous Timed Alarms and Errors (for Software Regression Testing and Other Applications)

*[1] *LabVIEW is a registered trademark of National Instrument Corporation.*

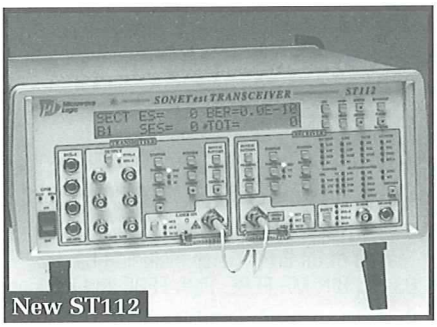
Applications

- SONET Network Element Testing
- Loopback Testing
- End-to-End Testing and Monitoring
- Path Provisioning and Performance Monitoring

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

See Tektronix on the World Wide Web: http://www.tek.com



ST112 Portable Transceiver

The portable ST112 transmission analyzer is on the leading edge of today's growing need for SONET testing. It's designed not only to support today's needs, but tomorrow's emerging technologies as well. The powerful ST112 is a compact single-unit solution for providing extensive SONET STSX-1, OC-1, OC-3, OC-3c, and OC-12 signal generation and analysis for tributary and network testing. Optimized for lab-based conformance and field-based installation testing, the ST112 extends SONET testing technology to ATM by delivering a clear channel STS-3c concatenated mapping in addition to the standard DS3 and VT1.5 mappings. The ST112 combines easy-to-use, powerful test solutions with user-upgradeable software to meet evolving SONET standards.

RUGGED, PORTABLE DESIGN WITH POWERFUL FEATURES

While its portable, lightweight transceiver design makes the ST112 an ideal SONET test set, its extensive DSX-1 and DSX-3 test capabilities also provide outstanding network payload drop testings. At less than 22 pounds, the ST112 is the single-unit solution for all SONET testing where portability and ease-of-use are important. Standard RS-232, GPIB, and parallel printer interfaces, as well as VT100 terminal capability, provide the ST112 with complete remote control, display, and printed report features.

SIMPLE TO USE

The following features make the ST112 simple to use:

- Front-panel LEDs provide instantaneous identification of the operational status and alarms
- Built-in LCD screen displays test menus and results
- AutoLink feature automatically resets receiver to match user-updated transmitter settings
- VT100 terminal interface allows easy remote access to extended menus
- Interruptible pause/resume aids completion of long test cycles

UPGRADEABLE SOFTWARE EVOLVES WITH SONET STANDARDS

The ST112's advanced design enables the user to easily install software upgrades. This feature avoids obsolescence and keeps the ST112 on the leading edge of the evolving SONET standards.

EXTENSIVE SONET TEST CAPABILITIES

The ST112's SONET capabilities include not only optical carrier generation, but also STS-3c, DS3, and VT1.5 payload generation. Additional features include:

- VT Channel Scan for testing VT mappings
- Event sync (Option 07) provides output signals for deriving switch timing or propagation delay from alarm conditions
- Byte synchronous payload mapping for next generation DLC testing
- Full error and alarm generation

The ST112 Receiver analyzes the incoming optical signal and displays performance monitoring information for the optical signal and payloads.

TROUBLESCAN SYSTEMATICALLY SEARCHES FOR ERRORS

The ST112 has been carefully engineered to enable the user to work smarter, not harder. For example, the ST112 Receiver has a unique, time-saving feature called STS TroubleScan, which systematically scans the entire input signal and displays any detected errors and alarms on all payload envelopes.

Characteristics

SYNCHRONIZATION INTERFACES

Internal –
SONET: 51.84 MHz ±10 ppm.
DS3: 44.736 MHz ±10 ppm.
DS1: 1.544 MHz ±100 ppm.

External – SONET: 51.84 MHz ±100 ppm; 155.52 MHz ±20 ppm.

SDH/SONET Test Sets

New ST112 SONET Test Set

Loop Timing – Recovered Rx Clock to Transmitter.

BITS Timing – DSX-1 input used as Tx Timing Reference.

PAYLOADS

DS3 Payload –
General: A single internally or externally generated asynchronous DS3 signal is mapped into an STS-1 payload.
Frame Patterns: M13, C-bit, unframed.
Payload Patterns: $2^{23} - 1$, $2^{15} - 1$, AIS, Idle, All Ones.

Tributary VT1.5 Payload –
General: A single internally or externally generated asynchronous DS1 signal is mapped into a specified STS-1 payload virtual tributary.
Active channel pattern: PRBS $2^{23} - 1$, QRW, 3/24, 55 Octet, All Ones.
Framing: Unframed, SF, ESF, SLC96.
Modes: Floating, Bit Asynchronous, Simplified H4 Coding, Bit Synchronous Locked, Byte Floating, Byte Locked.
VT Pointer Justification: Positive and negative single justifications. New Data Flag (NDF) operations cause the pointer to jump to a new location.
Payload structure: DS1 payload is mapped into one channel or all 28 channels.

STS-c Payload – An internally generated $2^{23} - 1$ PRBS sequence with valid path overhead.

ALARM AND ERROR GENERATION

Section – Loss of Signal (LOS), Loss of Frame (LOF), BER, Single error inject.

Line – Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Bit Error Rate (BER), Single error inject.

Path – Loss of Pointer (LOP), STS Path Yellow, STS Path AIS, BER, Single error inject, Far End Block Error (FEBE).

VT – VT LOP, VT Path Yellow, VT Path AIS, BER.

Alarm Type – Burst or continuous, External TTL event trigger when alarm is activated.

Random Bit Error Injection – 1.5×10^{-3} to 10^{-9} rate or single.

Bipolar Pulse Violation – 1.5×10^{-3} to 10^{-9} rate or single.

EDITING

Transport and Path Overhead Byte Modification – All of the overhead bytes except B1-B3 and H1-H3.

Pointer Control – Single positive and negative pointer justifications and NDF pointer changes to any valid value for both SPE and VT.

GENERAL

Frame Detection –
STS-1: Detection based on A1, A2.
STS-3/12: Detection based on A1, A2, A2.

Indicator Lamps – LEDs provide current and history status for Section, Line, Path, SPE, VT, DS1, and DS3 status.

NOTE: CLASS 1 LASER PRODUCT. This product conforms to the applicable requirements of 21 CFR 1040 at the date of manufacture.

MEASUREMENTS

SONET Alarms –
Section: B1 Code Errors OOF (Out-Of-Frame), LOF, Frame pattern errors, LOS.
Line: B2 Code Errors, LOP, FEBE, AIS.
Path: B3 Code Errors, AIS, Yellow, FEBE.

Payload Parameters –
VT path: BIP-2, AIS, Path, Yellow, FEBE.
DS3 payload: Parity and frame errors, bit errors, AIS, Idle and All Ones, X-Bit.
VT1.5 payload: Bit Errors (PRBS or fixed word), AIS, Yellow, CRC-6, Frame errors, LOF.
STS-3c payload: Bit Errors.

T-carrier Parameters –
DS3: BPV, Parity, Bit, and Status parameters.
DS1: BPV, CRC, Bit, and Status parameters.

PERFORMANCE STATISTICS

Parameters –
Section (B1): Total, Rate, ES, SES Total.
Line (B2): Total, Rate, ES, SES Total.
STS Path (B3): Total Rate, ES, SES.
VT Path (BIP-2): Total, Rate, ES, SES Total.
Payload/DS3 (Bit and Parity): Rate, Total, ES, SES.
Payload/DS1 (Bit Error): Rate, Total, ES.
Payload/3c (Bit Error): Rate, Total, ES.

DATA COMMUNICATIONS CHANNEL

Section – D1-D3, 192 KB/s.

Line – D4-D12, 576 KB/s.

ORDERWIRE

Local and Express handset interface.

REMOTE INTERFACES

Ports – RS-232C, GPIB, parallel printer.

Drivers – VT100 terminal.

OPTICAL SPECIFICATIONS

OC-1/3 Tx Power Out – –10 dBm.

OC-12 Tx Standard Power Out – –8 dBm.

OC-12 TX High Power Out – –4 dBm.

OC-1/3/12 Rx Sensitivity – –30 dBm.

POWER

AC Line – 115/220 V AC ±10%.

Power Consumption – 250 W maximum.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	152	6.0
Width	366	14.4
Depth	419	16.5
Weight	**kg**	**lb.**
Net	10	22

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

ST112
Portable SONET Transmission Tester.
Includes: Power Cord, Manual.

Opt. 03 – OC-1/3/3c Testing 1310 nm FC Connector.

Opt. 04 – OC-1/3/3c/12 Testing 1310 nm FC Connector.

Opt. 06 – LabVIEW*[1] Drivers for Remote Test.

Opt. 07 – Event Sync Output.

Opt. 1C – Replace BNC Connectors with WECO 560.

Opt. 2C – Replace 310 Connectors with Bantam.

Opt. 3C – Replace FC Connectors with SC.

Opt. 4C – Replace FC Connectors with ST.

Opt. 1M – Rackmount.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES

Soft Carrying Case for Transmitter or Receiver – Order 016-1442-00.

Transit Case for Transmitter or Receiver – Order 016-1443-00.

10-ft. 25-Pin Male-to-Male RS-232 Cable – Order 012-1384-00.

10-ft. 25-Pin Male to 9-Pin Female RS-232 Cable – Order 012-1298-00.

[1] LabVIEW is a registered trademark of National Instrument Corporation.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

SDH/SONET Test Sets

New ST2400

Features

ST2400

- 2.4 Gb/s Section and Line Testing for OC-48 and STM-16 (2.4 Gb/s Multiplexer Section/Regeneration Section–Europe)
- Easy Front-panel Control – No External PC Required
- Configurable as a Receiver, a Transmitter, or a Transceiver
- Through Mode Operation
- Software Download of New Features
- Full-screen VT100 Operation
- Integrated ST112 Control Option for DS1 through OC-48 SONET Testing
- Works with CTS 750 for E1 to STM-16 SDH Testing
- Compact Size for Portability
- Payload Independent

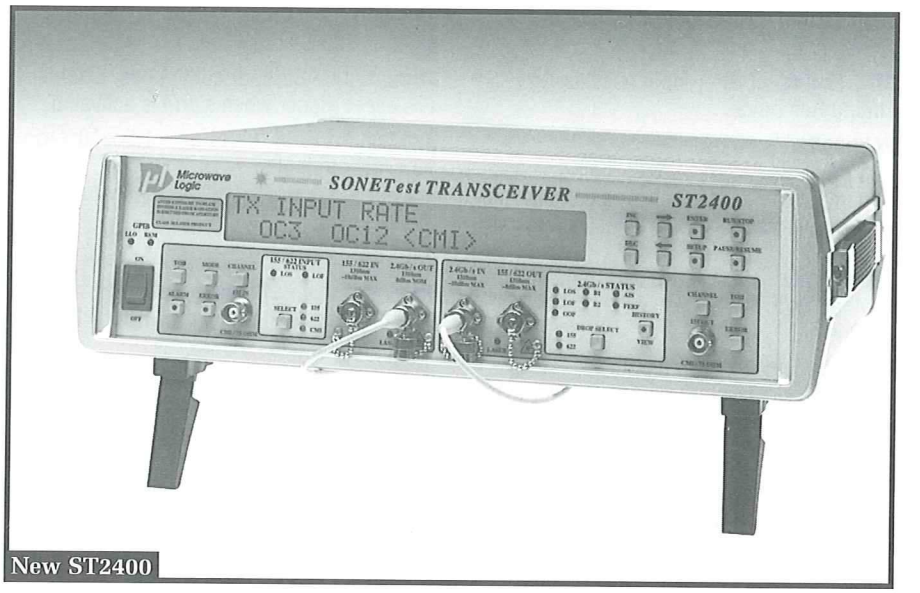
Applications

- Testing of 2.4 Gb/s SONET-SDH Network Elements and Transmission Lines
- 10 Gb/s System (OC-192 or STM-64) Drop Testing
- Independent Monitoring and Arbitration at System Boundaries
- Network Evaluation, Provisioning, and Maintenance
- SDH/SONET Bit Error Rate Tester for SONET Component and Equipment Manufacturers (Conformance and Compliance)

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

See Tektronix on the World Wide Web: http://www.tek.com



New ST2400

ST2400 OC-48/STM-16 Generator/Analyzer

The ST2400 provides intuitive 2.4 Gb/s SONET and SDH testing in a portable package. The ST2400 operates: 1) Standalone; 2) In conjunction with Tektronix CTS 710/750 or any lower-rate SONET or SDH test set; or 3) As an add-on to the ST112 SONET Transmission Tester for DS1 through OC-48 testing (also as an add-on to the CTS 750 SDH Transmission Tester for E1 through STM-16 testing–Europe). The ST2400 is easy to use and helps assure the "health" of your network.

The 2.4 b/s transport capacity offered by OC-48 and STM-16 systems represent the equivalent of over 32,000 voice channels. That's a lot of customers, all of whom expect uninterrupted, high quality service.

The ST2400 works alone or with lower-rate SDH/SONET testers to assure that your critical 2.4 Gb/s transport systems are installed and operating correctly. If troubles occur, the ST2400 can locate and fix problems quickly.

The ST2400 provides passive monitoring and active testing. It operates in both "through" and "terminal" modes. The ST2400 applications include section and line testing of 2.4 Gb/s SDH/SONET network elements and transmission lines for product evaluation, provisioning, and maintenance; 10 Gb/s system (OC-192 or STM-64) drop testing and independent monitoring and arbitration at system boundaries, such as between LEC (Local-Exchange Carrier) and IXC (Inner-Exchange Carrier) networks or between SONET and SDH networks. In through mode, the 2.4 Gb/s signal can be relayed unchanged or have alarms and errors injected for stress and conformance testing.

The ST2400 does not require a separate computer for control and is about half the size of most 2.4 Gb/s testers.

PASSIVE MONITORING

The ST2400 Receiver provides cost-effective, independent, and non-intrusive monitoring of LEC-IXC, SDH/SONET, or other cross-boundary 2.4 Gb/s lines. Results can be monitored remotely via RS-232 or GPIB. ST112/ST2400 integrated control software is available for full-rate SONET testing. The OC-48/STM-16 optical signal is split through a passive coupler which is located in an optical cross-connect bay or other convenient location. Since there is no active regeneration of the optical line, the system-under-test must have adequate margin to allow insertion of the coupler. Measurements can be made with the ST2400 (receiver only configuration – Option 3R), which is very cost effective for passive monitoring. As required, an ST112 or other SDH/SONET tributary test set can be used in conjunction with the ST2400. Measurements are made with the ST2400 and, as required, the ST112 or similar tributary tester.

SDH/SONET Test Sets

New ST2400

ACTIVE ANALYSIS OF THE 2.4 Gb/s LINE
For active analysis of the 2.4 Gb/s line, the ST2400 is actively inserted into the signal path. An ST112 or any 155 Mb/s or 622 Mb/s SDH/SONET test set is required to provide a framed signal input to the ST2400. The ST2400 provides a variety of signal and analysis options for complete testing of the 2.4 Gb/s line.

ACTIVE "THROUGH" ANALYSIS OF THE 2.4 Gb/s LINE
For active "through" analysis of the 2.4 Gb/s line, the ST2400 is actively inserted into the signal path as either a regenerator or as a stress tester. The OC-48/STM-16 signal is looped through the ST2400. The signal can be passed through regenerated and unchanged or with alarms and errors added for stress or conformance testing. Standalone, the ST2400 can quickly verify the 2.4 Gb/s signal for correct operation. In conjunction with a companion SDH/SONET tributary test set such as the ST112, CTS 710, or CTS 750, the ST2400 can make all the transmission measurements required to completely test the SONET system.

Characteristics

TRANSMITTER
Source Modes – 2.4 Gb/s output created from: 1) 155 Mb/s electrical CMI or optical input, 2) 622 Mb/s optical input; 3) Internally-generated 2.4 Gb/s signal, 4) In through mode, from the incoming signal inputs are monitored for LOS and OOF.

Error Inject – Single section errors or error rates from 1 x 10^{-3} to 1 x 10^{-9}, selected channel or all channels.

Alarm Generation –
LOS: User-selected from 1 to 127 µs.
LOF, OOF, L-AIS, L-FERF: User-set for 1 to 127 frames or continuous.

Transport Overhead Manipulation –
All TOH bytes (except the pointer and parity bytes) can be overwritten, continuously or for up to 127 frames.

Other Outputs – 50 Ω ECL frame sync, 50 Ω TTL event trigger.

NOTE: 1310 LASER IS CLASS 3B, 1550 LASER IS CLASS 1. To prevent personal injury, refer to the safety requirements provided in the ST2400 manual.

RECEIVER
Drop Modes – 155 Mb/s electrical and optical drop or 622 Mb/s optical drop.

Measurements – The 2.4 Gb/s input is monitored for section (B1) and line (B2) parity errors and line FEBE errors.

Alarms Detected – The 2.4 Gb/s input is monitored for LOS, LOF, OOF, L-AIS, and L-FERF.

Overhead Display – All bytes are extracted and displayed.

REMOTE CONTROL AND PRINTING
Interface – IEEE 488.2 GPIB, Two RS-232C serial interfaces (one for ST112 integrated control), Parallel printer interface.

POWER
AC Line – 100 to 240 V AC.

Maximum Power Consumption – 250 W maximum.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	114	4.5
Width	366	14.4
Depth	419	16.5
Weight	**kg**	**lb.**
Net	10	22

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

ST2400
OC-48/STM-16 Generator/Analyzer.
Includes: Power Cord, Manual, 155 Mb/s Optical and Electrical and 622 Mb/s Optical Adds/Drops.

Opt. 04 – Full Rate DS1-2.4 Gb/s SONET Test Package.
Opt. 3C – Replace FC Connectors with SC.
Opt. 3R – Delete Transmitter Function.
Opt. 3T – Delete Receiver Function.
Opt. 4C – Replace FC Connectors with ST.
Opt. 5C – 1550 nm Optics for 2.4 Gb/s Receive.
Opt. 6C – 1550 nm Optics for 2.4 Gb/s Transmit.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz.
Opt. A2 – United Kingdom 240 V, 50 Hz.
Opt. A3 – Australian 240 V, 50 Hz.
Opt. A4 – North American 240 V, 60 Hz.
Opt. A5 – Switzerland 220 V, 50 Hz.

RECOMMENDED ACCESSORIES
Soft Carrying Case for Transmitter or Receiver – Order 016-1442-00.
Transit Case for Transmitter or Receiver – Order 016-1443-00.
10-ft. 25-Pin Male-to-Male RS-232 Cable – Order 012-1384-00.
10-ft. 25-Pin Male to 9-Pin Female RS-232 Cable – Order 012-1298-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

SDH/SONET Analyzer

New ST103A

Features

ST103A

- VT Channel Scan
- Multiple SONET Alarm Generation
- J1 Trace Byte Programming
- Quick Setups
- User-defined Configurations
- Non-SONET Testing
- Payload Mappings
- Multiple Outputs
- DCC and Orderwire Access
- Payload Frame Formats
- Switch TIme and Payload Delays
- SONET Loop Timing
- LabVIEW*[1] for Windows Compatibility
- Receiver Frame Capture
- RS-232, GPIB, and Parallel Printer Interfaces
- Both Bit- and Byte-synchronous VT 1.5 Payload Mappings with SLC-96 and ESF Frame Formats
- SONET Data Communications Channel Access
- Multiple Simultaneous SONET Alarms
- 87/3 and Burst-of-7 Pointer Stress Sequences
- SONET Line Loop Timing on an OC-n Signal
- APS Switching Time and SPE Transport Delay Measurements
- VT 1.5 Payload Analysis, 7X4 and 1X28 Mapping

[1] LabVIEW is a registered trademark of National Instrument Corporation.

Applications

- Network Pointer and Payload Stress Tests
- Conformance and Compliance Testing
- Pass/Fail Testing
- Tributary Mapping and Demapping

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

See Tektronix on the World Wide Web: http://www.tek.com



ST103A SONET Transmitter and Receiver

Today's rapidly expanding SONET marketplace has created the demand for versatile test instruments that provide SONET signal generation and analysis in accordance with Bellcore and CCITT optical transport specifications. The ST103A SONET Transmitter and Receiver respond to this need for test applications from DS1 through OC-12. Separate transmit and receive units allow the ultimate flexibility in lab and manufacturing applications where targeting test resources is desired.

The ST103A also provides seamless integration into manufacturing test and remote monitoring systems with optional LabVIEW*[1] for Windows instrument drivers and remote access software packages.

Characteristics

TRANSMITTER

Timing Synchronization Interfaces –
Internal:
SONET: 51.84 MHz ±10 ppm.
External:
SONET: 51.84 MHz, 155 MHz, 622 MHz (Option 04) at ±1% ppm, ECL level;
DS1 – Signal: 1.544 MHz ±5 ppm, bipolar input, 100 Ω balanced, 6 V_{p-p} nominal;
DS1 – Clock: 1.544 MHz ±5 ppm, TTL level signal terminated DC, 50 Ω to ground, rear-panel BNC.

STS-1 Interfaces –
Data – Bipolar: Three STS-1 outputs, B3ZS encoded, front-panel 75 Ω BNC.
Data – ECL: One STS-1 output, rear-panel 50 Ω BNC.
Clock – ECL: One STS-1 output, rear-panel 50 Ω BNC.
Sync – ECL: One STS-1 Frame Sync output, rear-panel 50 Ω BNC.
Programmable sync – TTL: One output, rear-panel 50 Ω BNC.

STS-1 Interfaces –
Data – ECL: One NRZ output, rear-panel 50 Ω BNC.
Clock – ECL: One output, rear-panel 50 Ω BNC.

Auxiliary Interfaces –
External DS3 signal: 44.736 MHz ±20 ppm, B3ZS-encoded bipolar input, front-panel 75 Ω balanced.
Event sync: One output, TTL level, rear-panel 50 Ω BNC.
Pointer trigger: One output, TTL level, rear-panel, 50 Ω BNC.

Frame Structure–
STS-1: Composition per GR-253-CORE, VT1.5, asynchronous DS3 mapping.
STS-3: Repeats the internal STS-1 frame three times.
STS-12: Repeats the internal STS-3 frame four times.

Overhead Bit Options –
Byte modification: Via Edit menu. All Overhead bytes except for B1, B2, B3, C1, H1, H2, H3, and H4 can be modified.
Error injection: Modify bytes to specified number of frames in Overhead menu. 1 to 255 bytes continuously.

SPS New Data Flag – Defined by user, range is 0 to 782.

VT Payload –
Internal DS1 – Active channel pattern: PRBS $2^9 - 1$, $2^{15} - 1$, $2^{20} - 1$, $2^{23} - 1$, QRW, 24-Bit programmable.
Internal framing: Unframed or D4 framed.
External: Pattern and framing.
Modes supported: Locked bit synchronous, floating bit asynchronous, locked byte synchronous, floating byte synchronous.

VT New Data Flag – Defined by user.

STS-1 Level Mapping –
Internal DS3 – Frame patterns: M13, C-bit, unframed.
Internal DS3 – Payload patterns: PRBS (inverted $2^{15} - 1$), 8-bit fixed word.
External DS3: B3ZS encoded DSX-3, front-panel 75 Ω BNC.

SDH/SONET Analyzer

New ST103A

Alarm and Error Generation – Loss of Signal (LOS), Loss of Frame (LOF), Section Bit Error Rate, Single Error Inject, Channel Error Inject.

Line Layer – Line Alarm Indication Signal (AIS), Line Far End Receive Failure (FERF), user-set Line Bit Error Rate from 10^{-3} to 10^{-9}, Single Error Inject.

APS Byte Failure – Specified number of frames (1 to 255) or continuously.

Path Layer – STS Yellow Alarm, STS Path Bit ERROR Rate, Single Error Inject, Pointer Errors.

VT Layer –
VT path yellow: Continuous or on selected number of frames (1 to 255).
VT bit error rate: Defined by user within the range of 10^{-4} to 10^{-9}.
Pointer errors: Pointer Justification (PJ) occurs if three or more bits are inverted.

RECEIVER
STS-1 Interfaces –
STS-1: 51.84 MHz ±10 ppm.
STSX-1: Monitor or terminate levels.

STS-3 Interfaces –
STS-3: 155.52 MHz ±20 ppm.
NRZ: ECL, 50 Ω BNC.
Clock: ECL, 50 Ω BNC.

DS1 Interfaces –
DS1: 1.544 MHz ±130 ppm.
DSX-1: B3ZS or AMI, monitor or terminate levels.

DS3 Interfaces –
DS3: 44.736 MHz ±20 ppm.
DSX-3: Bridge or terminate levels.

Auxiliary Interfaces –
Frame capture trigger: TTL level input, 1 kΩ BNC.
Bit error: TTL level output, 50 Ω.
B3 error: TTL level output, 50 Ω BNC.

TOH/POH Monitor – TTL level output, 50-Pin port.

Section Measurements –
B1 coding errors: Total, rate, ESs, %EFSs.
SEFS: Total.
SESs: Total for x or more CVs or OOF (x = 9 for STS-1 rate, x = 16 for OC3 rate, x = 63 for OC12 rate).
SONET frame: A1, A2, Pattern errors, OOF.

Line Measurements –
B2 coding errors: Total, rate, ESs, %EFSs.
SESs: Total for x or more CVs or OOF (x = 12 for STS-1 rate, x = 32 for OC3 rate, x = 124 for OC12 rate).
Alarm and error: LOP, FERF, Pointer out-of-range, APS byte failure, invalid K1.

STS Path Measurements –
B3 – Total, Rate, ESs, %ESFs.
SESs: Total for nine or more CVs or OOF.

VT Path (Floating VT) Measurements –
BIB-2: Total, rate, ESs, %EFSs.
SESs: Total for nine or more CVs or OOF.

DS3 (Payload or Input) Measurements –
M13 or C-bit parity: Rate, total ESs, %EFSs.
Bit errors (PRBS or fixed word): Rate, total ESs, %ESFs.
Alarms: BPV, AIS, Idle, FEBE, X-Bit, and all 1s.

DS1 (Payload or Input) Measurements –
Bit errors (PRBS or fixed word): Rate, total ESs, %ESFs.
Alarms: BPV, AIS, Yellow, CRC-6, OOF, Frame errors.

Pointer Measurements – Detects and stores PJ or NDF on a selected VT.

APS Measurements – Protection Switching Counts (PSCs), Protection Switching Duration (PSD).

Frame Measurements – RAM captures last 40 STS-1 frames before/after user-defined trigger.

Time Control – Single or repeat test set from one second to nine days in one second intervals, Untimed test control.

Test Storage –
TIme: Current test and previous test.
Initialization: Local or remote.

Local Test Retrieval – Front-panel call-up and display, Send to GPIB or RS-232C ports, Output report to local printer.

Remote Test Retrieval – Selectable report format/content, Front-panel call-up and display, Send to GPIB or RS-232C ports, Output report to local printer.

OPTICAL OUTPUT
OC-1/3 Tx Power Out – –9 dBm.

OC-12 Tx Standard Power Out – –8 dBm.

OC-1/3/12 Rx Sensitivity – –25 dBm.

NOTE: CLASS I LASER PRODUCT. This product conforms to the applicable requirements of 21 CFR 1040 at the date of manufacture.

DISPLAY
14 line x 30 column Double Supertwist LCD.

INTERFACES
GPIB, RS-232C, and Centronics Printer Port.

POWER
AC Line – 115 V.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	152	6.0
Width	366	14.4
Depth	419	16.5
Weight	**kg**	**lb.**
Net	10	22

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

ST103A
SONET Transmitter and Receiver.
Includes: Power Cord, Manual, OC-1/3, STS-1/3, DSI/3.

Opt. 04 – OC-1/3/12, STS-1/3/12, DS1/3 Pair.
Opt. 06 – LabVIEW*[1] Drivers for Remote Test.
Opt. 1C – Replace BNC Connectors with WECO 560.
Opt. 1R – Rack Mount for Receiver.
Opt. 1T – Rack Mount for Transmitter.
Opt. 3C – Replace FC Connectors with SC.
Opt. 4C – Replace FC Connectors with ST.
Opt. 3R – Delete OC-3 Transmitter Unit.
Opt. 3T – Delete OC-3 Receiver Unit.
Opt. 4R – Delete OC-12 Transmitter Unit.
Opt. 4T – Delete OC-12 Receiver Unit.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES
Soft Carrying Case for Transmitter or Receiver – Order 016-1442-00.
Transit Case for Transmitter or Receiver – Order 016-1443-00.
10-ft. 25-Pin Male-to-Male RS-232 Cable – Order 012-1384-00.
10-ft. 25-Pin Male to 9-Pin Female RS-232 Cable – Order 012-1298-00.

[1] LabVIEW is a registered trademark of National Instrument Corporation.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

SDH/SONET Analyzers

New SJ300E SDH and SONET Jitter Analyzer

Features

SJ300E

- Generates and Measures Jitter on SDH/SONET Optical Inputs, up to 622 Mb/s
- Measures Jitter Generation, Transfer, and Tolerance
- Stores and Executes Test Sequences for Jitter Tolerance and Transfer Testing
- Detects and Records Jitter Hits
- Generates and Measures Wander on 1.544 Mb/s and 2.048 MHz Synchronization Signals
- Generates and Measures Jitter Up to 622 Mb/s
- Wander Option (Opt. 06) Includes PC Software for Uploading, Calculating and Analyzing Wander Data
- Data Correlation Method Used to Measure Jitter Transfer Provides Superior Accuracy
- Measures and Generates Wander on SDH/SONET Lines
- Tests Conformance to all ANSI, Bellcore, and ITU-T Timing Standards – Bellcore GR-0253-CORE (TR-NWT-000253), CCITT G.958, CCITT G.703, ANSI T1.101, ANSI T1.120, ITU-TG.83 July 95
- RS-232 and GPIB Interfaces for Remote Operation
- Real Time Wander Analysis and Display
- Adapter Available for STSX-1 and STSX-3 (STM-1) Analysis

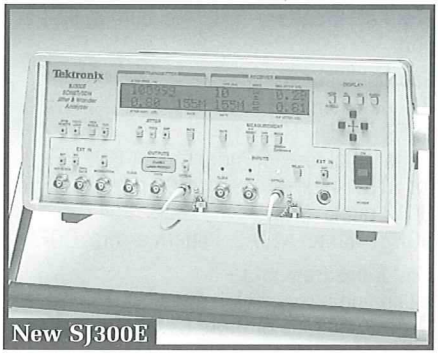
Applications

- Measure Jitter and Wander Generated and Tolerated by SDH/SONET Equipment and Clock-recovery ICs
- Measure Jitter and Wander Transfer of SDH/SONET Equipment
- Measure or Monitor Jitter and Wander at Line or Synchronization Interfaces
- Generate and Analyze Line and Synchronization Phase Transients

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

See Tektronix on the World Wide Web: http://www.tek.com



SJ300E SDH/SONET Jitter and Wander Analyzer

SDH/SONET jitter and wander are causing increased concern in the industry. The SJ300E provides the assurance that your systems are operating properly. It enables manufacturers and service providers to verify proper operation and standards compliance of their products and networks. With its comprehensive measurements and associated analysis tools, the SJ300E is a complete solution.

Jitter and wander can cause severe problems in SONET and SDH systems. The SJ300E offers complete generation and measurement of phase jitter parameters on SDH/SONET signals up to 622 Mb/s. In addition, it generates and analyzes line and synchronization signal wander in SDH/SONET and ATM systems.

NETWORK TEST CAPABILITIES

The SJ300E can also perform network wander tests. This includes sync transient generation, a choice of monitor or terminate levels for measuring sync signals, and a wide choice of sync signal framing patterns. The wander test option (Option 06) includes software for fast analysis and graphical display of Time Deviation/Maximum Interval Error (TDEVMTIE). This PC-based software drastically reduces the time and effort required to do wander analysis.

Characteristics

TRANSMIT AND RECEIVE LINE RATES

STS-1 – 51.84 Mb/s.

STS-3/STM-1 – 155.52 Mb/s.

OC-1 – 51.84 Mb/s.

OC-3/STM-1 – 155.52 Mb/s.

OC-12/STM-12 – 622.08 Mb/s.

PATTERN GENERATION/MEASUREMENT

Generator – Internal 2^7 PRBS or external "through data."

Receiver – A PRBS signal of pattern length 2^7 or a SDH/SONET formatted signal with the payload portion consisting of all zeros or all ones.

JITTER GENERATION

Generator –

Jitter frequency: 1 Hz to 1/125 of baud rate.
Frequency accuracy: ±20 ppm.
Jitter amplitude: Up to 22 UI_{p-p} depending on jitter frequency.
Resolution: 0.01 UI.
Resolution accuracy: ±1%, ±0.01 UI.

TRANSMITTER OUTPUTS

Clock Out –

Frequency: 51.84, 155.52, or 622.08 MHz ±20 ppm.
Level: ECL nominal levels.
Impedance: 50 Ω to –2 V terminated.
Connector: BNC (internal) with external CLOCK IN. Same frequency as external clock.

Data Out –

Baud rate: Equals frequency of CLOCK Out, NRZ.
Impedance: 50 Ω to –2 V terminated.
Connector: BNC.

Optical Out –

Baud rate: Equals frequency of CLOCK out.
Connector: FC/PC.
Mean output power (EOL): –9 dBm ±3 dBm.
Center wavelength: 1305 nm ±35 nm.
Spectral width (at –3 dB): 5 nm maximum.

Ref Clock Out –

Output: Same as CLOCK out without added jitter.
Amplitude: 0.4 to 1.2 V_{p-p} into 50 Ω.
Impedance: 50 Ω AC-coupled, to ground.
Connector: BNC.

TRANSMITTER INPUTS

Clock In –

Frequency: 51.84, 155.52, or 622.08 MHz ±100 ppm.
Level: ECL nominal levels.
Impedance: 50 Ω or AC-coupled.
Connector: BNC.

Thru Data In –

Level: ECL nominal levels.
Impedance: 50 Ω to –2 V terminated, NRZ.
Connector: BNC.

External Modulation In –

Impedance: 50 Ω terminated to ground.
Connector: BNC connector.
Sensitivity: 0.1 V/UI.
Accuracy: ±5%.
Amplitude limits: ±0.8 V maximum.
Rate-of-change limits:
52 MHz: ±0.135 V/µs.
155 MHz: ±0.405 V/µs.
622 MHz:±1.62 V/µs.

SDH/SONET Analyzers

New SJ300E SDH and SONET Jitter Analyzer

RECEIVER PEAK-TO-PEAK JITTER

Wide Mode –
Jitter amplitude: Up to 16 UI_{p-p}, depending on the jitter frequency and receiver baud rate.
Resolution: 0.01 UI.
Amplitude accuracy: 52 MHz: ±1%, ±0.01 UI; 155 MHz: ±1%, ±0.02 UI; 622 MHz: ±1%, ±0.03 UI.

Fine Mode –
Frequency response: First-order high-pass filter with cutoff frequencies that depend on receiver baud rate as follows: 52 Mb/s: 13 Hz + 3 Hz; 155 Mb/s: 30 Hz + 10 Hz; 622 Mb/s: 120 Hz + 35 Hz.
Jitter amplitude: Up to 0.6 UI_{p-p}, depending on the jitter frequency and receiver baud rate.
Resolution: 0.001 UI.
Amplitude accuracy: 52 MHz: ±3%, ±0.002 UI; 155 MHz: ±3%, ±0.003 UI; 622 MHz: ±5%, ±0.009 UI.

TRANSFER FUNCTIONS

Range – +3 to –50 dB.

Resolution – 0.01 dB

Note: The maximum jitter amplitude received cannot exceed the maximum receiver input range.

RECEIVER RMS JITTER

Wide Mode –
Frequency response: First-order high-pass filter at the greater of 12 kHz and the selected high-pass filter. Third-order, maximally flat, low-pass filter at 1/125 of the receiver baud rate.
Jitter range: Measures RMS value of jitter that meets the wide mode peak-to-peak jitter tolerance.
Resolution: 0.01 UI.
Amplitude accuracy:
52 MHz: ±3%, ±0.01 UI_{rms}.
155 MHz: ±3%, ±0.01 UI_{rms}.
622 MHz: ±3%, ±0.02 UI_{rms}.

Fine Mode –
Jitter range: Measures RMS value of jitter that meets the peak-to-peak requirements.
Resolution: 0.001 UI_{rms}.
Amplitude accuracy:
52 MHz: ±3%, ±0.001 UI_{rms}.
155 MHz: ±3%, ±0.002 UI_{rms}.
622 MHz: ±5%, ±0.003 UI_{rms}.
Window range: 1 to 99 seconds or infinity.
Resolution: 1 second.
Selectable high-pass filters:
52 Mb/s: 10 Hz, 100 Hz, or 20 kHz.
155 Mb/s: 10 Hz, 500 Hz, or 65 kHz.
622 Mb/s: 10 Hz, 1000 Hz, or 250 kHz.
Threshold range: 0.000 to 16 UI_{p-p}.
Resolution: 0.001 UI_{p-p}.

RECEIVER INPUTS

Clock In –
Rate: 51.84, 155.52, or 622.08 Mb/s ±20 ppm.
Level: ECL nominal levels.
Impedance: 50 Ω terminated to –2 V or AC-coupled.
Connector: BNC.

Data In –
Rate: 51.84, 155.52, or 622.08 Mb/s ±20 ppm.
Level: ECL nominal levels
Impedance: 50 Ω terminated to –2 V, NRZ.
Connector: BNC.

Optical In –
Rate: 51.84, 155.52, or 622.08 Mb/s ±20 ppm.
Connector: FC/PC.
Power: –22 to –5 dBm.
Wavelength: 1200 to 1600 nm.

Ref Clock In –
DS1: 1.544 Mb/s AMI, framed all 1s; Framing: ESF/SF.
E1: 2.048 Mb/s HDB3, framed all 1s;
2 MHz: 2.048 MHz square wave.
Connector: WECO 310 (100 Ω balanced), BNC (75 Ω unbalanced).

RECEIVER OUTPUTS

Ref Clock Out –
Level: 0.4 to 1.2 V_{p-p}, AC-coupled.
Impedance: 50 Ω to ground.
Connector: BNC.

BITS WANDER (OPTION 06)

Frequency Range – 0 to 10 Hz.

Amplitude Range –
MTIE: 99,999 ns.
TDEV: 99,999 ns.

Amplitude Resolution – 1 ns.

Amplitude Accuracy – +5%, +2 ns.

Slew Rate – +80,000 ns/s maximum.

MTIE Observation Time Range –
Internal: 0.1 to 99.9 seconds.
External: 0.02 to 105 seconds.

TDEV Integration Time Range –
Internal: 0.1 to 99 seconds.
External: 0.02 to 1000 seconds.

BITS IN Input – WECO 310 (100 Ω balanced), BNC (75 Ω unbalanced).
DS1: 1.544 Mb/s AMI, framed all 1s.
E1: 2.048 Mb/s HDB3, framed all 1s.
2 MHz: 2.048 MHz square wave.

BITS OUT Output – WECO 310 (100 Ω balanced), BNC (75 Ω unbalanced).
DS1: 1.544 Mb/s AMI, framed all 1s.
E1: 2.048 Mb/s HDB3, framed all 1s.
2 MHz: 2.048 MHz square wave.

POWER

AC Line – 115 V/230 V AC ±10%.

Power Consumption – 100 W maximum.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	152	6.0
Width	366	14.4
Depth	419	16.5
Weight	**kg**	**lb.**
Net	10	22

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

SJ300E
SDH/SONET Jitter and Wander Analyzer.
Includes: Power Cord, Manual.

Opt. 03 – SONET OC-1/3, SDH STM-1 Optical.
Opt. 04 – OC-1/3/12, STM-1/4 Optical.
Opt. 06 – DS1, E1, 51-622 Mb Wander Test.
Opt. 07 – Bipolar ECL, 10-MHz-DS1 Convert (SC100).
Opt. 08 – Bipolar ECL, 10-MHz-E1 Convert (SC100).
Opt. 1M – Rack Mount.
Opt. 3C – Replace FC Connectors with SC.
Opt. 4C – Replace FC Connectors with ST.
Opt. 4S – FFT Software Application Diskette.
Opt. 7C – Replace DS1 Connectors with E1 BNC.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

UNIVERSAL POWER PLUG OPTIONS
Opt. A1 to Opt. A5.

RECOMMENDED ACCESSORIES
Soft Carrying Case for Transmitter or Receiver – Order 016-1442-00.
Transit Case for Transmitter or Receiver – Order 016-1443-00.
10-ft. 25-Pin Male-to-Male RS-232 Cable – Order 012-1384-00.
10-ft. 25-Pin Male to 9-Pin Female RS-232 Cable – Order 012-1298-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ATM Analyzer
New ATM150

Features

ATM150

- Standard Interfaces Include DS1/DS3, E1/E3
- Operation up to 155 Mb/s
- Optional Interfaces Include 100 Mb/s Fiber (TAXI), 155 Mb/s OC-3c/STM-1
- QoS (Quality of Service)
- Portable, Economical ATM Test Set
- Propagation Delay Measurement
- Mis-inserted Cell Detection
- Transport Overhead and Alarm Testing
- Remote Control
- Constant Bit Rate (CBR) Voice and Video
- Variable Bit Rate (VBR) Data Mixed Traffic Profiles
- 8,192 Different Destinations
- Up to Four VCI/VPI Addresses
- Powerful Traffic Emulation Capabilities
- Tests Conformance to All ITU G703, G.751, G.832, Bellcore TR-TSY-499, and ATM Forum UNI Specifications Version 3.0

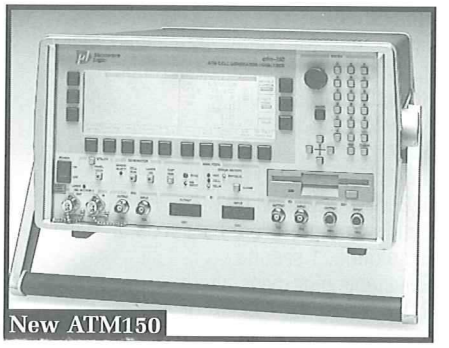
Applications

- Factory Conformance and Compliance Testing
- Field Installation and Setup
- Network Testing
- Switch and Network Performance Analysis
- ATM Interface Card Testing, R&D, and Manufacturing
- Traffic Loading

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

See Tektronix on the World Wide Web: http://www.tek.com



ATM150 Cell Generator and Analyzer

The ATM150 offers powerful, real-time, programmable, and portable ATM cell switch and network performance analysis. Particularly effective for verifying the performance of switches and networks under loaded conditions, the economical ATM150 can be used in the field, lab, or manufacturing applications.

ATM offers efficient transport and switching of video, data, and voice traffic across private and public networks. Since ATM is an emerging technology, standards are still in the definition stage. It's critical during this period of change that ATM products and systems be thoroughly tested to ensure proper operation and conformance to current industry specifications. The ATM150 is a powerful, easy-to-use ATM test instrument that will evolve with the standards by virtue of its modular design which allows new physical interfaces, such as DS1, DS3, E1, E3, 100 Mb TAXI, STM-1/OC-3c, etc., to be added as standards stabilize.

The ATM150 offers an exceptionally diverse choice of user-selectable cell traffic distributions. These patterns simulate Constant Bit Rate (CBR) voice and video, Variable Bit Rate (VBR) data, and mixed traffic profiles over a range of average and peak bandwidths. Simulated traffic can be used for highly accurate switch and network throughput analysis and benchmarking. The generator can send active cells to 8,192 different destinations. This includes test cells up to four VCI/VPI addresses.

A complete set of alarms and errors is generated and detected by the ATM150.

Characteristics

DS1/DS3 INTERFACE

DS1/DS3 Physical Interface allows ATM150 to generate and analyze cell streams at 44.736 Mb/s or 1.544 Mb/s. Interface can transmit and receive ATM cells within a DS3 frame (either M23 or C-bit) or a DS1 frame (either SF or ESF). These cells can be directly mapped or an IEEE 802.6 Physical Layer Convergence Protocol (PLCP) can be used.

GENERATOR

DS3 Alarm Generation – LOS: Generates all zero output. LOF: Inverts all M and F bits in the DS3 frame. AIS: Inserts a 1010 pattern in the DS3 payload. LCV: Causes one line code violation on the B3ZS code 10 times a second. IDLE: Inserts a 1100 pattern in the DS3 payload. PARITY: M23 mode – all P-bits are inverted. C-bit mode – all parity C-bits are inverted. FERF: Sets X1 and X2 to zero. FEBE: Sets FEBE C-bits to zero.

DS1 Alarm Generation – LOS: Generates all zero output. AIS: Generates unframed all-ones pattern. LOF (Red): Removes all framing. Yellow: Generates framing appropriate yellow alarm.

PLCP Alarm Generation – LOF: Inverts a bit in the A1 and A2 byte. PARITY: Inverts a bit in the P0-P11 bytes. RAI (Yellow): Sets bit 5 in the G1 byte. FEBE: Inserts one FEBE in each frame. B1: Inserts one BIP error in each frame.

Output Timing – Internal or recovered.

DS1 Output – Rates: 1.544 Mb/s ±20 PPM. Encoding: Bipolar. Impedance: 100 Ω. Level: Cross-connect. Connector: WECO 310 compatible.

DS3 Output – Rates: 44.736 Mb/s ±20 PPM. Encoding: Bipolar with Three Zero Suppression (B3ZS). Impedance: 75 Ω. Level: Cross-connect (700 mV). Connector: BNC.

Data Source – Internal or loop-back.

ANALYZER

DS1 Alarm Monitoring – LOS: Detects all zero input. AIS: Detects an unframed all-ones pattern. LOF (COFA): Detects loss or change of framing. Yellow: Generates framing appropriate yellow alarm. CRC-6: Counts CRC-6 errors in ESF mode. Frame Bit: Counts incorrect framing bits. LCV: Counts line code violations.

ATM Analyzer

New ATM150

DS3 Alarm Monitoring – LOS: Detects sequence of ≥175 zeros. LOF: Detects frame alignment changes or cannot be found. AIS: Detects continuous 1010 pattern in DS3 payload. LCV: Detects line code violation in B3ZS encoding. IDLE: Detects continuous 1100 pattern in DS3 payload. PARITY: M23 mode – detects P-bit parity errors. C-bit mode – detects C-bits parity errors. FERF: Detects if X1 and X2 are zero. FEBE: Detects if FEBE C-bits are zero.

PLCP Alarm Monitoring – LOF: Detects PLCP frame alignment changes or cannot be found. PARITY: Detects errors in P bytes and A1-A2 bytes. RAI (Yellow): Detects bit 5 in G1 byte. FEBE: Detects FEBE indications. B1: Detects BIP errors.

Cell Delineation Search Parameters – Alpha: Seven incorrect headers to begin a search for new cell alignment. Delta: Six correct headers to declare delineation.

DS1 Input – Rate: 1.544 Mb/s ±100 PPM. Encoding: Bipolar. Impedance: 100 Ω. Level: Cross-connect. Connector: WECO 310 compatible.

DS3 Input – Rate: 44.736 Mb/s ±100 PPM. Encoding: Bipolar with Three Zero Suppression (B3ZS). Impedance: 75 Ω. Level: Cross-connect. Connector: BNC.

E1/E3 INTERFACE

E1/E3 Physical Interface allows the ATM150 to generate and analyze cell streams at 34.368 Mb/s or 2.048 Mb/s. Interface can transmit and receive ATM cells within an E3 frame or an E1 frame. Cells can be directly mapped or an IEEE 802.6 Physical Layer Convergence Protocol (PLCP) can be used.

GENERATOR

E3 Alarm Generation – LOS: Generates all zero output. FRAME: Errors bits in the E3 frame. LCV: Causes one line code violation on the HDB3 code 10 times a second. PARITY: Errors parity bits. FERF: Inserts FERF bit (G.832). RAI: Sets bit 11 of the frame (G.751).

E1 Alarm Generation – LOS: Generates all zero output. AIS: Generates AIS or TS16 AIS. LOF: Removes all framing. Remote: Generates remote alarm or remote multiframe alarm.

PLCP Alarm Generation – LOF: Inverts a bit in the A1 and A2 byte. PARITY: Inverts a bit in the P0 to P11 bytes. RAI (Yellow): Sets bit 5 in the G1 byte. FEBE: Inserts one FEBE in each frame. B1: Inserts one BIP error in each frame.

Output Timing – Internal or recovered.

E1 Output – Rates: 2.048 Mb/s ±20 PPM. Encoding: HDB3. Impedance: 120 Ω. Connector: Siemens 3-Pin.

E3 Output – Rates: 34.368 Mb/s ±20 PPM. Encoding: HDB3. Impedance: 75 Ω. Connector: BNC.

Data Source – Internal or loop-back.

ANALYZER

E1 Alarm Monitoring – LOS: Detects all zero input. AIS: Indicates when AIS or TS 16 AIS exists for 104 ms. OOF: Detects loss or change of framing. RED: Detects 25 intervals of 4 ms with an OOF. CRC: Counts CRC errors. Frame Bit: Counts incorrect framing bits. LCV: Counts line code violations. FEBE: Counts Far End Block Errors.

E3 Alarm Monitoring – LOS: Detects when sequence of ≥32 zeros occurs. OOF: Detects when frame alignment changes or cannot be found. AIS: Detects all ones pattern. LCV: Counts line code violations. PARITY: Counts parity errors. FERF: Detects FERF (G.832). RAI: Detects RAI (G.751). FEBE: Counts FEBE (G.832).

PLCP Alarm Monitoring – LOF: Detects when PLCP frame alignment changes or cannot be found. PARITY: Detects errors in P bytes and A1-A2 bytes. RAI (Yellow): Detects bit 5 in G1 byte. FEBE: Detects FEBE indications. B1: Detects BIP errors.

Cell Delineation Search Parameters – Alpha: Seven incorrect headers to begin a search for new cell alignment. Delta: Six correct headers to declare delineation.

E1 Input – Rate: 2.048 Mb/s ±100 PPM. Encoding: AMI or HDB3. Impedance: 120 Ω. Connector: Siemens 3-Pin.

E3 Input – Rate: 34.368 Mb/s ±100 PPM. Encoding: AMI or HDB3. Impedance: 75 Ω. Connector: BNC.

REMOTE

Interfaces – RS-232, GPIB, and printer ports.

POWER

Line Voltage – 100/120 or 200/220 V AC.

Power Consumption – 150 W maximum.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	203.2	8
Width	355.6	14
Depth	508	20
Weight	**kg**	**lbs.**
Net	13.6	30

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

ATM150
Cell Generator and Analyzer.
Includes: Power Cord, Manual, DS1/DS3, E1/E3.

Opt. 03 – OC-3c 1310 nm I/O FC Connectors.
Opt. 05 – 100 Mb TAXI Interface.
Opt. 41 – Delete E1/E3 Interfaces.
Opt. 42 – Delete DS1/3 Interfaces.
Opt. 1M – Rack Mount.
Opt. 3C – Replace FC Connector with SC for OC-3c.
Opt. 4C – Replace FC Connector with ST for OC-3c.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

UNIVERSAL POWER PLUG OPTIONS

Opt. A1 to Opt. A5.

RECOMMENDED ACCESSORIES

Transit Case for Transmitter or Receiver – Order 016-1447-00.

10-ft. 25-Pin Male-to-Male RS-232 Cable – Order 012-1384-00.

10-ft. 25-Pin Male to 9-Pin Female RS-232 – Cable Order 012-1298-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

See Tektronix on the World Wide Web: http://www.tek.com

SDH/SONET Analyzer, Generator/Receiver

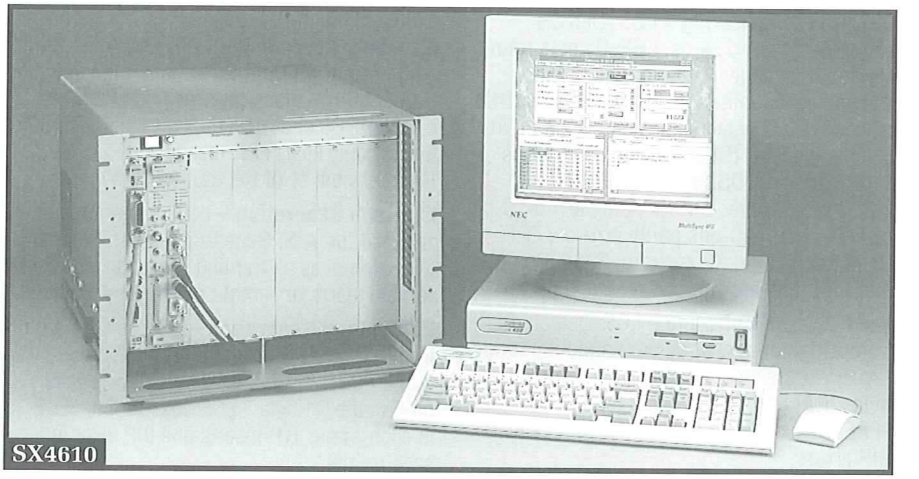
SX4610 • VX4610

Features

- 52, 155 and 622 Mb/s Transmit and Receive
- Bit Error Rate Testing
- BIP Error Testing and Analysis
- VT/TU/SPE/AU Payload Mapping and Demapping with Optional Tributary Test Modules
- Pass/Fail Testing
- Graphical User Interface Simplifies Test Development
- Easy to Integrate
- C-size, Message Based Control
- IEEE 488.2 with SCPI Compatible Commands

Applications

- Production Test
- Design Verification and Debug
- Standards Compliance Evaluation



SX4610 SDH/SONET Analyzer

The SX4610 is a VXI based SDH/SONET Analyzer that meets the testing needs for the development and production test of both SDH and SONET Network Elements, including Add-drop multiplexers (ADM), Digital Cross-connects, and Line-terminal multiplexers. The SX4610 is comprehensive enough to meet your current testing requirements, yet leaves room for your future broadband test needs.

COMPREHENSIVE TESTING

At the heart of the SX4610 SDH/SONET Analyzer is the VX4610 SDH/SONET Generator/Receiver module that provides comprehensive testing at 52, 155 and 622 Mb/s, including:

- Testing of Bit Error Rates for B1, B2, B3, payload errors
- Complete alarm monitoring and generation
- Control to read and write all Section/Transport and Path Overhead bytes
- Payload mapping and demapping simulation and verification
- APS/MSP testing
- DCC and User channel access
- Measurement analysis according to ITU-T Rec. G.826, Rec. G.821 and ANSI T1M1.3

For rigorous stress testing, design verification, and standards compliance, the SX4610 offers the following advanced capabilities:

- User defined payload generation and capture
- Frequency offset up to ±100 ppm with 0.1 ppm resolution
- Extended triggering with trigger position control

QUICK TEST PROGRAM DEVELOPMENT

The SX4610 comes with an easy to use Windows-based Graphical User Interface preloaded on the PC controller. This interface allows users to quickly learn and operate the analyzer. The User Interface also provides three ways to dramatically simplify test program development.

First, the User Interface can be used to create pass/fail tests. Once saved to memory, multiple tests can be stored on the VX4610 module. These pass/fail tests can then be executed with just a few lines of code. This technique allows users to generate new tests with the SX4610 and run these tests from almost any controller or operating system without having to learn a new command language.

Second, the User Interface contains a Command Builder and Command Monitor, which can be used to quickly generate and evaluate commands and command test sequences. These commands can then be "cut and pasted" into virtually any software development environment.

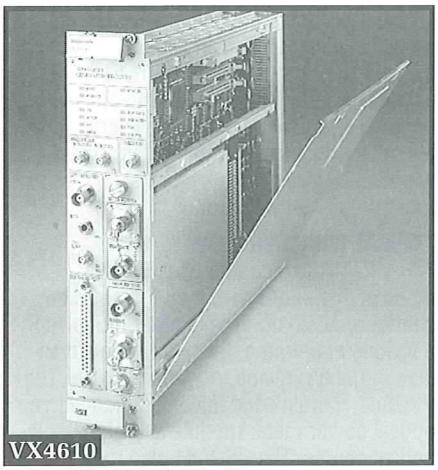
Finally, test program development is simplified by having all of the core test functionality – Generator, Receiver and Measurement Analysis – in a single message based module. This integration removes any synchronization and external cabling problems.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

SDH/SONET Analyzer, Generator/Receiver

SX4610 • VX4610



SDH/SONET Generator/Receiver Module.

EASY TO INTEGRATE AND UPDATE

The SX4610 has an open systems architecture that is flexible to integrate and upgrade. The SX4610 Analyzer is not computer platform dependent, and can be used in conjunction with virtually any existing software environment.

VX4610 SDH/SONET Generator/Receiver Module

The VX4610 SDH/SONET Generator/Receiver Module is a single C-sized, 2-wide message based instrument and can be ordered as a separate module for integration into existing VXI test systems. This module includes complete SDH/SONET frame generation/analysis. The VX4610 module comes standard with a 52 and 155 Mb/s electrical interface plug-in. Optional optical/electrical interface plug-ins and add-on tributary modules can be added for specific test applications.

Configuration

The base SX4610 configuration includes:

- VX4610 SDH/SONET Generator/Receiver (with 52 and 155 Mb/s electrical plug-in)
- 486 MS-DOS PC controller with Super VGA monitor, Windows software, GPIB card and GPIB cable
- 13-slot VXI mainframe with Slot 0 controller
- User Interface Software package

Options can add the following capabilities:

- Optical Transmit/Receive for 52, 155 and 622 Mb/s
- Mapping/Demapping for DS1/DS3, including complete VT control/analysis and tributary testing
- Mapping/Demapping for 2 Mb/s , 34 Mb/s and 139 Mb/s, including complete TU control/analysis, and tributary testing

Additional Broadband Test Products

The SX4610 is the basis for a broadband test platform. Additional modules, both from Tektronix (see VXI Section) and other vendors, can augment the test capabilities. In the future, additional modules will become available to extend the broadband testing capability. The architecture of the SDH/SONET analyzer is designed to offer additional functionality (new measurement capabilities and measurements such as pointer sequencing).

Characteristics

Frame formats – STS-1, STS-3, STS-3c, STS-12 to ANSI T1.105 and GIR-TSY-0000253; STM-1, STM-4 to ITU-T Rec. G.707-709.

Mappings (Optional) – 2 Mb/s into TU-12, 34 Mb/s into TU-3, 1.544 Mb/s into VT1.5, 44.736 Mb/s into STS-1 SPE, 139 Mb/s into AU-4.

TEST INTERFACES

Optical – 52, 155, 622 Mb/s (1310 nm).

Coded Electrical – 52 Mb/s (B3ZS) and 155 Mb/s (CMI).

ECL Electrical Interface – Complementary Clock and Data for both Transmit and Receive. Supports standard ECL as well as PECL (Vt= +3.2 V) from 52 Mb/s to 622 Mb/s.

Measurements – Error Totals, Error Rate and Error Seconds on B1, B2, B3, line FEBE, Path FEBE, VT/TU BIP, VT/TU FEBE, payload.

Error Analysis – According to G.826, G.821 and T1M1.3.

Pointer Control – Single, Burst, Settable pointer value with and without New Data Flag, illegal pointer, and T1X1.6/G.783 pointer sequences.

Triggering and Frame Capture – Triggered capture of 64 sequential payloads, extensive Transmit and Receive section trigger outputs for stimulus and response testing, Triggered capture of 54 sequential STM-1/STS-3c, and Programmable trigger position.

Please refer to the data sheet for more technical specifications.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

SX4610
SDH/SONET Analyzer.
Includes: MS-DOS 486 PC Controller with Super VGA Monitor, GPIB Card with GPIB Cables, 13-slot VXI Mainframe with Slot 0 Controller and Manuals, VX4610 SDH/SONET Generator/Receiver (52 and 155 Mb/s Electrical Plug-in), VX4610 User Manual, Graphical User Interface Software Package, and SX4610 Analyzer User Manual.

VX4610
SDH/SONET Generator/Receiver Module.
Includes: 52 and 155 Mb/s Electrical Plug-in, VX4610 User Manual, Graphical User Interface Software Package, and Instruction Manual.

Options common to the SX4610 Analyzer and the VX4610 Generator/Receiver Module:

Opt. 02 – ECL Electrical Interface (52 to 622 Mb/s).

Opt. 03 – 52/155 Mb/s Electrical and 155 Mb/s Optical Plug-in.

Opt. 04 – 52/155 Mb/s Electrical and 52/155/622 Mb/s Optical Plug-in.

For Add/Drop and Tributary testing, order the following option modules:

Opt. 22 – DS1/DS3 (1.5/45 Mb/s).

Opt. 36 – E1, E3, E4 (2, 34, 139 Mb/s).

Options for the SX4610 Analyzer only :

Opt. 1C – Delete PC Controller.

INTERNATIONAL POWER PLUG OPTIONS (Mainframe)

Opt. A1 – Universal Euro 220 V, 50 Hz.
Opt. A2 – United Kingdom 240 V, 50 Hz.
Opt. A3 – Australian 240 V, 50 Hz.
Opt. A4 – North American 240 V, 60 Hz.
Opt. A5 – Switzerland 220 V, 50 Hz.
See General Customer Information Section for additional description.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

Optical Attenuator
VXOA41

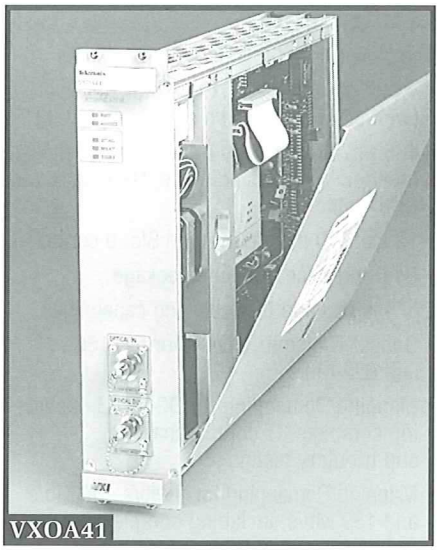
Features

VXOA41

- Singlemode and Multimode Input/Outputs
- Four User Changeable Optical Fiber Connector Type
- Compact Physical Size
- Message Based Control
- "C" Sized Card Configuration

Applications

- Bit Error Testing
- Receiver Performance Evaluation
- Fiber Optic Link and System R&D
- OTDR Fiber Attenuation Calibration
- Calibration of Optical Power Meter Linearity
- General Control of Fiber Based Optical Power


VXOA41

VXOA41 Optical Attenuator

The Tektronix VXOA41 optical attenuator is a high-performance instrument used to control the level of optical power propagating through an optical fiber. This product is a plug-in C-sized instrument module for use in a VXIbus System. It provides computer controlled optical attenuation from 0 to 60 dB in 0.01 dB steps.

VXOA41 Attenuators accept and deliver optical input and output signals on connectorized optical fiber cables. The standard version VXOA41 provides for singlemode fiber input and output. Options 01, 02, and 03 provide for the input and output of the three most commonly used multimode fiber sizes (50 µm, 62.5 µm, and 100 µm fiber core diameters).

Technical specifications for the VXOA41 are essentially the same as the Tektronix OA5000 Series GPIB Programmable Optical Attenuators with only minor exceptions.

KEY APPLICATIONS

The VXOA41 products are intended for use in production testing of high-speed fiber optic transmission equipment during its manufacture. Optical receiver sensitivity testing (bit error rate measured as a function of optical signal level) is an important application for this attenuator. The VXOA41 is a computer controlled optical attenuation plug-in module for use in VXI based automated test systems.

VXOA41 products provide one basic functional building block in an all-VXI Tektronix manufacturing test system for SDH/SONET physical layer compliance testing applications. The VXOA41 can also be used as a retrofit module in existing VXI test systems supplied by other manufacturers, as well as those supplied by Tektronix.

TYPICAL CONFIGURATIONS

The VXOA41 is a double-wide VXIbus module. The instrument may therefore be configured with numerous other modules in a VXIbus mainframe, thereby taking advantage of the backplane triggers available. The VXOA41 is often used in conjunction with an optical power meter module and/or a stable optical source. The VXOA41 also may be used in a VXI-based SDH/SONET test system for qualifying SONET transmitters and receivers over their specified dynamic operating range (optical power range). Control of the instrument is accomplished through VXI Message based Communications and with an IEEE 488.2 compliant command set.

FRONT-PANEL INDICATORS

The VXOA41 has five LED indicators on the front panel. Two of these are the standard Tektronix VXIbus indicators: READY and ACCESSED. The other three indicators are specific to the VXOA41: ATT ADJ, MIN ATT, and DISABLE. The user adjusts the various states and settings of the instrument through the command set.

FRONT-PANEL OPTICAL CONNECTORS

The VXOA41 is provided with FC fiber optic connectors installed on the front panel. Users wishing to convert these bulkhead connectors to another type (ST, SC, or DIN-47256) will need to order one Universal Fiber Optic Connector Adapter Kit (020-1885-00) per bulkhead connector that is to be changed. Users who wish to convert both input and output connectors will need to order two Universal Fiber Optic Connector Adapter Kits.

MAINTENANCE

The only routine maintenance required of the user is the cleaning of the optical input and output optical connectors. There is no rigid schedule for the frequency of this maintenance. It depends largely on the cleanliness and frequency of fiber connections and disconnections made to the instrument. It is suggested that any noticeable increase in insertion loss to the instrument is indicative of possible fiber optic connectors which require cleaning.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

Optical Attenuator
VXOA41

BITE
Built-In-Test Equipment (BITE) is provided by several self-tests that are automatically performed on power-up and may also be invoked on command. Circuitry tested includes the CPU and all memory. The VXOA41 supports the IEEE 488.2 defined *TST? and *CAL? commands. Front panel LEDs provide visual BITE for instrument readiness, system controller access, attenuation adjustment, minimum attenuation condition, and shutter status. Instrument parameters and conditions may be read at any time by the system controller.

EQUIPMENT REQUIRED
The VXOA41 is not a standalone instrument and must be used with a Tektronix C-size Mainframe and VXI Slot 0 controller and/or Resource Manager. Additionally a software utility is needed that is capable of sending and receiving VXI message-based commands and queries to and from a VXI device.

Characteristics

OPTICAL

Wavelength Range – 600 nm – 1700 nm (usable wavelengths are > 1100 nm for singlemode).

Input/Output Fiber Type –
Singlemode (standard).
50/125 µm diameter (Option 01).
62.5/125 µm diameter (Option 02).
100/140 µm diameter (Option 03).

Insertion Loss – 2 dB from 1100 – 1600 nm; SM & MM. 4 dB from 700 – 1100 nm; MM only.

Attenuation Range – 60 dB from 700 nm – 1350 nm. 50 dB from 1350 nm – 1600 nm. >100 dB with shutter closed (for standard, Opt. 01, and Opt. 02 versions). > 90dB with shutter closed (for Opt. 03).

Accuracy – MM unit: ±0.15 dB (±0.05 dB typ.) at 850 ±20 nm, 1300 ±20 nm, and 1550 ±20 nm.
SM unit: ±0.15 dB at 1300 ±20 nm, 1550 ±20 nm.
SM unit: ±0.25 dB at other wavelengths.

Linearity – MM units: ±0.05 dB, 600 nm – 1700 nm.
SM Units: ±0.05 dB, 1100 nm – 1700 nm.

Repeatability – ±0.05 dB.

Mode Dependent Loss –
Relative attenuation: ±0.05 dB.
Insertion loss: 0.25 dB (Option 01); 0.35 dB (Opt. 02 and Opt. 03).

Temperature Dependence – ±0.005 dB/°C/db ATT setting; ±0.02 dB/°C (insertion loss). (0 – 50°C relative to 25°C).

Input Return Loss – SM unit: <–45 dB, MM unit: <–25 dB.

Polarization Dependence – <±0.2 dB diff. in throughput attenuation.

Maximum Optical Input – 100 mW (+20 dBm) continuous.

ENVIRONMENTAL

Temperature – Operating: 0°C – 50°C. Nonoperating: –55°C – 60°C.

Altitude – Operating: 4.6 km (15,000 ft.). Nonoperating: 15 km (50,000 ft.).

Humidity – Operating: 90% RH, 0°C – 50°C. Nonoperating: 90% RH, 60°C.

Shock – 60 g's (Ω sine) 11 ms duration, 3 shocks in each direction along 3 major axes, 18 total shocks.

Bench Handling – 12 drops from 45° and/or 4 inches.

Transportation Handling – Nonoperating, drops of 36 inches on all edges, faces, corners.

Emissions, EMI (Conducted & Radiated) – FCC Rules and Regulations, Part 15, Subpart J, Class A; VFG 243; CISPR 22.

Susceptibility, EMI – Radiated: IEC 801-3 (3 V/m). Conducted: MIL-461B (1980) CS01, CS02, and CS06).

Susceptibility, ESD – 6 kV maximum ESD discharge applied to operating instrument.

PHYSICAL CHARACTERISTICS

Double-wide, C-size module

Dimensions, Overall	mm	in.
Width	60.66	2.388
Height	366.70	14.437
Depth	345.03	13.584
Weight	**kg**	**lb.**
Net	2.4	5.25

POWER REQUIREMENTS*1
+24 V – 0.32 A
+12 V – 0.00 A
+5 V – 2.30 A
–2 V – 0.68 A
–5.2 V – 0.05 A
–12 V – 0.00 A
–12 V – 0.04 A

Power Dissipated – 22 W.

Required Cooling –
1.5 liters/sec at 0.04 mm H_2O.

**1 Maximum peak current in amps.*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

VXOA41
VXI Programmable Optical Attenuator.
Includes: VXI Optical Attenuation C-sized Plug-in Module with Female FC (installed) Input and Output Optical Bulkhead Connectors; User Manual (070-8777-00); Single Mode| Fiber Input and Output.

Opt. 01 – Substitute 50/125 µm Fiber Input and Output.

Opt. 02 – Substitute 62.5/125 µm Fiber Input and Output.

Opt. 03 – Substitute 100/140 µm Fiber Input and Output.

OPTIONAL ACCESSORIES

Universal Fiber Optic Connector Adapter Kit – Universal Fiber Optic Connector Adapter Kits (020-1885-00) provide the field installable parts necessary to convert VXOA41 front-panel optical bulkhead (female) connectors to ST, SC, and DIN-47256 input and output optical connectors (FC connectors come installed on instrument). One kit is needed for each of two instrument connectors.

Fiber Optic Cables – Refer to page 335 for complete list.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

Communications Signal Analyzer
CSA 803A

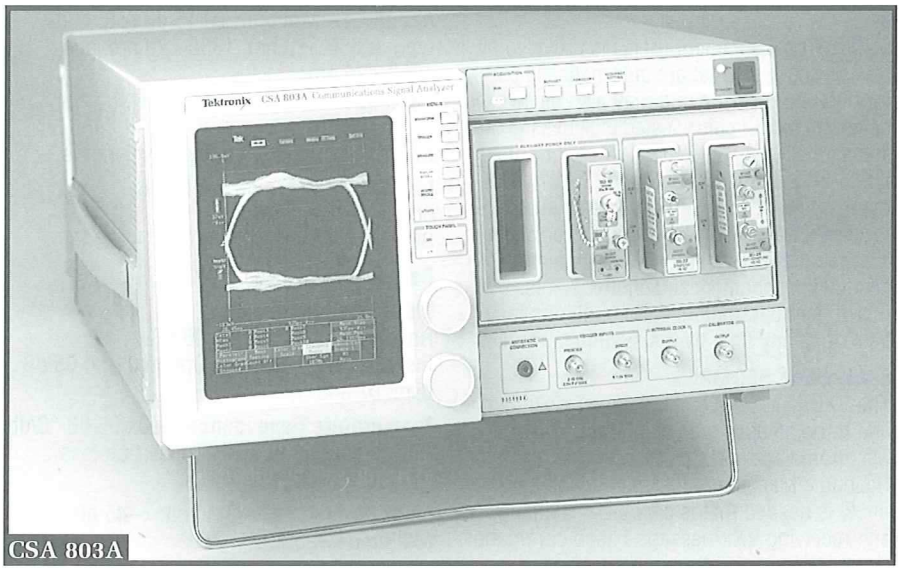
Features

CSA 803A

- DC to 50 GHz Bandwidth
- Automatic Statistical Analysis
- 38 Industry Standard Masks (ITU-T and ANSI)
- High Resolution and Repeatability
- 7 ps Rise Time (SD32)
- Modularity Through Sampling Heads
- Triggering to 10 GHz (Prescaler)
- TDR for Precision Impedance Analysis
- FFT for Spectral Analysis
- Extinction Ratio Measured Automatically
- Built-in Automatic Eye Pattern and Pulse Template Testing

Applications

- Optical Standards Compliance Testing
- Electrical Standards Compliance Testing
- Timing Analysis
- Pass/Fail Mask Measurements for Telecom (SDH/ SONET) and Datacomm (FDDI/ Fiberchannel)



CSA 803A

CSA 803A

The CSA 803A communications signal analyzer offers the highest bandwidth and time resolution of the 11000 Series. In addition to the easy-to-use, touch-screen user interface and powerful automatic measurement system common to all 11000 Series instruments, the CSA 803A adds single-ended and differential TDR and TDT, timing resolution to 0.01 ps, and up to 50 GHz bandwidth (depending on the sampling head used). This unmatched performance and feature set makes the unit ideal for semiconductor device testing. TDR characterization of circuit boards, IC packages, cables and high-speed digital communication measurements.

The CSA 803A accepts up to two dual-channel SD Series sampling heads and has built-in trigger capability of up to 10 GHz through the prescaler.

RESOLUTION AND REPEATABILITY
The state-of-the-art digital time base in the CSA 803A provides unmatched timing resolution, with sample intervals to 10 femtoseconds (0.01 ps) and measurement repeatability to 1 ps. In addition, the vertical system provides 8-Bits of vertical resolution at all deflection factors (80 µV LSB at 2 mV/div). Powerful on-board waveform processing allows expansion with averaging to sensitivities in the 100 µV/div range and beyond.

NON-VOLATILE STORAGE
Waveforms, settings and user defined masks are preserved in battery backed-up memory for added convenience.

FAST FOURIER TRANSFORM (FFT)
FFT allows for analysis of both spectral magnitude and phase of acquired waveforms.

FASTEST ACQUISITION
The CSA 803A, with its multiprocessor-based architecture and high-speed analog, error-sample feedback-loop technology, has the highest sample rate of any sampling oscilloscope. The 200 kHz sampling rate gives the CSA 803A a "real time" feel for waveform controls and allows high-speed data capture for histograms and automated measurements.

MODULARITY MAKES ROOM FOR GROWTH
In the Tektronix tradition, the CSA 803A can be tailored through modular plug-in sampling heads for a variety of applications. Modularity also offers a path for growth and expansion as new sampling heads become available. For example, for applications requiring superior noise performance, the SD-22 Sampling Head offers two channels of acquisition at 12.5 GHz with 450 µV (typical) of noise. High bandwidth acquisition and TDR are available in the SD-24 sampling head, which offers two channels with 20 GHz bandwidth and two polarity-selectable TDR step generators. The complete SD Series of sampling heads is listed on page 99.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, RS-232C, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*

Communications Signal Analyzer
CSA 803A

STATISTICAL MEASUREMENTS
A built-in statistical database allows the instruments to accumulate three-dimensional waveform data-time, voltage, and sample density. The database is a 512 x 256 x 16-Bit data array which accumulates waveform data by counting the number of times each pixel in the display is activated. This information is then displayed in a color-graded format that gives you an instant qualitative view of the acquired waveform. The power of the statistical database is the measurement capabilities – time and voltage histograms and automatic statistical measurements.

COMMUNICATION APPLICATIONS USING THE STATISTICAL DATABASE
Time and voltage histograms are powerful statistical tools for measuring noise and jitter in communication signals. The histograms include useful information such as mean, RMS deviation, and pk-pk, displayed and continuously updated at a user selectable rate. High sample rates make it possible to analyze data concurrent with acquisition rather than in a batch mode later on. The statistical database allows you to change histogram parameters without reacquiring data.

For the first time you can make jitter and noise measurements with one simple selection from an on-screen menu. Controls are provided for adjusting left and right limits, selecting RMS or pk-pk and absolute or relative measurements. For eye diagram measurements you can choose either the eye crossing or the mesial level for jitter measurement location. Either top line or base line can be selected for noise measurements. The CSA does the rest, and displays the jitter and noise measurements in the status menu at the bottom of the screen.

MASK TESTING
For Compliance test to ITU-T and ANSI standards, 38 predefined telecom masks are available by adding Option 1T. The CSA 803A settings are all automatically determined by pressing AUTOSET while the desired mask is displayed. See table for a complete listing of masks.

In addition, you can define and edit up to 10 masks simultaneously. These masks (polygons) may each have up to 50 vertices. The CSA 803A then counts the individual and total samples that fall in each of the defined masks. Once defined the masks can be stored for future use.

Predefined Standard ITU-T and ANSI Eye Pattern and Pulse Masks (Option 1T)

ITU-T SDH and ANSI SONET Optical Standards

OC-1 51.84 Mb/s	OC-3/STM-1 155.52 Mb/s	OC-9 466.56 Mb/s
OC-12/STM-4 622.08 Mb/s	OC-18 933.12 Mb/s	OC-24 1.2442 Gb/s
OC-36 1.8662 Gb	OC-48/STM-16 2.4883 Gb/s	

ANSI T1.102 Electrical Standards

DS1 1.544 Mb/s	DS1 (old) 1.544 Mb/s	DS1C 3.152 Mb/s
DS2 6.312 Mb/s	DS3 44.736 Mb/s	DS4NA 139.26 Mb/s
DS4XNA 139.26 Mb/s	STS1 51.84 Mb/s	STS3 155.52 Mb/s
STSX3 155.52 Mb/s		

ITU-T G.703 Electrical Standards

Single Pulse 64 Kb/s	Double Pulse 64 Kb/s	Data Pulse 64 Kb/s
Timing Pulse 64 Kb/s	Pulse 1.544 Mb/s	Sym. Pair 2.048 Mb/s
Coax Pair 2.048 Mb/s	Sym. Pair 6.312 Mb/s	Coax Pair 6.312 Mb/s
Pulse 8.448 Mb/s	Coax Pair 32.064 Mb/s	Pulse 34.368 Mb/s
Coax Pair 44.736 Mb/s	Pulse 97.728 Mb/s	Zero Pulse 139.26 Mb/s
One Pulse 139.26 Mb/s	STM1 155.52 Mb/s	CEPT 565 Mb/s

Other Masks

FDDI 125 Mb/s	User Programmable (default is OC-192/STM-64)

AUTOMATED MEASUREMENTS MAKE IT EASY
The CSA 803A offers a comprehensive, accurate, and automatic measurement system. Up to six measurements can be displayed on screen at any time, all updated continuously. Any number of measurements may be made over the GPIB or RS-232C interfaces.

For the first time in the industry, you now can make automatic jitter and noise measurements using the statistical measurement mode. Statistical measurements allow automatic pulse parameter measurements on random signals such as eye diagrams and allow you to make stable and accurate measurements even in the presence of jitter and noise.

All measurement parameters are user-controllable and measurement levels may be set in relative (i.e., percentage) or absolute terms. Measurements are also fully annotated so there is no question about which part of the waveform is used for making the measurements.

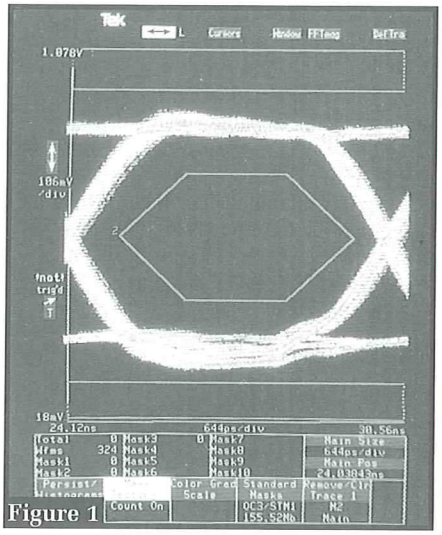


Figure 1

Predefined masks (Option 1T) allow for complete compliance testing without the need for an external computer. See table for a complete mask listing.

Measurements include extinction ratio; amplitude measurements, such as mean, RMS, p-p, and overshoot; timing measurements, such as width, propagation delay, and phase; and energy measurements that provide direct area or energy results! Measurement statistics are also available to evaluate the stability of any measurement result.

ON-BOARD WAVEFORM PROCESSING
The extensive on-board waveform processing capability of the CSA 803A not only provides smooth "real time" update rate and control response, it also allows complex waveform calculations to be performed and displayed in the same continuously updated fashion. Calculated waveforms can be as simple as addition of two channels, or more complex, from basic operators (+, –, x, ÷) to specialized math functions such as square root, differentiate, log, envelope, and filter. Calculations can include acquired waveforms, stored waveforms, and constants.

All measurement functions except hardware measurements are allowed on calculated traces. In addition, the instrument can be set to stop acquisition after certain conditions, such as when a specified number of averages have been completed.

WINDOWING SHOWS THE DETAILS
The CSA 803A offers another first for sampling oscilloscopes – windows. Similar to the delayed sweep on conventional oscilloscopes, windows allow viewing a long interval on one trace while examining the details of a section of the waveform on a second trace.

Communications Signal Analyzer

CSA 803A

Up to seven windows can be created on a single main trace, each with independent positions. The instrument can even be programmed to automatically locate a window on a specified transition within the main waveform. Like the other oscilloscopes in the 11000 Series, windows in the CSA 803A are actually re-acquired with a higher resolution than the main waveform – not just digitally expanded from the main trace, as in some lower performance instruments.

Characteristics

VERTICAL SYSTEM

Rise Time/Bandwidth – Determined by the sampling head used.*1

Vertical Resolution – 8-Bits full screen (80 µV LSB at 2 mV/div deflection factor).

Amplifier Gain Accuracy – ±1% of all settings.

Deflection Factors – 2 to 255 mV/div in 1 mV/div increments.

Offset Range – ±2 V.

HORIZONTAL SYSTEM

Main and Window Time Base – 1 ps/div to 5 ms/div, settable in 1-2-5 sequence or in 1 ps increments.

TIME BASE ACCURACY*2

Time interval	Accuracy
≥ 10 ns	0.01% x time interval + 8 ps
1 ns	10 ps
100 ps	5 ps
10 ps	2 ps

Record Length – 512, 1024, 2048, 4096, and 5120 points.

Windows – Any number of window records may be placed on any number of main records, up to a maximum of 8 displayed traces. All window records have the same duration, but may be independently positioned on any main record. The window may be set to automatically track a moving edge on the main record.

Maximum Sample Rate – 200 kHz.

TRIGGER SYSTEM

Trigger Bandwidth – 3.0 GHz (direct), 2 to 10 GHz (Prescaled).

Trigger Holdoff – Adjustable from 5 µs to 2.5 s.

Trigger Sensitivity*3 – Direct: DC Coupled, 100 mV p-p, DC –3.0 GHz; Prescaled: AC Coupled, 600 mV p-p, AC Coupled: Attenuates signals below 30 kHz.

Delay Jitter (Ext. Trigger) – 2.0 ps (1.3 ps typical) +5 ppm of selected delay (RMS).

Internal Clock – 100 kHz (drives TDR, Internal Clock Output, and Calibrator).

Trigger Input Range – ±1.5 V (direct), ±2.5 V (Prescaled).

MEASUREMENT SYSTEM

Waveform Processing Functions – Add, subtract, multiply, divide, absolute, average, differentiate, envelope, exponent, integrate, natural log, log, signum, square root, smoothing, and filter.

Measurement Set – Max, min, mid, p-p, mean, RMS, amplitude, extinction ratio, overshoot, undershoot, noise*4, rise, fall, frequency, period, prop delay, cross, width, phase, duty cycle, jitter*4, area +, area –, and energy. Measurements are constantly updated; mean and standard deviation available on all measurements.

Measurement Parameters – Proximal, mesial, distal,and start/stop levels: May be set to relative or absolute values.

Cursors – Paired or split dots, vertical bars, and horizontal bars.

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

Operating Temperature – 0°C to 50°C.

Nonoperating Temperature – –40°C to +75°C.

Altitude, Vibration, Shock, Bench Handling – Operating and nonoperating: Meets MIL-T-28800C, Type III, Class 5.

Safety – Listed UL 1244, CSA Bulletin 556B.

Electromagnetic Compatibility – Meets the following requirements of MIL-STD-461C: CE-03 Pt 4 Curve 1, CS-01 Pt 7, CS-02 Pt 4, CS-06 Pt 5, RE-02, Pt 7, RS-01 Pt 4, RS-02 Pt 5, RS-03 Pt 7, (limited to 1 GHz). Meets FCC Part 15, subpart J, Class A.

For Germany: Meets VDE 0871/6.78 Class B.

Humidity – To 95% RH at up to 50°C.

PHYSICAL CHARACTERISTICS

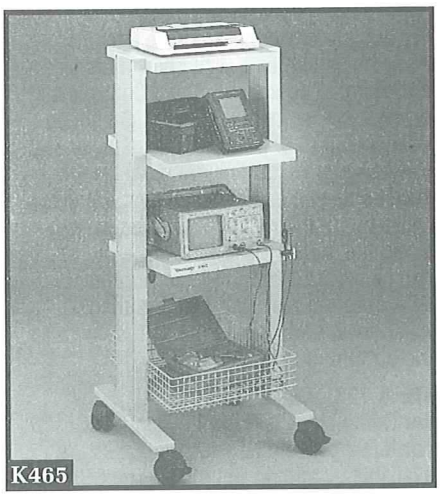
	Benchtop		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	599	23.6	550	21.6
Weight ≈	**kg**	**lb.**	**kg**	**lb.**
Net	21.8	48	22.7	50
Shipping	31.3	69	32.3	71

**1 See Sampling Head Characteristics on page 99. The CSA 803A mainframe has no acquisition bandwidth limits.*

**2 Interpolate linearly between cardinal points.*

**3 CSA 803A has external trigger only; requires >23 ns pretrigger or use of DL-11 Delay Lines to view trigger point.*

**4 Available only in statistical measurement mode.*



Accessory

K465

Instrument Cart

- Ergonomic design
- Simple height, angle, and shelf adjustments
- Durable steel and aluminum construction
- Large diameter smooth rolling casters
- Nylon safety straps included

Communications Signal Analyzer

CSA 803A

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CSA 803A
Communications Signal Analyzer.
Includes: Tutorial Manual (070-7718-00), User Reference (070-7719-00), Command Reference (070-7720-01), Programmer Reference (070-7738-01), Service Reference (070-7721-00), 12-inch SMA-SMA Cable, 2 ea. 8.5 in. SMA-SMA Cable, 1 Wrist Strap, Power Cord, U.S., Power Cord, U.S., 120 V (161-0066-00).

Opt. 1T – Predefined Telecom Masks.

Opt. 1R – Rackmount.

Opt. 10 – Deletes the 10 GHz prescaler trigger capability. This does not affect the 3.0 GHz trigger.

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – United Kingdom 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.
See General Customer Information Section for additional description.

SOFTWARE
See Software Section for selection guide and complete description of software available.

SD-14
High Impedance Probe Sampler 3 GHz.
Includes: Installation/User Manual (070-8286-00); Service Manual (070-8285-00); 4-post ECB Mount Ground Socket; Edge Tab Ground Socket; 10 ea. Wire-Form Ground, .050 Spacing; 10 ea. Wire-Form Ground, .040 Spacing; Plastic Accessories Case.

SD-20
Loopthrough Sampling Head 20 GHz.
Includes: Installation/User Reference (070-7531-00), Service Reference (070-7528-00), Precision 3.5 mm Termination (011-0155-00), 2 SMA Short-circuit Terminations (015-1020-00).

SD-24
Dual TDR/Sampling Head 20 GHz.
Includes: Installation/User Reference (070-7052-00), Service Reference (070-7053-00), 2 SMA Short-circuit Terminations (015-1020-00).

SD-26
Dual Sampling Head 20 GHz.
Includes: Installation/User Reference (070-7226-01), Service Reference (070-7227-01), 2 SMA Short-circuit Terminations (015-1020-00).

SD-22
Low-noise Sampling Head 12.5 GHz.
Includes: Installation/User Reference (070-7226-01), Service Reference (070-7227-01), 2 SMA Short-circuit Terminations (015-1020-00).

SD-30
Sampling Head 40 GHz.
Includes: Installation/User Reference (070-7904-00), Service Reference (070-7905-00), 2 SMA Short-circuit Terminations (015-1020-00).

SD-32
Sampling Head 50 GHz.
Includes: Installation/User Reference (070-8268-00), Service Reference (070-8269-00), 1 SMA Short-circuit Termination (015-1020-00).

SD-42
Optical-to-Electrical Converter 6.4 GHz.

SD-46
Optical-to-Electrical Converter 20 GHz.

RECOMMENDED ACCESSORIES – Also see page 434.

PROBES
LOW-Z-PROBES (50 Ω INPUT)
10X, DC – 9.0 GHz. Order P6150.

ACTIVE PROBES
(Requires 1103 Power Supply) –
10X. DC – 1 GHz, ≥10 MΩ Input Impedance, 1.9 pF. Order P6204.

10X. DC – 4 GHz, ≥100 kΩ Input Impedance, 0.4 pF. Order P6217.

CART
Order K465.

CAMERAS/PLOTTERS
Camera – Order C-9 with Opt. 1A and Opt. 11.

Plotter – Order HC100.

CALIBRATION STEP GENERATOR
U.S. – Order 067-1338-00.
Universal European – (240 V, 50 Hz). Order 067-1338-01.
UK – (240 V, 50 Hz). Order 067-1338-02.
Australia – (240 V, 50 Hz). Order 067-1338-03.
Switzerland – (240 V, 50 Hz). Order 067-1338-05.
Japan – (100 V, 50-60 Hz). Order 067-1338-06.

ADDITIONAL ACCESSORIES
Power Strip – Four Outlet, 6 ft., Noise/Surge Suppression.

SMA Accessory Kit – Order 020-1693-00.
Includes: 2 ea. 2X and 5X Attenuators; 2 ea. SMA Terminations, Male Short Circuit, Female Short Circuit, Male 50 Ω, Female 50 Ω, 2 ea. 50 Ω Signal Cables (2 ns), 2 ea. 500 ps Semi-rigid Cable, 2 ea. Male-to-Male Adapters, 2 ea. SMA Male-to-BNC Female, 2 ea. Female-to-Female, 1 ea. 50 Ω Power Divider, 1 ea. Combination Wrench (0.312, 6 point).

3.5 mm Accessory Kit –
Order 020-1692-00.
Includes: 1 ea. 50 Ω Reference Air Line, 1 ea. Male-to-Male Adapter, 1 ea. Female-to-Female Adapter, 1 ea. 26.5 GHz 50 Ω Terminator (Male), 1 ea. 26.5 GHz 50 Ω Terminator (Female), 1 ea. 26.5 GHz Short Circuit (Male), 1 ea. 26.5 GHz Short Circuit (Female), 2 ea. 50 Ω Terminators (6 dB 26.5 GHz, 2.9 mm), 2 ea. 50 Ω Terminators (20 dB 26.5 GHz, 2.9 mm), 1 ea. Power Divider (26.5 GHz, 2.9 mm), 2 ea. Signal Blews (2 ns, Male-to-Male), 2 ea. Signal Cables (500 ps, Male-to-Male, 2.9 mm Semi-rigid), 1 ea. Torque Wrench, 1 each Combination Wrench (0.312, 6 point), 1 ea. Combination Wrench (0.281, 6 point).

2X Attenuator –
SMA Male-to-Female. Order 015-1001-00.

5X Attenuator –
SMA Male-to-Female. Order 015-1002-00.

75 Ω to 50 Ω Min. Loss Attenuator –
BNC, AC coupled. Order 011-0112-00.

Power Divider – Order 015-1014-00.

Blank Sampling Head – Order 200-3395-00.

ECL Terminator – Provides the bias and termination for ECL device outputs. At 10 GHz bandwidth and 1% precision attenuation, accurate AC and DC measurements are ensured. Attenuation: 10X ±1.0% @ DC, 20 dB ±3 dB, DC to 10 GHz. Aberrations: ±3% max with 100 ps rise time. Order 015-0558-00.

DC Block (Coupling Capacitor) –
SMA. Order 015-1013-00. BNC. Order 015-0221-00.

Slip-On Connector – Order 015-0553-00.

Connector Savers – SMA. Order 015-0549-00. APC. Order 015-0552-00.

CABLES AND EXTENDERS
Sampling Head Extender Cables –
(1 m). Order 012-1220-00.
(2 m). Order 012-1221-00.

Acquisition Extender – Order 067-1324-00.

Card Cage Extender – Order 067-1267-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, RS-232C, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*

Optical-to-Electrical Converters

P6701A • P6703A • P6711 • P6713 • P6721 • P6751

Features

P6701A
- 500 to 950 nm
- DC to 850 MHz
- Si PIN

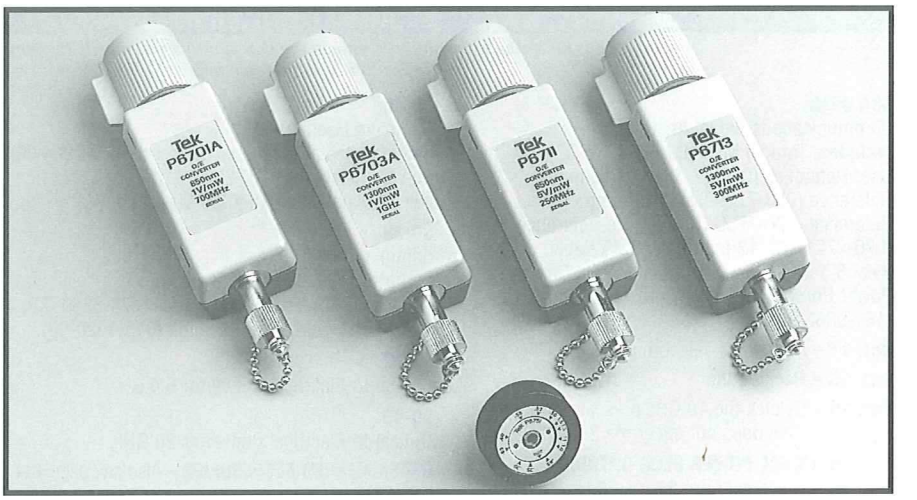
P6703A
- 1100 to 1700 nm
- DC to 1 GHz
- InGaAs PIN

P6711
- 500 to 950 nm
- DC to 250 MHz
- High Gain
- Si PIN

P6713
- 1100 to 1700 nm
- DC to 300 MHz
- High Gain
- InGaAs PIN

P6721
- 400 to 1000 nm
- DC to 50 MHz
- Large Area Detector (3 mm)
- Si PIN

P6751 SPATIAL INPUT HEAD
- 500 to 1500 nm
- Tunable
- Collimated Beam Input
- Multimode Fiber Output



P6701A, P6703A, P6711, P6713 Optical-to-Electrical Converters and P6751 Spatial Input Head.

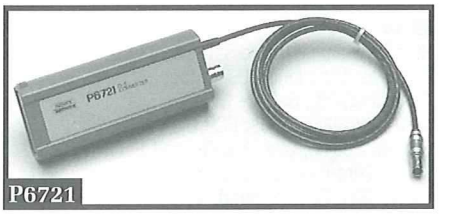
Product Description

The Tektronix P6701A/P6703A/P6711/P6713 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® Interface or any other oscilloscope when used in conjunction with the Tektronix 1103 TEKPROBE® Interface Power Supply.

Use of the 11801B oscilloscope's TEKPROBE® Interface allows the oscilloscope to supply power to the P6700 Series probes, automatically determine and display the proper scale factor (in microwatts of optical power) and set the input termination to the required 50 Ω.

The P6700 Series provides a calibrated means of analog analysis of optical signals in the wavelength range 500 to 950 nm (P6701A/P6711) and 1100 to 1700 nm (P6703A/P6713). Thus the functions of an optical power meter and the high-speed analog waveform analysis capability of an oscilloscope are combined in one instrument. The user has the capability of acquiring, displaying and analyzing mixed analog and digital, optical and electrical signals simultaneously.

The P6701A and P6703A have an added DC stable circuit from decreased offset drift (≤1 µW). This improves the performance for extinction ratio measurements and absolute optical power levels. The P6711 and P6713 have increased gain and lower noise, and thus have improved the sensitivity of the converters and are excellent choices for LED measurements.The P6721 is a high gain optical-to-electrical converter for use with plastic fiber and larger diameter glass fiber. For the laser disk service, automotive optical communication and others, the P6721 is a



link to waveform test and measurement tools. The P6721 uses Tektronix probe power or the 1101A Power Supply.

The P6751 Spatial Input Head is a tunable lens system for sampling optical energy from any collimated source and delivering it via a fiber optic cable to the P6700 Series Optical-to-Electrical Converter. The P6751 is easily mounted using standard optical bench fixtures. This spatial input head can be adjusted (500 to 1500 nm) by the user to optimize the amount of optical energy delivered to the P6700 Series. The P6751 has a standard SMA fiber optic cable connector. The P6751 is intended for use with 100/140 µm diameter multimode fiber.

Also available is a series of fiber optic jumper cables for interfacing the P6700 Series and P6751 with other industry standard optical fiber connectors.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

Optical-to-Electrical Converters

P6701A • P6703A • P6711 • P6713 • P6721 • P6751

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), fiber based systems based on the FDDI and SONET standard, optical disk devices, and high-speed fiber optic communications systems.

Characteristics

	P6701A	P6703A	P6711	P6713	P6721
Wavelength Response	500 to 950 nm	1100 to 1700 nm	500 to 950 nm	1100 to 1700 nm	400 to 1000 nm
Bandwidth	DC to 850 MHz	DC to 1 GHz	DC to 250 MHz	DC to 300 MHz	DC to 50 MHz
Rise Time	≤700 ps	≤500 ps	≤2 ns	≤1.6 ns	≤10 ns
Conversion Gain	1 V/mW at 850 nm	1 V/mW at 1300 nm	5 V/mW at 850 nm	5 V/mW at 1300 nm	10 V/mW at 660 nm
Max Input Optical Power	1 mW	1 mW	200 µW	200 µW	0.3 mW
Noise Equivalent Power	≤1 µW(RMS)	≤1 µW(RMS)	≤250 nW(RMS)	≤200 nW (RMS)	≤200 nW(RMS)
Max Input Fiber Core Diameter	200 µm	100 µm	200 µm	100 µm	1000 µm

Note: For further technical information on these above products request the following product literature: For P6701A, P6711, P6703A, P6713 – #3TW-7914 (Data Sheet). For P6721 – #3TW-8309-0 (Data Sheet). For P6751 – #3TW-7304-1 (Data Sheet/Application Note).

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P6701A
Optical-to-Electrical Converter.
Includes: Option Specified Fiber Optic Input Connector, Carrying Case (016-0156-03), and Instruction Manual (070-8237-00).

Opt. 01 – FC Input Connector.
Opt. 02 – ST*[1] Input Connector.
Opt. 03 – DIN 47256 Input Connector.
Opt. 04 – SMA Input Connector.
Opt. 05 – SC Input Connector.

P6703A
Optical-to-Electrical Converter.
Includes: Option Specified Fiber Optic Input Connector, Carrying Case (016-0156-03), and Instruction Manual (070-8237-00).

Opt. 01 – FC Input Connector.
Opt. 02 – ST*[1] Input Connector.
Opt. 03 – DIN 47256 Connector.
Opt. 04 – SMA Input Connector.
Opt. 05 – SC Input Connector.

P6711
Optical-to-Electrical Converter.
Includes: Option Specified Fiber Optic Input Connector, Carrying Case (016-0156-03), and Instruction Manual (070-8237-00).

Opt. 01 – FC Input Connector.
Opt. 02 – ST*[1] Input Connector.
Opt. 03 – DIN 47256 Connector.
Opt. 04 – SMA Input Connector.
Opt. 05 – SC Input Connector.

P6713
Optical-to-Electrical Converter.
Includes: Option Specified Fiber Optic Input Connector, Carrying Case (016-0156-03), and Instruction Manual (070-8237-00).

Opt. 01 – FC Input Connector.
Opt. 02 – ST*[1] Input Connector.
Opt. 03 – DIN 47256 Connector.
Opt. 04 – SMA Input Connector.
Opt. 05 – SC Input Connector.

P6721
Optical-to-Electrical Converter.
Includes: Standard TOSLINK Fiber Optic Input Connector, and Instruction Manual (070-7842-00).

P6751
Spatial Input Head.
Includes: Adjustment Tool and Instruction Sheet.

OPTIONAL ACCESSORIES

TEKPROBE® Power Supply – Order 1103.

Fiber Optic Cables – Single Mode and Multimode

The following fiber optic cable assemblies are intended to provide high quality interconnections between fiber optic test equipment having the same or different optical connector types. Each cable assembly consists of a single jacketed fiber connectorized on both ends with male connectors. Cables with different type connectors on each end are for interconnecting two instruments having dissimilar female connectors. The type of connector installed on each end of the fibers are indicated below.

SINGLE MODE

Fiber Optic Cables – 2 meter length, 8/125 µm core/cladding diameter, including in-line connector adapter.

FC/PC to diamond 3.5 Connectors. Order 174-1385-00.
FC/PC to ST*[1] Connectors. Order 174-1386-00.
FC/PC to FC/PC Connectors. Order 174-1387-00.
FC/PC to Biconic Connectors. Order 174-1388-00.
FC/PC to diamond 2.5 Connectors. Order 174-1497-00.

MULTIMODE

Fiber Optic Cables – 2 meter length, 62.5/125 µm core/cladding diameter.

FC/PC to FC/PC Connectors. Order 174-2322-00.
FC/PC to Biconic Connectors. Order 174-2323-00.
FC/PC to SMA Connectors. Order 174-2324-00.

Fiber Optic Cables – 2 meter length, 100/140 µm core/cladding diameter.

SMA to ST*[1] Connectors. Order 174-0876-00.
SMA to diamond 3.5 Connectors. Order 174-0877-00.
SMA to FC Connectors. Order 174-0878-00.
SMA to SMA Connectors. Order 174-0879-00.
SMA to Biconic Connectors. Order 174-0880-00.
SMA to diamond 2.5 Connectors. Order 174-1303-00.

**1 ST is a registered trademark of AT&T.*

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See Tektronix on the World Wide Web: http://www.tek.com

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Tektronix Measurement products are manufactured in ISO registered facilities.

SDH/SONET Reference Receivers

ORS52 • ORS156 • ORS622 • ORS2488

Features

ORS52/ORS156/ORS622/ORS2488

- Strict ITU-T G.957 Compliance
- Data Rates Through 2.488 Gbits/s
- Bessel-Thompson Frequency Response
- Accurate Extinction Ratio Measurements
- Low Distortion Eye Pattern and Pulse Measurements
- DC Coupled and Stabilized Amplification
- Convenient and Flexible Configurations
- Measures Average Optical Power
- Easy to Use
- Fully GPIB Controllable



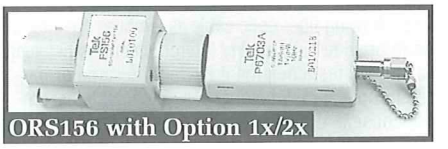
ORS622 with Options 31 and 41

Verifying SDH/SONET System Performance

The Synchronous Data Hierarchy (SDH) and the Synchronous Optical NETwork (SONET) standards are crucial to the next generation of high-speed digital telecommunications systems. The Tektronix ORS Series of optical reference receivers fills a crucial test system gap for verifying SDH/SONET optical system performance.

These are true optical receivers, not just filters. The result is a precision optical reference receiver that can be relied upon to faithfully represent transmitted signals at specific SDH/SONET bit rates for the purpose of waveform or eye pattern analysis. Without an optical reference receiver of this completeness and precision, optical transmitter signal evaluation can become fraught with uncertainties caused by unrelated optical transmitter noise.

In addition to defining optical system signal hierarchy and signal characteristics, SDH/SONET also defines test methodologies and specifications for verifying equipment and system performance. Prominent in this is the use of an SDH/SONET optical reference receiver and an oscilloscope for display and comparison of the data eye pattern to specified masks.



ORS156 with Option 1x/2x

ORS SERIES SPECIFICATIONS

SDH/SONET recommendations define the nominal transfer function for an optical reference receiver as being a fourth-order Bessel-Thompson response. The following table lists the corresponding attenuation at various frequencies, f. In this table f_0 is the receiver's bit rate and f_r is the 3 dB cutoff, which is defined as $f_r = 0.75f_0$.

Allowable deviation from the nominal attenuation in the table is very tightly specified in the SDH/SONET recommendations. The actual allowable deviation values depend on f/f_r and the bit rate. These values run as low as ±0.3 dB.

NOMINAL PERFORMANCE VALUES FOR AN SDH/SONET OPTICAL REFERENCE RECEIVER
(O/E Converter and Filter Together)

f/f_0	f/f_r	Attenuation (dB)	f/f_0	f/f_r	Attenuation (dB)
0.15	0.2	0.1	1.0	1.33	5.7
0.3	0.4	0.4	1.05	1.4	6.4
0.45	0.6	1.0	1.2	1.6	8.5
0.6	0.8	1.9	1.35	1.8	10.9
0.75	1.0	3.0	1.5	2.0	13.4
0.9	1.2	4.5	2.0	2.67	21.5

Each Tektronix ORS Series SDH/SONET Reference Receiver undergoes extensive frequency-response testing. All verification tests are documented. The verification document is supplied as part of the ORS Series SDH/SONET Reference Receiver. This document contains the serial number of the receiver as well as the measured verification data for that receiver.

Receiver selection is based, first of all, on the SDH/SONET bit rate of interest. For greatest flexibility, a receiver based on the OCP5502 O/E converter is recommended even for OC-1 applications. The broad bandwidth of the OCP5502 allows later addition of filters to cover higher bit rates as needed without having to purchase an additional O/E converter. For OC-1 applications requiring economy and high sensitivity, but not requiring flexibility for higher bit rates, a receiver based on the P6713 O/E Converter is recommended. Where economy or coverage of more than one bit rate is the greatest concern, receivers based on the P6703A O/E Converter are the appropriate choice for testing OC-1 and OC-3/STM-1-Bit rates.

The ORS Series SDH/SONET Reference Receivers are TEKPROBE® compatible. When used with Tektronix oscilloscopes having the TEKPROBE® interface, screen displays will show the proper scale factor for the optical signal (microwatts of optical power). This allows direct measurement and display of results without having to manually apply conversion factors. For oscilloscopes or other instruments not having this TEKPROBE® interface, a Tektronix 1103 Power Supply can be ordered separately for ORS Series Reference Receivers using P6703A or P6713 O/E Converters. ORS Series Reference Receivers using the OCP5502 O/E Converter and the ORS2488 are compatible with (but do not require) the TEKPROBE® Interface for their operation.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*

SDH/SONET Reference Receivers

ORS622 • ORS2488 • ORS52 • ORS156

SELECTION TABLES

Receiver	Option	Configuration	Optical Connectors	Key Benefits
OC-1 (51.84 Mbits/s)				
ORS52		OCP5502/FS52 and OC-1 calibration	FC, ST, DIN 47256, and SC	Greatest flexibility. Can add filters for OC-3 and OC-12. Built-in power meter. GPIB.
	1P	Delete OCP5502 power supply resulting in TM5000 compatible plug-in instrument	same	Provides compatibility with bench or rackmountable TM5000 Series Modular Instrument Mainframes.
	1x*1	P6703A/FS52 and OC-1 calibration	*1	Greatest value. Can add filter for OC-3.
	2x*1	P6713/FS52 and OC-1 calibration	*1	Highest sensitivity.
OC-3/STM-1 (155.52 Mbits/s)				
ORS156		OCP5502/FS156 and OC-3 calibration	FC,ST, DIN 47256, and SC	Greatest flexibility. Can add filters for OC-1 and OC-12. Built-in power meter. GPIB.
	1P	Delete OCP5502 power supply resulting in TM5000 compatible plug-in instrument	same	Provides compatibility with bench or rackmountable TM5000 Series Modular Instrument Mainframes.
	1x*1	P6703A/FS156 and OC-3 calibration	*1	Greatest value. Can add filter for OC-1.
	31	Add FS52 and OC-1 calibration		
OC-12/STM-4 (622.08 Mbits/s)				
ORS622		OCP5502/FS622 and OC-12 calibration	FC, ST, DIN 47256, and SC	Greatest flexibility. Built-in power meter. GPIB. Multiple bit rate options.
	1P	Delete OCP5502 power supply resulting in TM5000 compatible plug-in instrument	same	Provides compatibility with bench or rackmountable TM5000 Series Modular Instrument Mainframes.
	31	Add FS52 and OC-1 calibration		
	41	Add FS156 and OC-3 calibration		
OC-48/STM-16 (2.488 Gbits/s)				
ORS2488		ORS2488 (includes power supply) and OC-48 calibration	FC, ST, DIN 47256, and SC	Specific to OC-48/STM-16 data rate. Built-in power meter. GPIB.
	1P	Delete OE converter power supply resulting in TM5000 compatible plug-in instrument	same	Provides compatibility with bench or rackmountable TM5000 Series Modular Instrument Mainframes.

**1 x=1 (FC Optical Input Connector). x=2 (ST Optical Input Connector). x=3 (DIN 47256 Optical Input Connector). x=4 (SMA Optical Input Connector). x=5 (SC Optical Input Connector). Note: [a] For further technical information on ORS Series products, request Data Sheet #3TW-8530-1. [b] For information on SDH/SONET Reference Receiver calibration services available for new or previously purchased O/E Converters, contact your local Tektronix sales office.*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

ORS52 – SDH/SONET Receiver.
Includes: OCP5502, FS52 Filter, Calibration Document (062-1266-00), Instruction Manuals (070-8562-00).

Opt. 1P – Delete OCP5502 Power Supply.

Opt. 11 – Delete OCP5502/Add P6703A Opt. 01 – FC Optical Input Connector.

Opt. 12 – Delete OCP5502/Add P6703A Opt. 02 – ST Optical Input Connector.

Opt. 13 – Delete OCP5502/Add P6703A Opt. 03 – DIN 47256 Optical Input Connector.

Opt. 14 – Delete OCP5502/Add P6703A Opt. 04 – SMA Optical Input Connector.

Opt. 15 – Delete OCP5502/Add P6703A Opt. 05 – SC Optical Input Connector.

Opt. 21 – Delete OCP5502/Add P6713A Opt. 01 – FC Optical Input Connector.

Opt. 22 – Delete OCP5502/Add P6713A Opt. 02 – ST Optical Input Connector.

Opt. 23 – Delete OCP5502/Add P6713A Opt. 03 – DIN 47256 Optical Input Connector.

Opt. 24 – Delete OCP5502/Add P6713A Opt. 04 – SMA Optical Input Connector.

Opt. 25 – Delete OCP5502/Add P6713A Opt. 05 – SC Optical Input Connector.

ORS156 – SDH/SONET Receiver.
Includes: OCP5502, FS156 Filter, Calibration Document (063-1266-00), Instruction Manuals (070-8562-00).

Opt. 1P – Delete OCP5502 Power Supply.

Opt. 11 – Delete OCP5502/Add P6703A Opt. 01 – FC Optical Input Connector.

Opt. 12 – Delete OCP5502/Add P6703A Opt. 02 – ST Optical Input Connector.

Opt. 13 – Delete OCP5502/Add P6703A Opt. 03 – DIN 47256 Optical Input Connector.

Opt. 14 – Delete OCP5502/Add P6703A Opt. 04 – SMA Optical Input Connector.

Opt. 15 – Delete OCP5502/Add P6703A Opt. 05 – SC Optical Input Connector.

Opt. 31 – Add FS52 Filter and OC-1 Calibration.

ORS622 – SDH/SONET Receiver.
Includes: OCP5502, FS622 Filter, Calibration Document (063-1266-00), Instruction Manuals (070-8562-00).

Opt. 1P – Delete OCP5502 Power Supply.

Opt. 31 – Add FS52 Filter and OC-1 Calibration.

Opt. 41 – Add FS156 Filter and OC-3/STM-1 Calibration.

ORS2488 – SDH/SONET Receiver.
Includes: Calibration Document (063-1266-0), Instruction Manual (070-8731-00).

Opt. 1P – Delete ORS2488 Power Supply.

ADDITIONAL ACCESSORIES

Fiber Optic Cables – Refer to page 335 for complete list.

TEKPROBE® Interface Cable – Order 012-1372-00.

TEKPROBE® Power Supply – Order 1103*1.

**1 For use with oscilloscopes or other signal analysis instruments not having Tektronix TEKPROBE™ Interface compatibility, the ORS52 and ORS156 Reference Receivers using the P6713 O/E Converters require a Tektronix 1103 Power Supply to be ordered separately.*

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

Optical-to-Electrical Converters/Power Meters

OCP 5002 • OCP 5502

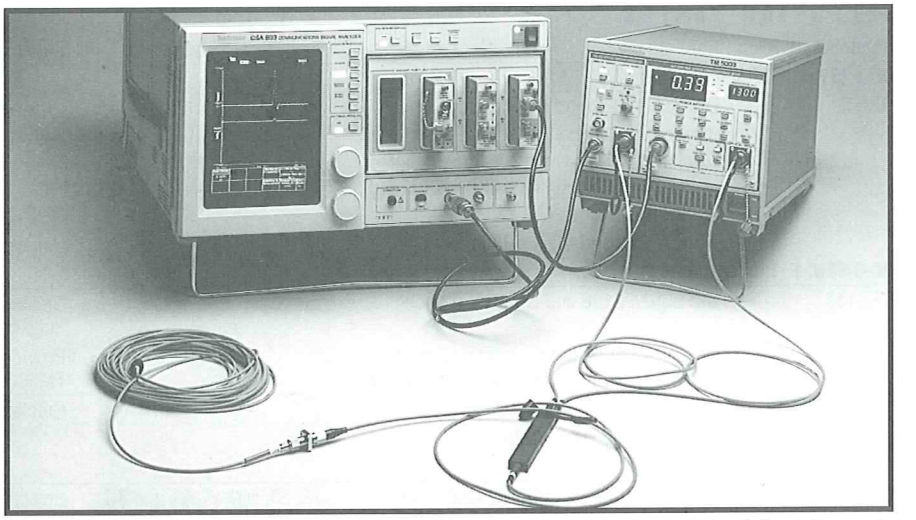
Features

OCP 5002/OCP 5502

- DC to 2 GHz Optical-to-Electrical Conversion
- Extremely Low Drift
- Low Equivalent Input Noise
- High Optical Return Loss
- Average Reading Optical Power Meter
- GPIB IEEE 488.2 Controllable
- TEKPROBE® Interface Compatible
- Multiple Optical Connector Types Accommodated
  - FC/PC
  - DIN 47256
  - ST*1
  - SC

Applications

- Accurate Extinction Ratio Measurements
- Optical Eye Pattern Analysis
- LED and Laser Transmitter Characterization
- FDDI and SONET Waveform Standards Verification
- High Sensitivity Optical Reflection Measurements
- High Resolution Optical Reflectometry
- Optical Digital Communication Measurements
- Optical Component Characterization



High Resolution Optical Reflection Measurement using OIG 502, OCP 5002 and the CSA 803A.

OCP 5002/OCP 5502 Optical-to-Electrical Converters/Power Meters

The OCP 5000 Series instruments are optical-to-electrical converters with an average reading optical power meter integrated into their design. This combination eliminates the need to use two separate instruments to make parametric measurements on optical signals.

The OCP 5502 is a functionally equivalent instrument, packaged as a standalone, monolithic unit. The OCP 5000 Series instruments can be operated from the front-panel keypad or from a GPIB controller. The GPIB interface meets the IEEE 488.2 standard. The front-panel controls are all matched over the bus and all readings can be communicated over the GPIB interface.

The power meter displays average optical power input in W, dBm and dB. You can set the calibration level to a user defined wavelength (within the 1100 to 1650 nm range) with a simple button push or GPIB command. This feature allows you to use the OCP 5000 Series instruments to design tests and applications that meet your specifications.

In addition to operating with any Tektronix oscilloscope, OCP 5000 Series instruments offer additional functionality when connected with instruments that have a TEKPROBE® interface. With the optional TEKPROBE® cable, users can read the optical power units directly on the oscilloscope screen.

The Tektronix OCP 5000 Series instruments in the standard configuration are shipped with the "FC" Style optical connector on the input. They are also shipped with field installable front-panel connectors to change the input to either "ST*1," "SC," or "DIN 47256" style connectors. Changing the input connectors is simple and the manual includes clear instructions on how to make this change whenever needed.



OPTICAL REFLECTION TESTS

Optical reflections in fiber optic systems can seriously degrade transmission performance, especially in high-speed communications links using laser sources. Characterization of the reflective performance of optical connectors and components can be crucial to ensuring signal integrity in fiber optic communications equipment.

**1 ST is a registered trademark of AT&T.*

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

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Optical-to-Electrical Converters/Power Meters

OCP 5002 • OCP 5502

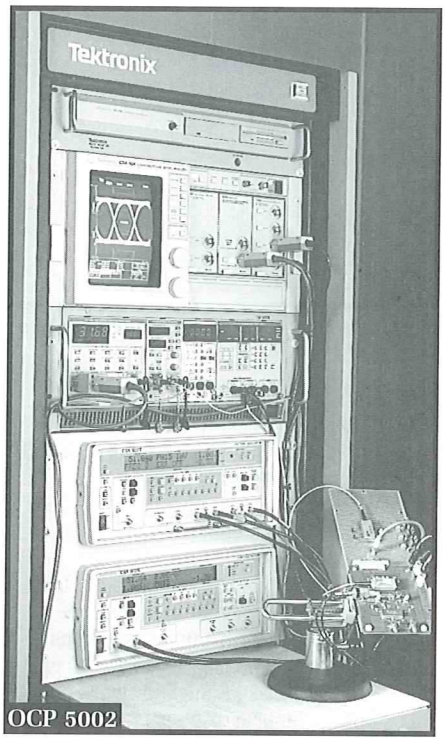
The OCP 5000 Series instruments can be used with the Tektronix CSA 803A Communication Signal Analyzer or 11801B Oscilloscope and the OIG 502 Optical Impulse Generator to evaluate optical reflections. The return loss of optical reflections can be measured to levels ≤50 dB. Depending on the specific instrument configuration used, multiple reflection events in optical fiber can be spatially resolved to the centimeter range. Single reflection events in optical fiber can be measured down to sub-millimeter accuracy levels.

OPTICAL DIGITAL COMMUNICATION TESTS

The OCP 5000 Series instruments, with their 2 GHz bandwidth, are excellent optical-to-electrical converters for use in FDDI and SONET compliance testing. When combined with other Tektronix instruments, the OCP 5000 instruments can be used for mask test verification to the FDDI and SONET waveform standards.

The OCP 5000 Series instruments, when coupled with the Tektronix CSA 803A Communication Signal Analyzer, can perform on-board optical eye pattern analysis even at the low signal levels characteristic of LED transmitters.

When the OCP 5000 Series instruments are coupled with the Tektronix 11801B oscilloscope equipped with the TEKPROBE® interface, users can evaluate complex time-domain optical signals to determine the physical layer performance of a fiber optic communication network. Accurate extinction ratio measurements are made possible by the low (<0.5 µW) DC drift of the optical-to-electrical converter when the instrument is in the DC Stable Mode.



Tektronix Physical Layer Standards Compliance Test System for testing to high-speed digital communications standards such as FDDI and SDH/SONET. OCP 5002 shown in TM5006 Modular Instrument Mainframe.

The OCP 5000 Series instruments are used as one of the base optical-to-electrical converters in the Tektronix ORS Series SDH/SONET Reference Receivers. For further information on these Reference Receivers consult the separate entry on these products appearing in this catalog.

OPTICAL COMPONENT CHARACTERIZATION

The combination of an average reading optical power meter and a 2 GHz optical-to-electrical converter in one instrument provides unique benefits when either manual or program control modes are being used. This combination allows users to fulfill most of their optical component characterization requirements with a single instrument. It also allows different tests and multiple test steps to be run without disconnecting and reconnecting optical fiber connectors. This reduces both testing time and cost as well as increases measurement reliability and repeatability.

The OCP 5000 Series instruments meet or exceed performance specifications for characterizing many of the latest fiber optic components, such as lasers and LEDs.

CHARACTERISTICS

Optical Converter	**OCP 5002/OCP 5502**
Wavelength Response	1100-1650 nm
Bandwidth	DC-2 GHz*1
Rise Time	260 ps
Conversion Gain	1 V/mW ±8% at 1300 nm
Calibrated Offset	0-1 mW ±1%
Maximum Input Optical Power	2 mW offset at 1 mW 1 mW (no offset)
Noise Equivalent Power	≤1 µW RMS
Optical Power Meter	
Dynamic Range	+7 dBm to –80 dBm
Accuracy*2	≤5% at 1300 nm

**1 –3 dB Optical/–6 dB Electrical.*
**2 With FC/PC connectors.*

Note: For further technical information on the OCP 5000 Series products request Data Sheet #3TW-7671-1.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

OCP 5002
2 GHz Optical Converter/Power Meter.
Includes: Instruction Manual (070-7817-00), Universal Optical Input/Output Connector Kit (020-1885-00).

OCP 5502
2 GHz Optical Converter/Power Meter.
Includes: Instruction Manual (070-7817-00), Universal Optical Input/Output Connector Kit (020-1885-00).

Opt. 1P – Delete OCP5502 Power Supply.

OPTIONAL ACCESSORIES

Fiber Optic Cables –
Refer to page 335 for complete list.

TEKPROBE® Interface Cable –
Order 012-1372-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

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Optical-to-Electrical Converters

SA-42 • SA-46 • SD-42 • SD-46

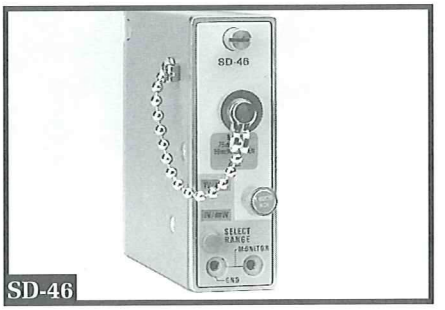
Features

SD-42
- 55 ps Optical Impulse Response
- DC – 6.4 GHz Optical Bandwidth
- 1000 nm – 1700 nm Spectral Response
- Mean Optical Power Monitor Function

SD-46
- 22 ps Optical Impulse Response
- DC –20 GHz Optical Bandwidth
- 1200 nm – 1650 nm Spectral Response
- Mean Optical Power Monitor Function

SA-42
- 50 ps Optical Impulse Response
- DC –7 GHz (–3 dB), to 15 GHz (–25 dB)
- 1000 nm – 1700 nm Spectral Response
- Ultra Low Noise

SA-46
- 22 ps Optical Impulse Response
- DC –20 GHz Optical Bandwidth
- 1100 nm to 1650 nm Spectral Response



Optical-to-Electrical Converter Plug-in Head.



Optical-to-Electrical Converter Module.

SD-42

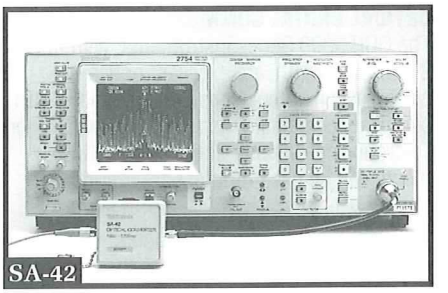
The SD-42 is an optical-to-electrical converter for use with the Tektronix CSA 803A or 11800 Series sampling oscilloscopes equipped with an SD-22, SD-24, or SD-26 Sampling Head. The optical-to-electrical conversion is linear up to 25 mW peak input with a calibrated deflection factor from 50 µW/div to 5 mW/div for optical wavelengths at 1300 nm. This unit has a 55 ps optical impulse response (max. FWHM) with the SD-24 and SD-26 Sampling Heads and 60 ps optical impulse response (max. FWHM) with the SD-22 Sampling Head.

SD-46

The SD-46 is an optical-to-electrical converter plug-in head for use with the Tektronix CSA 803A or 11800 Series sampling oscilloscopes equipped with an SD-22, SD-24, or SD-26 Sampling Head. The optical-to-electrical conversion is linear up to 25 mW peak input with a calibrated deflection factor from 60 µW/div to 6 mW/div for optical wavelengths at 1300 nm. This unit has a 28.5 ps optical impulse response (max. FWHM) with the SD-24 and SD-26 Sampling Heads.

The SD-42 and the SD-46 Optical-to-Electrical Converters can be plugged into the sampling unit or attached by a sampling head extender for remote use. The head extenders come in either 1 meter (012-1220-00) or 2 meter (012-1221-00) options. Refer to next page for SD-42 and SD-46 head extenders.

Optical signal input on the SD-42, SD-46, SA-42, and SA-46 is through a standard FC fiber optic connector. Other connector types can be accommodated by using fiber optic jumper cables offered by Tektronix. The SD-42 and the SD-46 also have a mean power meter function with selectable 1 V/nW and 1 V/µW ranges.



SA-42 Optical-to-Electrical Converter with Tektronix 2754 Spectrum Analyzer.

STANDALONE CONVERTER MODULES

The SA-46 and SA-42 are standalone, wide-bandwidth optical-to-electrical converters packaged as small (palm-sized) compact modules that are easy to use.

The SA-42 and SA-46 Optical-to-Electrical Converters can be used with Tektronix oscilloscopes and spectrum analyzers, as well as with other manufacturers' instruments. These wide-bandwidth optical converters support the analysis of the frequency and time domain characteristics of lightwave modulation in optical fiber based equipment and communications systems.

Both the SA-42 and SA-46 have an internal battery power source that can be recharged via the battery charger. The SA-42 and SA-46 units have integral battery test indicators to monitor battery status. Each of the units has an FC optical fiber input connector and a female "K" electrical output connector.

TYPICAL APPLICATIONS

Characterization of opto-electronic 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 SD-42 and the SA-42 Optical-to-Electrical Converters offer

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

Optical-to-Electrical Converters

SA-42 • SA-46 • SD-42 • SD-46

DC to 7 GHz bandwidth performance for wavelengths from 1000 nm to 1700 nm. The SD-42 and SD-46 Optical-to-Electrical Converters give fiber optic equipment developers and researchers optical waveform measurement capability from DC to 20 GHz in the 1200 nm to 1650 nm wavelength range.

Measurements such as rise time, aberration, optical power vs. drive current and voltage, modulation bandwidth, and sensitivity can now be made accurately and easily at high bandwidth.

The SA-42 or SA-46, combined with a Tektronix oscilloscope or spectrum analyzer, provides convenient optical waveform analysis capabilities. This is useful in the development and characterization of opto-electronic components and modules found in fiber optic transmission networks and fiber optic sensor systems.

CHARACTERISTICS

PULSE CHARACTERISTICS

	SD-42	SD-46	SA-42	SA-46
Impulse Response	55 ps Max (FWHM)	22 ps (FWHM)*1	50 ps Max (FWHM)	22 ps Max (FWHM)
Bandwidth	DC –6.4 GHz Optical	DC –20.0 GHz Optical	DC –7.0 GHz Optical	DC –20.0 GHz Optical
Spectral Response	1000 to 1700 nm	1200 to 1650 nm	1000 to 1700 nm	1100 to 1650 nm
Noise Equivalent Power	23 pW/$\sqrt{\text{Hz}}$ *2 ≤33 µW*3 ≤10 µW*4	32 pW/$\sqrt{\text{Hz}}$ *2 ≤45 µW*3 ≤16 µW*4	23 pW/$\sqrt{\text{Hz}}$ *2	32 pW/$\sqrt{\text{Hz}}$ *2 ≤45 µW*3 ≤16 µW*4
Linear Response Range	≤25 mW Peak Power ≤5 mW Average Power	≤25 mW Peak Power ≤5 mW Average Power	≤25 mW Peak Power ≤5 mW Average Power	≤25 mW Peak Power ≤5 mW Average Power
Aberrations	≤15% p-p*5	≤10% p-p*5	≤15% p-p*5	≤10% p-p*5
Conversion Gain	40 mV/mW	29 mV/mW	40 mV/mW	29 mV/mW
Conversion Factor	25 µW/mV	35 µW/mV	25 µW/mV	35 µW/mV

MEAN OPTICAL POWER MONITOR

Dynamic Range	5 nW to 5 mW (60 dB)	5 nW to 5 mW (60 dB)	NA	NA
Sensitivity Range 1 Sensitivity Range 2	1 V/mW ±10% 1 V/µW ±10%	1 V/mW ±10% 1 V/µW ±10%	NA	NA

ENVIRONMENTAL

Operating Temperature Range	0°C to 50°C	0°C to 50°C	0°C to 50°C	0°C to 50°C

**1 Calculated (.44/Optical Bandwidth).*

**2 Root Hertz into 50 Ω.*

**3 System specification with SD-24/SD-26.*

**4 System specification with SD-22.*

**5 Within the first 400 ps following a pulse input.*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

SD-42
Optical-to-Electrical Converter.
Includes: Red, 2 mm to Banana Lead, 1 m length (012-1286-00), Black, 2 mm to Banana Lead, 1 m length (012-1287-00), 50 Ω Semi-rigid Cable Link (174-1635-00), Instruction Manual (070-8671-00).

SD-46
Optical-to-Electrical Converter.
Includes: Red, 2 mm to Banana Lead, 1 m length (012-1286-00), Black, 2 mm to Banana Lead, 1 m length (012-1287-00), 50 Ω Semi-rigid Cable Link (174-1635-00), Instruction Manual (070-8671-00).

SA-42
Optical-to-Electrical Converter.
Includes: Instruction Manual (070-7733-00), Power Supply and Charger Unit (119-3716-00), DC Power Cable (174-1966-00), and Power Cable (161-0104-00).

SA-46
Optical-to-Electrical Converter.
Includes: Instruction Manual (070-8047-00), Power Supply and Charger Unit (119-3716-00), DC Power Cable (174-1966-00), and Power Cable (161-0104-00).

INTERNATIONAL POWER PLUG OPTIONS (SA-42 AND SA-46 ONLY)

Opt. A1 – Universal Euro 220 V, 50 Hz. (161-0104-06).

Opt. A2 – United Kingdom 240 V, 50 Hz. (161-0104-07).

Opt. A3 – Australian 240 V, 50 Hz. (161-0104-05).

Opt. A4 – North American 240 V, 60 Hz. (161-0104-08).

Opt. A5 – Switzerland 220 V, 50 Hz. (161-0167-00).

OPTIONAL ACCESSORIES

Fiber Optic Cables – Refer to page 335 for complete list.

OTHER ACCESSORIES

Sampling Head Extender Cables –
(1 m). Order 012-1220-00 (SD-42 and SD-46).
(2 m). Order 012-1221-00 (SD-42 and SD-46).

10 kHz to 21 GHz DC Block –
("N" Type). Order 015-0509-00.
(K to "N" Type Adapter). Order 015-0369-00.

See General Customer Information Section for additional description.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

Optical Impulse Generators

OIG 501 • OIG 502 • OA5002 • OA5012 • OA5022 • OA5032

Features

OIG 501/OIG 502

- Optical Wavelength
  – OIG 501-850 nm; OIG 502-1300 nm
- Near Gaussian Pulse Shape (Low Energy Mode)
- Easy to Use Front-panel Controls
- Compact/Small Size
- Selectable Pulse Repetition Rates
- Multiple Optical Connector Types Accommodated
  – FC/PC; DIN 47256; ST*1; SC
- Millimeter Resolution Optical Time Domain Reflectometry
- Optical Reflection Measurement
- Optical Component Characterization

OA5002/OA5012/OA5022/OA5032

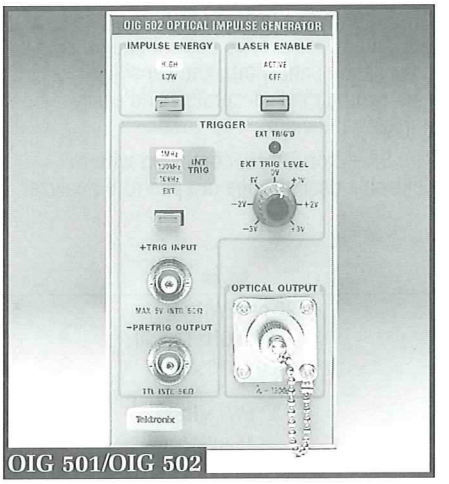
- 750 nm to 1600 nm Calibrated Spectral Response in One Unit
- Multiple Optical Connector Types Accommodated
  – FC/PC; DIN 47256; ST*1; SC
- GPIB, IEEE 488.2 Controllable
- Models for Single and Multimode Fiber
- Can Be Mounted Six Abreast in Standard Rackmount
- Evaluate Receiver Sensitivity as a Function of Optical Power
- General Development of Fiber Optic Equipment
- SDH/SONET and FDDI Standards Testing
- OTDR Attenuation Measurement Calibration
- Optical Power Meter Linearity Calibration
- Manufacturing Test of Fiber Optic Equipment

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *The OA5000 Series complies with IEEE Standard 488.2, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*



OIG 501/OIG 502

OIG 501/OIG 502

The OIG 501/OIG 502 Optical Impulse Generators are laser impulse sources that operate at 850 and 1300 nm respectively. The OIG 500 Series sources produce very narrow and stable optical pulses at various user selectable repetition rates.

The user may select either internal or external triggering. The trigger level can be adjusted from ±3 V. The internal triggering repetition rates are 10 kHz, 100 kHz or 1 MHz. These rates are selectable with front-panel switches.

The output is stabilized to provide repeatable output signal levels.

The OIG 501/OIG 502 have two user-selectable output pulse modes: high impulse energy or low impulse energy. The OIG 501/OIG 502 have a 60 ns pre-trigger for easy viewing of the impulses on a variety of oscilloscopes.

Highly stable measurements are made possible by a trigger jitter of ≤5 ps (RMS) and an impulse amplitude variation of <±10% at impulse repetition rates between 10 kHz and 1.0 MHz.

MILLIMETER RESOLUTION OPTICAL TIME DOMAIN REFLECTOMETRY

When combined with other Tektronix instruments such as an optical-to-electrical converter (OCP5000, P6700 or SD/SA-40 Series products) and a high-performance oscilloscope (CSA 803A or 11801B) the OIG 500 Series Optical Impulse Generators can be used to perform extremely high resolution optical time domain reflectometry (OTDR).

These OTDR measurements allow the precise location of Fresnel reflecting single events to <0.1 millimeter. Multiple Fresnel reflectors can be precisely located and measured even when they are spaced as close together as two centimeters.

For more information on this application request Tektronix Application Note #3TW-8058-1 ("High Resolution Optical Reflection Testing with the Tektronix OIG 500 Series Optical Impulse Generators").

OPTICAL REFLECTION MEASUREMENTS

Optical reflections in fiber optic systems can seriously degrade transmission performance, especially in high-speed communications links using laser sources. Characterization of reflective performance of optical connectors and components can be crucial to ensuring signal integrity in these systems. Multiple reflections can occur throughout the optical pathway. It is useful for designers to identify and isolate the specific sources of these reflections.

The OIG 500 Series instruments can be used with Tektronix CSA 803A or Communication Signal Analyzer, or 11801B oscilloscope to evaluate optical reflections. The return loss of optical reflections can be measured to 50 dB levels.

OPTICAL COMPONENT CHARACTERIZATION

With the OIG 500 Series and the CSA 803A, the user can easily characterize optical devices in terms of their frequency response, rise time, and aberration levels.

**1 ST is a registered trademark of AT&T.*

CHARACTERISTICS

	OIG 501	OIG 502
Wavelength	850 nm*1	1300 nm*2
Impulse Width		
Low Energy	≤35 ps	≤35 ps
High Energy	≤300 ps	≤300 ps
Max Output Optical Power		
Low Energy	≥15 mW	≥5 mW
High Energy	≥30 mW	≥15 mW
Impulse Amplitude Variation	10% from 10 kHz to 1.0 MHz	
External Trigger	DC to 1.0 MHz	DC to 1.0 MHz
Internal Trigger	10 kHz 100 kHz 1.0 MHz	10 kHz 100 kHz 1.0 MHz

**1 ±50 nm.* **2 ±20 nm.*

Note: For further technical information, request Product Data Sheet #3TW-7797-1.

Optical Impulse Generators

A Vital Link in Optical Systems Analysis

Tektronix Programmable Optical Attenuators provide a convenient, accurate and cost-effective means of controlling optical power levels in fiber optic media.

The OA5000 Series instruments provide variable attenuation of single and multimode fiber optic signals commonly used in communications equipment. Attenuation levels can be varied manually, using the front-panel controls or automatically via programmable computer control.

TYPICAL APPLICATIONS

Communication standards using optical components typically require that the receiver operate over a given optical power range. This specification is tested by monitoring the bit error rate (BER) as a function of optical power.

FDDI/LAN DESIGN

Using the OA5000 Series Optical Attenuators with the CSA803A Communications Signal Analyzer, network equipment designers can characterize, with repeatable results, the system performance over the specified optical power range.

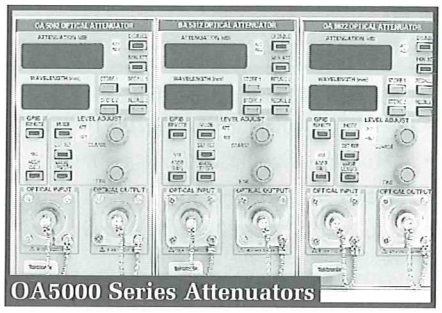
Signal levels may range from –14 dBm to –24 dBm for FDDI systems. The OA5022 Optical Attenuators provide the signal level variation and input fiber size required for FDDI compliance testing.

SDH/SONET COMPLIANCE TESTING

SDH/SONET compliant signal levels may be as high as +2 dBm to as low as –34 dBm. To verify the performance of SONET equipment over these signal levels, it is necessary to have calibrated attenuators with at least this much range. The OA5002 is the attenuator of choice for SDH/SONET testing.

MANUFACTURING AND OTHER AUTOMATED TEST APPLICATIONS

Because the OA5000 Series Optical Attenuators are GPIB Programmable, these units can be operated in a completely automated environment. With the step size of 0.01 dB and a calibrated attenuation range of 0 to 60 dB (continuous), measuring parameters, such as receiver linearity, is quickly and reliably accomplished. Also, with their storable attenuation levels, the OA5000 Series Optical Attenuators are very useful for repeat measurements in manufacturing environments.


OA5000 Series Attenuators

CHARACTERISTICS

Wavelength Range		750 to 1600 nm
Input	OA5002	Single Mode fiber
	OA5012	50 µm Multimode fiber
	OA5022	62.5 µm Multimode fiber
	OA5032	100 µm Multimode fiber
Insertion Loss		≤2.0 dB
Return Loss		≤–45 dB*1 ≤–25 dB*2
Attenuation Range		≥60 dB*3 ≥50 dB*4
Disable		≥100 dB*5 ≥90 dB*5
Accuracy		±0.15 dB (±0.05 dB typ.)
Repeatability		±0.05 dB
Linearity		±0.05 dB

**1 OA5002.* **4 1350-1600 nm.*

**2 OA5012/OA5022/OA5032.* **5 OA5032.*

**3 750-1350 nm.*

Note: [a]For further technical information request Product Data Sheet #3TW-8032-1. [b]For information on OA5000 Series compatibility with other fiber sizes, contact your local Tektronix sales office.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

OIG 501
Optical Impulse Generator.

OIG 502
Optical Impulse Generator.
Both Include: Instruction Manual (070-7818-01), Universal Optical Input/Output Connector Kit (020-1885-00).

OPTIONAL ACCESSORIES
Fiber Optic Cables – Refer to page 335 for complete list.

OA5002
Optical Attenuator.
Includes: Single Mode Input and Output; Universal Optical Input and Output Connector Kit (020-1885-00); and Instruction Manual (070-7612-00).

OA5012
Optical Attenuator.
Includes: 50 Micron Multimode Input and Output; Universal Optical Input and Output Connector Kit (020-1885-00); and Instruction Manual (070-7612-00).

OA5022
Optical Attenuator.
Includes: 62.5 Micron Multimode Input and Output; Universal Optical Input and Output Connector Kit (020-1885-00); and Instruction Manual (070-7612-00).

OA5032
Optical Attenuator.
Includes: 100 Micron Multimode Input and Output; Universal Optical Input and Output Connector Kit (020-1885-00); and Instruction Manual (070-7612-00).

OPTIONAL ACCESSORIES
Fiber Optic Cables– Refer to page 335 for complete list.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *The OA5000 Series complies with IEEE Standard 488.2, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*

Bit Error Rate Testers

New gigaBERT® GB700 • New gigaBERT® GB1400

Features

gigaBERT® GB700/gigaBERT® GB1400

- Operating Frequency Ranges 700/1400 MHz
- Internal PLL Synthesized Clock Source
- PRBS $2^7 - 1$ to $2^{23} - 1$
- Up to 1 Mbit Programmable WORD (Options 8R and 8T) (128 Kbits, gigaBERT GB700)
- Auto-synchronization
- Clock/Data Delay 4 ns, 5 ps Resolution (1400), 20 ps Resolution (700)
- PECL Compatibility: Tx, Rx (700) Tx Only (1400)
- Automatic Eye-width Measurement (1400)
- TTL, ECL, and PECL I/O Compatible
- Reference Data Input for Proprietary Framed Data (gigaBERT GB1400 only)
- Optional Pattern Editor (Windows based) for Custom Word Patterns

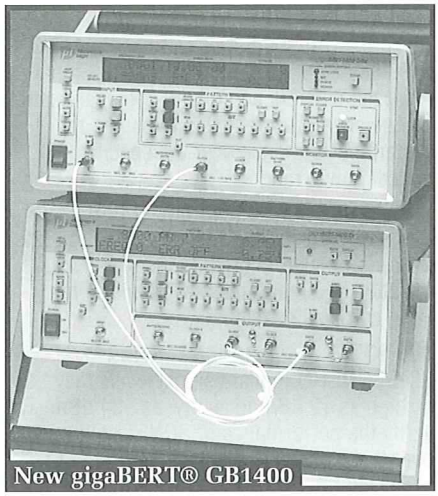
Applications

- Gigabit LAN/SONET/SDH Testing
- Satellite System Testing
- High-speed Circuits and System Design
- Manufacturing Test in TE Environment
- GaAs, ECL, and Optical Component Testing
- Clock Recovery Circuit
- Parallel-to-Serial Analysis with multiBERT™ MB100

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

See Tektronix on the World Wide Web: http://www.tek.com



New gigaBERT® GB1400

gigaBERT® GB700 and gigaBERT® GB1400 Pattern Generator and Error Detector

The gigaBERT Generator and Analyzer operate at bit rates to 1400 Mb/s (700 Mb/s, gigaBERT GB700). These instruments are cost-effective for low-speed applications today and will accommodate your future high-speed requirements as well.

SYMMETRICAL, LOW-JITTER OUTPUT WAVEFORMS

The gigaBERT generates low-jitter, symmetrical waveforms over its entire operating frequency range. The clock and data ports provide both true and inverted output signals. The instrument can drive single-ended or differential inputs.

PRBS OR USER-DEFINED TEST PATTERNS

By generating pseudo-random bit sequences (PRBS) up to $2^{23} - 1$ bits in length, or user-programmable patterns containing up to 1 Mb, the user can effectively simulate live traffic or "worst case" patterns. PRBS patterns are CCITT compatible. User-programmed patterns can be created locally using setup menus or externally by using a workstation or PC. Externally created patterns can be downloaded via the GPIB or RS-232 port. All user patterns are saved in battery-backed RAM. Pre-programmed PROMs can be factory installed.

ADJUSTABLE INPUTS FOR MAXIMUM FLEXIBILITY

The clock and data ports on the gigaBERT Analyzer accept both true and inverted inputs. Single-ended or differential signals can be internally terminated. Input data delay is adjustable to accommodate different clock and data signal path delays.

AUTO-SEARCH FOR EASY SETUP

Auto Search greatly simplifies Analyzer setup. The gigaBERT Analyzer automatically synchronizes to the incoming signal by 1) Setting the input data decision voltage to its optimum value; 2) Adjusting input data delay for an optimum clock/data phase relationship; 3) selecting the correct PRBS test pattern; and 4) selecting the correct pattern polarity (normal or inverted).

It synchronizes with any pattern sourced by a gigaBERT Generator. It can perform a bit-by-bit comparison of an arbitrary signal with an external Reference input. Thus the gigaBERT can perform bit error analysis on any data pattern with a known good reference pattern.

POWERFUL ANALYSIS AND REPORTING FUNCTIONS

The gigaBERT performs a full-rate, bit-by-bit analysis of the received signal. Bit error results are then used to calculate three bit error rate (BER) measures. Total BER is calculated from the last power-on or reset. Window BER is calculated over a sliding window specified in terms of time (1 second to 24 hours) or bits 1^8 to 1^{16}-Bits). Test BER is calculated from the start of the current test.

Moreover, the gigaBERT calculates errored seconds (ES), percentage error-free seconds (%EFS), severely-errored seconds (SES), degraded minutes (DM), unavailable seconds (US), and loss of signal (LOS) seconds. All bit error results – including the three BER measures – are calculated simultaneously and may be displayed during a test or after a test has been completed. A hard copy of all test results can be generated locally by connecting a printer to the parallel printer port or GPIB or RS-232 port. Reports may be printed when an error is detected, at the end of test intervals, or both.

FRONT PANEL OR AUTOMATED OPERATION

The gigaBERT provides easy operation augmented by set-up store and recall. Clear, concise LCD displays of setup and results make it easy to use.

The gigaBERT Generator and Analyzer can be controlled via the GPIB or RS-232 interface ports. The gigaBERT remote command set includes commands for all setup menus and front-panel selections. The status of front-panel indicators and test results can be remotely accessed.

Bit Error Rate Testers

New gigaBERT® GB700 • New gigaBERT® GB1400

Characteristics

(Both gigaBERT GB700 and gigaBERT GB1400)

PATTERN GENERATOR

Internal Clock Source –
Stability: 10 ppm.
Memory: 10 frequencies.

External Clock Input –
Termination select: 50 Ω to GND or –2 V, DC coupled.
Impedance: 50 Ω, AC coupled (50 Ω ECL Burst Mode).
Connector: SMA.

Data Patterns –
PRBS patterns: 2n – 1, where n = 7, 15, 17, 20, 23.
WORD order select: LSB or MSB first.
WORD memories: 10 WORDs.

Data and Clock Outputs –
Variable resolutions: 50 mV step into 50 Ω.
Source impedance: 50 Ω.
Connectors: SMA.
CLOCK/DATA skew: ±100 ps maximum, rising edge to rising edge.

Two-Channel Data Outputs Clock/2 (Rear Panel) (gigaBERT GB1400 only) –
Format: NRZ-L.
Level: ECL reverse terminated.
Quantity: 2.
Rate: 1/2 clock rate.
PRN phase: 1/2 frame.
WORD: Alternating bits.
Connectors: SMA.

Characteristics Continued	gigaBERT® GB700	gigaBERT® GB1400
Power		
Line Voltage	90 to 250 V AC	90 to 132 V AC ±10%, 180 to 264 V AC ±10%
Line Frequency	–	47 to 63 Hz
Power Consumption	125 VA maximum	100 VA maximum

Clock Outputs (True and Complement) –
Source impedance: 50 Ω.
Connectors: SMA.

Error Injection – Internal: Single or 10^{-n} for n = 3, 4, 5, 6, 7 rate.

Auxiliary Outputs – Connectors: SMA.

ANALYZER

Clock Input – Connector: SMA.

Data Input – Connector: SMA.

Data Input (gigaBERT GB1400 only) –
Impedance: 50 Ω.
Termination voltage: Selectable, GND, –2.0 V or AC.

Patterns –
PRBS patterns: 2^n – 1, where n = 7, 15, 17, 20, 23.
WORD memories: 10 WORD.

Reference Data Input –
Input level: 0.5 V to 1.5 V_{p-p}.
Connector: SMA.

Monitor Outputs –
Functions: Data, Clock, Pattern Sync.
Connectors: SMA.

Measurements – Frequency: System clock, 10 kHz resolution.

Bit Error Rate (gigaBERT GB1400 only) –
Additional calculations: ES, EFS, TES, SES, DM, US, LOS.
History indicators: Sync loss, bit error, phase error, power loss.

Interface –
GPIB: IEEE 488.2 compatible.
RS-232C: DB-25 connector.

Environmental –
Operating temperature: 0 to +50°C.
EMI: Complies with FCC A and VFG 243 (gigaBERT GB700 only).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.	mm	in.
Height	152	6.0	152	6.0
Width	366	14.4	366	14.4
Depth	340	13.4	419	16.5
Weight	**kg**	**lb.**	**kg**	**lb.**
Net	10	22	10	22

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

gigaBERT® GB700
Pattern Generator and Error Detector.
Includes: Power Cord, Manual.

gigaBERT® GB1400
Pattern Generator and Error Detector.
Includes: Power Cord, Manual.

Options for both –
Opt. 1R – Rack Mount for Error Detector.
Opt. 1T – Rack Mount for Pattern Generator.
Opt. 2A – 75 Ω Termination, Both Units.
Opt. 2R – 75 Ω Termination, Error Detector Only.
Opt. 2T – 75 Ω Termination, Pattern Generator Only.
Opt. 4R – Delete Pattern Generator.
Opt. 4S – PC Pattern Editor Software Diskette.
Opt. 4T – Delete Error Detector.

gigaBERT® GB1400 Only –
Opt. 5A – BURST Mode, Both Units.
Opt. 5R – BURST Mode, Error Detector Only.
Opt. 5T – BURST Mode, Pattern Generator Only.
Opt. 7T – Positive ECL, Pattern Generator Only.
Opt. 8T – 1 Mword RAM, Generator Only.
Opt. 8R – 1 Mword RAM, Detector Only.
Opt. 9T – Preprogrammable ROM, Generator Only.
Opt. 9R – Preprogrammable ROM, Detector Only.

SERVICE ASSURANCE OPTIONS (gigaBERT® GB700)
Opt. R2 – Adds two years of post-warranty Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

INTERNATIONAL POWER PLUG OPTIONS (gigaBERT® GB700)
Opt. A1 – Universal Euro 220 V, 50 Hz.
Opt. A2 – United Kingdom 240 V, 50 Hz.
Opt. A3 – Australian 240 V, 50 Hz.
Opt. A4 – North American 240 V, 60 Hz.
Opt. A5 – Switzerland 220 V, 50 Hz.

RECOMMENDED ACCESSORIES
Soft Carrying Case for Transmitter or Receiver. Order 016-1442-00.
Transit Case for Transmitter or Receiver. Order 016-1443-00.
10-ft. 25-Pin Male-to-Male RS-232 Cable. Order 012-1384-00.
10-ft. 25-Pin Male to 9-Pin Female RS-232 Cable. Order 012-1298-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call. 1-503-627-1933, inside the U.S. call. 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

See Tektronix on the World Wide Web: http://www.tek.com

Bit Error Rate Tester

New multiBERT™ MB100

Features

multiBERT™ MB100

- Up to 32 Channels, 100 Mword/s Rate
- Parallel BER (Bit Error Rate) Measurements
- Automatic Synchronization
- 64 Kbits Deep Programmable Memory per Channel
- Error Injection: Single or Multiple Rates
- ±2 ns Delay by 100 ps Step Delay Controls per Channel and Clock Outputs
- Aggregated BER and Each-channel BER Measurements
- Channel Isolation (Mask-off) Function Capability

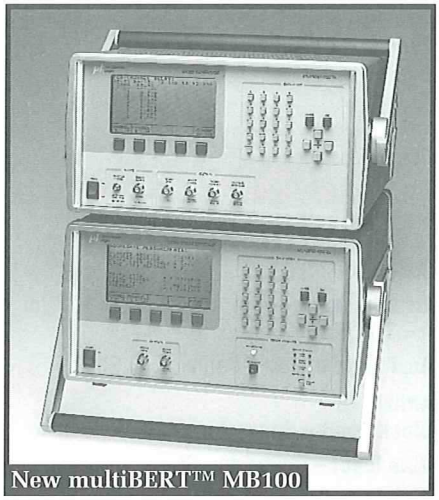
Applications

- Fiber Channel Conformance Testing
- Parallel to Serial Tester
- Bus-oriented Transmission Media Testing
- General Multiplexer/Demultiplexer Testing
- Crosstalk Testing Across Channels

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

See Tektronix on the World Wide Web: http://www.tek.com



New multiBERT™ MB100

multiBERT™ MB100 16 to 32 Channel BERT

The multiBERT MB100 Analyzer system is a parallel bit-error-rate-tester (BERT). It's designed to be a fully integrated test solution for high reliability bus-oriented subsystems or components requiring low bit error rate performance analysis. It can provide problem isolation for both design and manufacturing.

The multiBERT MB100 Series consists of the Pattern Generator unit, Error Detector unit, ECL-to-TTL Converter Pod, and the TTL-to-ECL Translator Pod. This system is a fully programmable pattern generator and error detector for parallel stimulus and testing.

The multiBERT MB100 Pattern Generator and multiBERT MB100 Error Detector are separate, stand-alone instruments which are used together to provide full flexibility in both parallel pattern generation and error detecting. The system is expandable up to 32 channels per unit.

The multiBERT MB100 Series is an ideal tool to be used in parallel interface circuits. It can also be used in multiplexed data circuits in conjunction with the gigaBERT1400 Serial BERT Pattern Generator and Error Detector. This includes testing of Fiber Channel, HIPPI, TDMA, WDMA, and many other evolving systems.

Characteristics

PATTERN GENERATOR

Inputs –

External clock inputs: Selectable.
CK-IN1: Direct input. Frequency: 100 MHz maximum; Amplitude: 0.5 to 1 V peak-to-peak; Termination: AC coupled 50 Ω or TTL 50 Ω to ground; Connector: BNC, front panel.
CK-IN2: Prescaled input. Prescale N: N = 4, 8, 10, 12, 16, 20, 24, and 32; Frequency: 1.4 GHz maximum. Divided clock must be <100 MHz; Amplitude: 0.5 to 1 V peak-to-peak; Termination: AC coupled, 50 Ω; Connector: SMA, front panel.

External sync input: Used to cascade multiBERT MB100 Tx units.
Level: ECL, single-ended, 50 Ω to –2 V termination; Connector: BNC, rear panel.

Clock Outputs –

CK-OUT1: Level: ECL, differential; Rate: Same as data rate. 100 MHz maximum; Delay range: ±2 ns, 100 ps step; Polarity: True or invert, selectable; Connector: AMP 201311-1, 75-Pin connector housing, rear panel.

CK-OUT2: Level: ECL, differential; Rate: One half data rate; Connector: AMP 201311-1, 75-Pin connector housing, rear panel.

CK-OUT3: Level: ECL, single-ended, 50 Ω to –2 V termination; Rate: Same as data rate; Connector: BNC front panel.

CK-OUT4: Level: ECL, single-ended, 50 Ω to –2 V termination. Rate: One half data rate; Connector: BNC front panel.

Pattern Generator –

Number of channels: 16 channels (24 channels with Option 3B, 32 channels with Option 3C).
Data format: NRZ.
Data pattern: Programmable or PRBS $2^n - 1$ (n = 7 and 15).
Pattern length: Programmable, 64 K maximum, 1 word resolution.
Memory size: 64 K deep per channel.
Static pattern storage: Two 64 K individual word patterns, battery-backed.

Error Insertion –

Controls: Error injection can be enabled or disabled on a per-channel basis.
Single error: Selected channel only.
Multiple error: Error rate of 10^{-n} (n = 3, 4, 5, 6, and 7). Error inserted into Enabled channels.

Data Outputs –

Data delay: ±2 ns in 100 ps steps per channel.
Output level: Converter Pod is available with Option 3E, Option 3F, or Option 3G.
Connector: AMP 201311-1, 75-Pin connector housing, rear panel.

Bit Error Rate Tester

New multiBERT™ MB 100

Channel Monitor Output –
Selection: Any channel may be selected.
Level: ECL, single-ended, 50 Ω to –2 V termination.
Connector: BNC, front panel.

Word Sync Outputs –
SYNC OUT1: Format: Single-bit wide, one pulse per pattern frame; Level: 0 to 2 V peak into 50 Ω to ground; Connector: BNC, front panel.

SYNC OUT2: Format: Single-bit wide, one pulse per pattern frame; Level: ECL, single-ended, 50 Ω to –2 V termination; Connector: BNC, rear panel.

Display – 16 x 32 back-lighted LCD.

Interface –
GPIB: Compatible with IEEE 488-2.
RS-232C: DB-25 connector.

Environmental – Operating temperature: +10 to +40°C.

Power –
AC line: 115 V.
Power Consumption: 250 W nominal.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	203.2	8
Width	355.6	14
Depth	431.8	17
Weight	**kg**	**lb.**
Net	14.5	32

ERROR DETECTOR

Clock Input –
CK-IN1: Frequency: 100 MHz maximum; Level: ECL, differential; Termination: 100 Ω, differential; Delay range: ±2 ns, 100 ps step; Clock phase: Rising edge aligned to data transition, nominal; Polarity: True or invert, selectable; Connector: AMP 201311-1, 75-Pin connector housing, rear panel and 6-foot cable.

Internal Reference Patterns –
Number of channels: 16 channels (24 channels with Option 3B, 32 channels with Option 3C).
Data pattern: Programmable or PRBS $2^n - 1$ (n = 7 and 15).
Pattern length: Programmable, 64 K maximum, 1 word resolution.
Memory size: 64 Kbits deep per channel.
Static pattern storage: Two 64 K individual word patterns, battery backed.

Synchronization Threshold –
Threshold level: Selectable between 256/4096 and 1/65 K in 8 levels.

Measurements –
Average frequency: System word clock frequency, 10 kHz resolution.

Bit error detection: Simultaneous parallel measurements.

Aggregated BER measurements: Total bits received: 0 to 1.6E+19; Total errors: 0 to 999,999,999, 0 to 1.6E+19 (remote read out); Averaged BER: 9.9E–01 to <1.0E–16, Zero error caused BER of (0.0E+00), 0 to 1.6E+19 (remote read out); Other: Elapsed seconds, errored seconds, synchronization loss seconds, and clock loss seconds: 0 to 4,000,000,000.

Per channel measurements: Total bits received: 0 to 1.6E+19; Total errors: 0 to 99,999,999, 0 to 1.6E+19 (remote read out); Average BER: 9.9E–01 to <1.0E–19 (remote read out); Errored seconds: 0 to 4,000,000,000.

Interface –
GPIB: Compatible with IEEE 488-2.
RS-232C: DB-25 connector.

Environmental –
Operating temperature: +10 to +40°C.

Power –
AC line: 115 V.
Power consumption: 250 W nominal.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	203.2	8
Width	355.6	14
Depth	431.8	17
Weight	**kg**	**lb.**
Net	14.5	32

ECL-TO-TTL, TTL-TO-ECL CONVERTER PODS (Option 3E, Option 3F, Option 3G)

Inputs/Outputs –
Inputs: Compatible with multiBERT MB100 Pattern Generator.
Connectors: AMP 201311-1, 75-Pin connector housing, rear panel and 6-foot cable.
Outputs: Data and Clock. Level: 0 to 5 V from 50 Ω source with unterminated load; Source impedance: 50 Ω; Connectors: Sub-miniature SMB (SSMB).

Power –
AC line: 115 V.
Power consumption: 50 W nominal.

PHYSICAL CHARACTERISTICS (EACH POD)

Dimensions	mm	in.
Height	152.4	6
Width	254	10
Depth	254	10
Weight	**kg**	**lb.**
Net	4.6	10

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

multiBERT™ MB100
16 to 32 Channel BERT.
Includes: Power Cord, Manual.

Opt. 1R – Rack Mount for Error Detector Unit.
Opt. 1T – Rack Mount for Pattern Generator Unit.
Opt. 2B – 16-channel Differential I/O.
Opt. 2C – 24-channel Differential I/O.
Opt. 3B – 24-channel, Both Units ECL.
Opt. 3C – 32-channel, Both Units ECL.
Opt. 3E – 16-channel ECL/TTL Converter Units.
Opt. 3F – 24-channel ECL/TTL Converter Units.
Opt. 3G – 32-channel ECL/TTL Converter Units.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES
Soft Carrying Case for Transmitter or Receiver. Order 016-1442-00.

Transit Case for Transmitter or Receiver. Order 016-1443-00.

10-ft. 25-Pin Male-to-Male RS-232 Cable. Order 012-1384-00.

10-ft. 25-Pin Male to 9-Pin Female RS-232 Cable Order 012-1298-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

See Tektronix on the World Wide Web: http://www.tek.com

Bit Error Rate Test Set

New packetBERT™ PB200

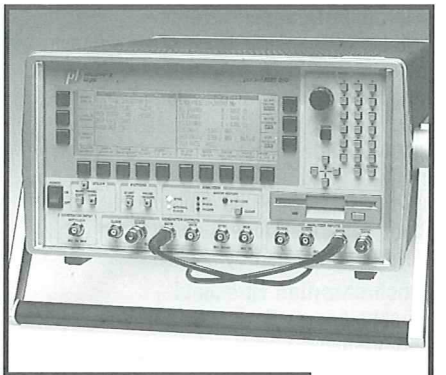
Features

packetBERT™ PB200

- Packet or Cell BER Testing
- DC to 200 Mb/s Data Rate, NRZ-1
- 256 Kbits Programmable WORD, PRBS, 1 s Density, and Selectable Mixed Mode
- Auto Search and Auto Sync Capability
- Controllable Gapped Tx Clock
- Automatic Eye-width Measurement and Extrapolation
- Clock/Data Delay up to 32 ns in 20 ps Increments
- Variable Data/Clock Amplitude and Offset Including ECL, PECL, and HI-Z TTL
- Mixed-mode Testing
- Optional Pattern Editor for Custom Word Patterns (Windows-based)

Applications

- Wireless and Satellite Communications
- B-ISDN, FITL, TDMA, and CDMA System Design
- Optical Module Development
- Semiconductor Device Development
- UTP, Fiber Optic Module Development
- Video-on-demand System Development



New packetBERT™ PB200

packetBERT™ PB200 Packet Generator and Error Detector

The packetBERT PB200 is particularly suited to packet-based systems. It's ideal for component or sub-system development testing of FDDI, B-ISDN, FITL, ATM, Satellite modems, and similar communications protocols.

The ability to generate a "Mixed Mode" data pattern allows flexibility in constructing many forms of test signals. Two separate programmable word memories of 16 to 256 Kbits in length allow the construction of a packet or cell that can consist of user-definable preamble, overhead, and data. The packetBERT PB200 data generator has one word memory that is used to define the overhead and preamble, and a second word memory to define the data. Each memory can consist of a user-defined pattern or PRBS. The packetBERT PB200 can also function as a fully featured non-packetized BERT.

SIGNAL ANALYSIS

For complete flexibility in signal analysis, the packetBERT PB200 allows BER analysis on all, or only part, of the received digital information. Analysis can be performed on only the overhead, only the data, or both overhead and data at the user's selection.

UNIQUE packetBERT PB200 FEATURES

The packetBERT PB200 provides several unique features and capabilities that are not found on other BERT products in this class. The receiver has a clock/data deskew range of 32 ns and the ability to measure propagation delay. Along with the Auto Search setup capability, the receiver can automatically measure "eye width" at user-selectable BERs, and extrapolate eye-widths at very low BERs from data accumulated over much shorter elapsed times than normally required. The transmitter can also generate a gapped clock.

Characteristics

GENERATOR

Clock –

External clock input: Frequency: DC to 200 MHz; Amplitude: 0.5 to 5.0 V p-p; Connector: BNC; Termination select: 50 Ω to –2 V, +3 V, AC or GND; Input range: ECL, TTL, PECL compatible; Threshold resolution: 10 mV step.

External clock reference input: Frequency: 10 MHz, ±100 ppm maximum; Amplitude: 0.5 to 2.0 V p-p, AC coupled; Termination: 50 Ω; Connector: BNC.

Internal synthesized clock source: Frequency: 1 Hz to 200 MHz; Resolution: 1 Hz; Accuracy: 10 ppm.

BURST clock: Programmable gap: 128 Kbits maximum, 8-Bit resolution.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

See Tektronix on the World Wide Web: http://www.tek.com

Bit Error Rate Test Set

New packetBERT™ PB200

Pattern Generator –
PRBS: $2^N - 1$, N = 31, 23, 15, 11, 10, 9, 7.

Programmable word: 256 Kbits maximum, 8-Bit resolution.

Mark density: PRBS $2^{10} - 1$ (1/8, 1/4, 1/2, 3/4, 7/8).

Mixed mode frame: 256 Kbits maximum, 8-Bit resolution.

Error injection: Error: Single, Rate, External (TTL); Field select: Overhead, payload, or both; Error rates: Error rate of 10^{-n}, n = 3, 4, 5, 6, 7.

Outputs –
Data and clock outputs: Format: NRZ; Configurations: Differential (True/Complement); Source impedance: 50 Ω; Connector: BNC; Amplitude: 0.5 V to 2.0 V, 10 mV step; Offset, 50 Ω to GND: –2.0 V to +1.8, 10 mV step (termination to 50 Ω will increase the range for PECL); Data delay range: ±1.0 ns, 20 ps resolution; Rise/fall time: 300 ps typical, 500 ps maximum (20 to 80%).

Pattern sync output: Signal level: 250 mV_{p-p} into 50 Ω load.

Auxiliary –
Data inhibit input: ECL, 50 Ω to –2 V, BNC.
Clock disable input: ECL, 50 Ω to –2 V, BNC.

ANALYZER

Data and Clock –
Clock input: External or internal from generator.

Data and clock inputs:
Data polarity: True/invert selectable; Input mode select: Single-ended or differential; Termination select: 50 Ω to –2 V, +3 V, AC or GND; Input range: ECL, TTL, PECL compatible; Threshold resolution: 10 mV step.

Synchronization –
Auto search: Clock and data threshold, Clock and data timing skew, Data pattern and polarity.

Measurements –
Frequency: 1 Hz to 200 MHz.
Bit errors: Window, Totalize, Timed Test, Simultaneous 1's, 0's, and All Errors.
BER test fleld: Overhead, payload, or both.
Propagation delay: Up to 128 Kbits.
Eye-width: Up to 32 ns.

Reference Data Patterns – Identical to Pattern Generator but independent.
Startup delay: 0 to 64 Kbits programmable.

Auxiliary –
Error count inhibit input: ECL, 50 Ω to –2 V, BNC.
Error detect output: RZ, TTL, 50 Ω source, BNC.
Analyzer clock disable: ECL, 50 Ω to –2 V, BNC.
Data delay output: ECL, 50 Ω source, BNC.

COMMON CHARACTERISTICS

Pattern –
Controls: Start/Stop, Pause/Resume, or Single Step.

Save/Load:
Floppy disk: 3.5 in.
Internal storage: 2 Mbits.

Remote Interface –
GPIB: IEEE 488.2 compatible.
RS-232C: DB9 connector.
Parallel printer: DB25 connector.
Monitor: DB15, VGA Analog Output.

Environmental –
Operating temperature: 5 to 40°C.
Storage temperature: –10 to 60°C.

Power –
AC line: 100 to 120 V AC, 200 to 240 V AC.
Power consumption: 300 W maximum.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	203.2	8
Width	355.6	14
Depth	508	20
Weight	**kg**	**lb.**
Net	13.6	30

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

packetBERT™ PB200
Packet Generator and Error Detector.
Includes: Power Cord, Manual.

Opt. 1M – Rack Mount.

Opt. 4S – PC Pattern Editor Software Diskette.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – United Kingdom 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.

RECOMMENDED ACCESSORIES
Transit Case for Transmitter or Receiver. Order 016-1447-00.

10-ft. 25-Pin Male-to-Male RS-232 Cable. Order 012-1384-00.

10-ft. 25-Pin Male to 9-Pin Female RS-232 Cable Order 012-1298-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.2-1987.*

See Tektronix on the World Wide Web: http://www.tek.com

Optical Receiver for RF Spectrum Analyzer
Q32605

Features

- Plug-in for Advantest RF Spectrum Analyzers
- Compatible with R3265A and R3271A Analyzers
- Direct On-screen Readout of Measurements
- High Optical Input Sensitivity
- Wide Frequency Range to 2.4 GHz
- Excellent Frequency Response Flatness
- High Input Return Loss

Applications

- Characterization of Cable TV Optical Assemblies:
  - Laser Diode Transmitters
  - Erbium Doped Fiber Amplifiers (EDFA)
- Direct Measurement of Cable TV Analog Parameters:
  - Relative Intensity Noise (RIN)
  - Carrier-to-Noise Ratio (C/N)
  - Percent Modulation

ADVANTEST Q32605

This plug-in combined with an Advantest RF Spectrum Analyzer is used to measure and display certain specific noise and modulation characteristics of optical sources and optical fiber amplifiers. These sources are operating in the 1200 nm to 1600 nm optical wavelength range and operating in continuous wave or with analog modulation in the 6 MHz – 2.4 GHz band. Such sources are used in telecommunications and cable TV transmission.

The Q32605 allows an Advantest R3265A or R3271A RF Spectrum Analyzer to directly measure the percent of modulation, average optical power, carrier-to-noise (C/N) ratio, and relative intensity noise (RIN) of single mode optical sources such as distributed feedback (DFB) lasers. All of these measurements are used to characterize fiber optic sources used in analog cable TV transmission.

Additionally, average optical power and RIN measurements are important in the characterization of lasers and fiber amplifiers used in digital telecommunications. These type measurements are made in design engineering, manufacturing, standards compliance test, and service applications using the above optical sources.

GENERAL

The Q32605 is a palm-sized plug-in module fitting into a front-panel slot in the Advantest R3265A or R3271A RF Spectrum Analyzer. This plug-in is a special purpose optical-to-electrical (O/E) converter whose electrical outputs are both AC and DC coupled into the spectrum analyzer. No modification to the analyzer is necessary to use this plug-in. Use of this plug-in with earlier Advantest R3265/3271 Spectrum Analyzers may require factory modification of the analyzer. Contact Tektronix for further information.

KEY PRODUCT FEATURES AND BENEFITS

The Advantest R3265A or R3271A RF Spectrum Analyzers have special built-in firmware that allows the operator to directly and easily make the above measurements by utilizing simple menu selections provided on the instrument front-panel display. Unlike alternative measurement methods, no time-consuming external equipment connection, reconfiguration or off-line manual computations are required by the operator to acquire the measurement data and to display the results.

Characteristics

Optical input wavelength range – 1200 nm to 1600 nm.

Maximum input optical power – Average light: +10 dBm. Modulated light: –7 dBm.

Modulated optical power measurements – Frequency range: 6 MHz to 2.4 GHz. Flatness: ±1.8 dBm, optical.*1 Optical input sensitivity: –57 dBm, optical,*2 –160 dB/Hz.*3

Average optical power measurements – Accuracy: ±0.25 dB. Measurement range: –20 dBm to +10 dBm.

Measurement function – RIN measurement: Directly read on Spectrum Analyzer screen. % modulation measurement: Directly read on Spectrum Analyzer screen.

Input/output – Optical input: FC/PC type connector, single mode fiber.*4 RF output: SMA type electrical connector.

Input return loss – ≤ 45 dB.

Operating environment – 0 to 40°C, ≤ 85% relative humidity.

Storage environment – –20 to +60°C, ≤ 90 % relative humidity.

**1 130 MHz as the standard.*

**2 Noise level converted to light input. For the RF spectrum analyzer: RBW = 1 Hz, VBW = 30 Hz, Att = 0 dB.*

**3 Noise level converted to RIN. Average optical power: +8dBm.*

**4 When a low reflection PC optical connector is used.*

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

Q32605
Advantest Optical Receiver Plug-in.
Includes: Instruction Manual.

Optical Spectrum Analyzers

Q8383 • Q8381A • Q8344A

Features

Q8383

- Double-pass Diffraction Type Measurements
- Wide Dynamic Range
- High Accuracy
- Low Polarization Dependence
- Excellent Linearity
- High Accuracy Wavelength Setting Resolution
- Optical Amplifier Noise Figure Measurement Function
- Accurate Pulse Measurements

Q8381A

- Single-pass Diffraction Type Measurements
- Wide Wavelength Range
- High Sensitivity
- Low Polarization Dependence
- Power Monitoring with Trend Display
- Versatile Memory Functions

Q8344A

- Michelson Interferometer Type Measurements
- Direct Coherence Length Measurements
- Fast Scanning

Applications

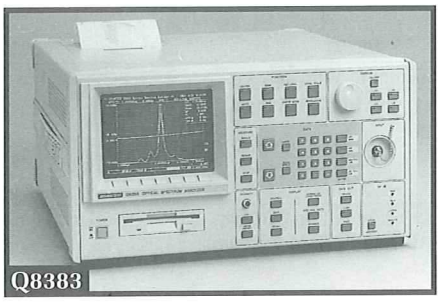
- Optical Fiber Amplifier Measurements
- Communications Laser and LED Transmitter Characterization
- Manufacturing Test of Optical Sources
- Optical Source Standards Compliance

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987.*

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.



Advantest Q8383

The Q8383 is an outstanding general purpose optical spectrum analyzer for use in the spectrum analysis of laser diodes (LDs), for measuring the wavelength characteristics of other optical components, and characterizing erbium doped fiber amplifiers (EDFA). The wide dynamic range of 65 dB has been achieved with a design employing a Czerny-Turner type double-pass monochromator which uses Advantest's unique optical technology. These innovations facilitate side mode suppression ratio (SMSR) measurements on DFB laser diodes and light level measurements of amplified spontaneous emissions (ASE) on fiber amplifiers.

For measurement of pulse modulated light, the Q8383 provides a pulse light mode and synchronous input terminal. This pulse mode measures the peak level within a specified gate time, while the synchronous input terminal measures the light pulse by controlling measurement timing from an external input signal. This spectrum analyzer is ideal for measurements when circulating loop tests are performed in long haul transmission experiments.

During optical tests on optical amplifier characteristics, gain and noise figure (NF) measurement accuracy are greatly affected by the characteristic performance of the spectrum analyzer. Critical characteristics include the dynamic range, polarization dependence, level accuracy, linearity, and wavelength resolution setting accuracy. The Q8383 provides a curve-fitting function ensuring that EDFA ASE level, gain, and NF measurements can be made easily with high accuracy using the optical amplifier NF measurement function.

The Q8383's unique measurement method offers an extremely low polarization dependence which is within ±0.05 dB at any wavelength. In addition the wavelength sensitivity compensation is performed for each and every unit. This results in a very low polarization dependency.

Advantest Q8381A

The Q8381A is a general purpose optical spectrum analyzer utilizing a single-pass monochromator design. Like the Q8383, it provides a high sensitivity measurement at a fast sweep speed. The Q8381A also provides a pulse measurement mode and an optical power measurement with trend display capability. The Q8381A provides a lower dynamic range but a wider optical wavelength range and lower price than the Q8383. Like the Q8383, the Q8381A has a battery backed-up internal memory and an MS-DOS compatible floppy disk drive for measurement and set-up data storage and retrieval. Although low by competitive standards, the polarization dependence of the Q8381A is not as low as that of the Q8383.

Advantest Q8344A

The Q8344A makes use of a Fourier spectrum analysis approach based on a Michelson interferometer. Because of this, the Q8344A can measure optical coherence that cannot be obtained directly using diffraction-type optical spectrum analyzers which use monochromators to make their measurements.

The features of this analyzer make it very effective for the evaluation of laser diodes used in optical data storage equipment, fiber optic gyroscopes, and related applications. The Q8344A has a built-in He-Ne laser that functions as the wavelength reference and ensures the wavelength measurement accuracy is maintained within ±0.1 nm (at 1.3 μm). Because of this internal reference source, no calibration is needed, thereby allowing this analyzer to provide long-term repeatable measurements.

This instrument is exceptionally well suited to the measurement of coherence length of LD and LED optical sources operated in continuous wave mode. Unlike the Q8383 and Q8381A, the Q8344A is not suitable for spectral analysis of modulated light sources.

Optical Spectrum Analyzers

Q8383 • Q8381A • Q8344A

CHARACTERISTICS

	Characteristic	Q8383	Q8381A	Q8344A
Wavelength	Measurement range	550 nm to 1750 nm	350 nm to 1750 nm	350 nm to 1750 nm
	Resolution settings	0.1, 0.2, 0.5, 1.0, 2.0, 5.0 nm	0.1, 0.2, 0.5, 1.0, 2.0, 5.0 nm	0.05 to 0.1 nm max resol. (at 0.85 & 1.31 µm)
	Accuracy	±0.5 nm	±0.5 nm	±0.1 nm
	Repetitive reproducibility	≤ 0.1 nm	≤ 0.1 nm	
Level	Measurement range (input sensitivity)	–85 to +10 dBm (1.2 to 1.65 µm) –55 to +10 dBm (0.55 to 1.75 µm)	–85 to +10 dBm (1.1-1.6 µm) –75 to +10 dBm (0.7-1.6 µm) –70 to +10 dBm (0.4-1.65 µm) –60 to +10 dBm (0.35-1.75 µm)	–70 to +10 dBm (0.7-1.6 µm) –60 to +10 dBm (0.45-1.7 µm) –45 to +10 dBm (0.35-1.75 µm)
	Polarization dependence	within ±0.05 dB	≤ 0.5 dB pk-pk	–
	Accuracy	within ±0.4 dB	≤ ±1.5 dB, (at 0.633, 1.31, & 1.55 µm)	≤ ±2.0 dB, (at 0.85 or 1.31 µm)
	Linearity	±0.05 dB (1.2 to 1.65 µm, –50 to +10 dBm)	±0.05 dB at ≤20 dB, ±1.0 dB at ≤40 dB	±0.05 dB at ≤10 dB, ±1.0 dB at ≤25 dB
	Scale	0.2, 0.5, 1.0, 2.0, 5.0, 10.0 dB/div and linear	0.2, 0.5, 1.0, 2.0, 5.0, 10.0 dB/div and linear	0.2, 0.5, 1.0, 2.0, 5.0, 10.0 dB/div and linear
	Dynamic range	≥ 55 dB (±0.5 nm from peak) ≥ 65 dB (±1.0 nm from peak)	≥ 40 dB (±1.0 nm from peak) ≥ 50 dB (±5 nm from peak)	–
Sweep	Measurement time	≤ 0.8 sec (≤ 200 nm span)	≤ 0.8 sec (≤ 200 nm span) ≤ 1.5 sec (≤ 500 nm span)	≤ 1.5 sec (SNGL mode, 1 avg.)
Pulse light measurement	Peak hold mode	≥ 10 ns pulse width, (≥ 30 µs recommended) ≥ 0.1 Hz pulse rep. rate Gate time: 1 ms to 10 sec	≥ 30 µs pulse width Gate time: 1 ms to 10 sec	N/A
	Synchronous (gated) measurement input	Sync. sig. input level: 3.5 V high, 1.5 V low, pos. logic Min optical pulse width: ≥10 ns (30 µs recommended) Optical pulse rep. rate: DC to 100 MHz	Sync. sig. input level: 3.5 V high, 1.5 V low, pos. logic Min optical pulse width: ≥10 ns (30 µs recommended)	N/A
Processing functions	Data storage	Battery backed-up RAM, MS-DOS format floppy disk	Battery backed-up RAM, MS-DOS format floppy disk	Battery backed-up RAM
	Calculation, analysis, & display	Optical amp NF function, Power monitor & trend, Measurement cursors, Dual screen & superimpose display, Split display, 3-D display function, Averaging	Auto optimum settings, Auto peak search, Measurement cursors, Power monitor & trend, Luminosity compensation, 3-D display function, Superimpose & split displays, Averaging	Coherence analysis, Auto optimum settings, Auto peak search, Measurement cursors, 3-D display function, Averaging
Input/Output	Optical input	FC type connector	FC type connector	FC type connector
	Data output	GPIB IEEE 488 control Internal printer Direct plotter output	GPIB IEEE 488 control Internal printer Direct plotter output	GPIB IEEE 488 control Internal printer option Direct plotter output
General	Operating environment	–10 to +40° C, ≤ 85% RH (noncondensing)	–10 to +40° C, ≤ 85% RH (noncondensing)	–10 to +40° C, ≤ 85% RH (noncondensing)
	Power supply	90 to 250 V AC, 48 to 66 Hz, ≤ 180 VA	90 to 250 V AC, 48 to 66 Hz, ≤ 180 VA	90 to 132 V AC , (198 to 250 V AC optional), 48 to 66 Hz, ≤ 180 VA
	Dimensions	424 (W) x 221 (H) x 450 (D) mm	424 (W) x 221 (H) x 450 (D) mm	424 (W) x 221 (H) x 500 (D) mm
	Weight	≤ 28 kg	≤ 29 kg	≤ 27 kg

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

Q8383 – Advantest Optical Spectrum Analyzer.
Includes: Instruction Manual, Power Cable (AO1402), Printer Paper (100-0688-00).

Q8381A – Advantest Optical Spectrum Analyzer.
Includes: Instruction Manual, Power Cable (AO1402), Printer Paper (100-0688-00), and 3.5 in. Floppy Disk.

Q8344A – Advantest Optical Spectrum Analyzer.
Includes: Instruction Manual, Power Cable (AO1402).

Opt. 01 – Built-in Printer (with paper).

Opt. 10 – 200 µm Fiber Input.

Opt. 40 – 198 to 250 V AC Power.

Thermal printer paper – Order 100-0688-00 for built-in printer (5 roll box).

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

Handheld Optical Power Meter

TQ8210

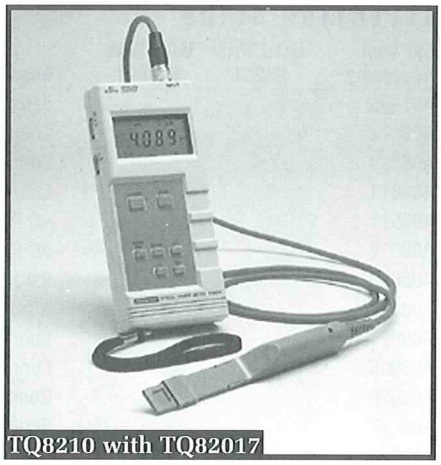
Features

TQ8210

- Automatic Wavelength Sensitivity Compensation
- Multiple Sensors Available
- Battery and AC Line Powered
- High Sensitivity
- Wide Dynamic Range
- Measurement Smoothing
- Max-hold Function
- Backlit Liquid Crystal Display
- Analog Output
- Easy to Use

Applications

- General Optical Power Measurements
- Fiber Optic Manufacturing Test
- Optical Communications Equipment R&D
- Optical Data Storage Testing
- Optical Equipment Calibration and Repair



TQ8210 with TQ82017

The Advantest TQ8210 is a general purpose battery or AC powered portable optical power meter. It is a compact and easy to use handheld unit weighing less than 400 g. The TQ8210 can be operated continuously on its internal battery supply for up to 13 hours before recharge. Optical power measurements can be made over –60 dBm to +17 dBm levels and in the 400 nm to 1650 nm wavelength range using one of the available power sensors specified below.

KEY FEATURES

Depending upon the measurement requirements and the physical configuration needed, one of several power sensor units can be selected to work with the TQ8210 mainframe. Optical power sensors using silicon photo diodes are available for use at shorter wavelengths. At longer wavelengths, sensors based on germanium (Ge) or indium-gallium-arsenide (InGaAs) are available and recommended. The TQ8210 automatically applies a wavelength sensitivity compensation factor to the optical power measurement for any of the available power sensors attached.

To allow maximum flexibility in making measurements in tight spaces or awkward positions, the power sensors are connected to the mainframe using a flexible electrical cable which is detachable from the handheld unit. The mechanical design of some power sensors also allow them to be used with both free-space optical beams as well as bare or connectorized optical fibers. A wide range of fiber connector types are accommodated by selecting the appropriate connector adapter for the sensor being used.

The TQ8210 has several built-in functions that contribute to its measurement capability and ease of use. Automatic measurement range selection and max-value hold is available with a button push. Also, measurement smoothing using a variable length moving average can be invoked using one button.

Power measurements can be conveniently displayed on a linear power scale (milliwatts, microwatts, nanowatts) or on a logarithmic absolute (dBm) or relative (dBr) scale. Sensor measurement offset is automatically detected and compensated.

Mainframe Characteristics

BASIC CAPABILITIES

Wavelength & Power Ranges – Depends upon sensor selected.

Sensor Plug-in Channels – One.

Resolution – 0.005% to 0.1% (Watt readout), 0.01dB (dBm readout).

Display – Backlit liquid crystal, 4 digits (wavelength), 4-1/2 digits (power).

TQ8210 OPTICAL POWER SENSOR SPECIFICATIONS:

Characteristic	TQ82014/TQ82017	TQ82015	Q82018A
Wavelength range	400 to 1100 nm	800 to 1600 nm	800 to 1650 nm
Power range*1	–60 to +17 dBm (1 nW to 50 mW)	–40 to +10 dBm (100 nW to 10 mW)	–60 to 0 dBm (1 nW to 1 mW)
Photo sensor type	Silicon photo diode	Germanium photo diode	InGaAs PIN photo diode
Optical input form*2	Beam or fiber	Beam or fiber	Fiber only
Size of photo sensor's active area	TQ82014: 8 mm dia.*3 TQ82017: 10 mm x 10 mm*4	5 mm dia.	–
Measurement ranges	8 ranges in 10 dB steps	5 ranges in 10 dB steps	6 ranges in 10 dB steps
Measurement accuracy	±5.0% (at 850 nm)	±5.0% (at 1300 nm)	±5.0% (at 1300 nm)
Connection to TQ8210 Mainframe	sensor attached cable	sensor attached cable	A01905 sensor cable

**1 At reference wavelength shown under Measurement Accuracy.*

**2 Refer to connector-to-adapter correspondence table on next page for required adapters.*

**3 The TQ82014 has a 38 mm (dia.) x 40 mm (length) cylindrical sensor housing with attached cord.*

**4 The TQ82017 has a wand-shaped sensor housing (3.2 mm thick x 18 mm wide tip) with attached cord.*

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

Handheld Optical Power Meter
TQ8210

(Mainframe Characteristics continued)

Sensor Wavelength Compensation – Automatic for sensor sensitivity at set wavelengths.

Units Display – Watts (mW, µW, nW), dBm, dBr, Wavelength (nm).

Range Switching – Automatic or manual.

Measurement Rate – ≥ 2 measurements/sec.

PROCESSING

Averaging – Digital smoothing by 2 to 20 sample moving average.

Measurement Functions – Maximum value hold (Watt meas.), Relative value measurement (dBr).

Offset & Zero – Automatic sensor offset zero compensation.

INPUT/OUTPUT

Optical Input – Input style & connector type determined by sensor & adapter, sensor attached with electrical cable to mainframe.

Data Output – Analog output voltage (0 to 2 V) proportional to input optical power, output impedance ≤ 10Ω.

GENERAL

Operating Environment – 0 to +40°C, ≤ 85% RH (non condensing).

Power Supply – Internal NiCd battery (operating life >10 hrs. with LCD backlight on, >13 hrs. with backlight off), 100 V AC (using AC adapter, which also charges the NiCd battery).

PHYSICAL CHARACTERISTICS

Dimensions (approximate)	mm
Width	80
Length	180
Height	35
Weight	**g**
Net	≤ 400

SELECTION GUIDE

Optional Accessory	Used With Q8221	Used With TQ8210	Description
A01905		√	Sensor cable
A08012	√	√	Connector adapter, FC
A08013	√	√	Connector adapter, D4
A08014		√	Connector adapter, OF2
A08017		√	AC Power adapter (90 to 110 V AC)
A08019		√	AC Power adapter (200 to 245 V AC)
A08020	√	√	Bare fiber adapter, V groove (requires A08021)
A08021	√	√	Adapter cap (required by A08020)
A08024		√	Bare fiber adapter, FC type
A08025		√	Connector adapter, AT&T Biconical
A08026		√	Connector adapter, Diamond 2.5
A08027		√	Connector adapter, Diamond 3.5
A08028	√	√	Connector adapter, Amphenol SMA
A08029		√	Connector adapter, Siemens
A08030		√	Connector adapter, Sumitomo Mini-BNC
A08031		√	Connector adapter, MBO
A08032		√	Connector adapter, HFBR-4000
A08081		√	Connector adapter, FC/PC (required by Q82018A)
A08082		√	Connector adapter, SC (required by Q82018A)
A08083		√	Connector adapter, ST (required by Q82018A)
A08084		√	Connector adapter, DIN (required by Q82018A)
A08087		√	Connector adapter, D4 (required by Q82018A)
A08090	√	√	Connector adapter, SC
A08095		√	Connector adapter, SMA 2.5
A08096	√	√	Connector adapter, ST
A08161	√		Connector adapter, FC (used with Q82208)
A08162	√		Connector adapter, SC (used with Q82208)
A08163	√		Connector adapter, ST (used with Q82208)
A08186	√		Connector adapter, low return loss
A08187	√		Connector adapter, FC (used with Q82215 and Q82216)

CONNECTOR-TO-ADAPTER CORRESPONDENCE

Connector Type	TQ82014	TQ82015	Q82018A
FC/PC	A08012	A08012	A08081 (Standard accessory)
SC	A08090	A08090	A08082
ST	A08096	A08096	A08083
Biconical	A08025	A08025	–
D4	A08013	A08013	A08087
DIN	A08029	A08029	A08084
SMA 2.5	A08095	A08095	–
SMA 3.175	A08028	A08028	–

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TQ8210
Handheld Optical Power Meter Mainframe.
Includes: Instruction Manual, AC Power Adapter.

TQ82014
Power Sensor, 0.4 µm to 1.1 µm.

TQ82015
Power Sensor, 0.8 µm to 1.6 µm (Ge).

TQ82017
Power Sensor, 0.4 µm to 1.1 µm, Thin Wand.

Q82018A
Power Sensor, 0.8 µm to 1.65 µm (InGaAs).

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

High Resolution Optical Spectrum Analyzer
Q8347

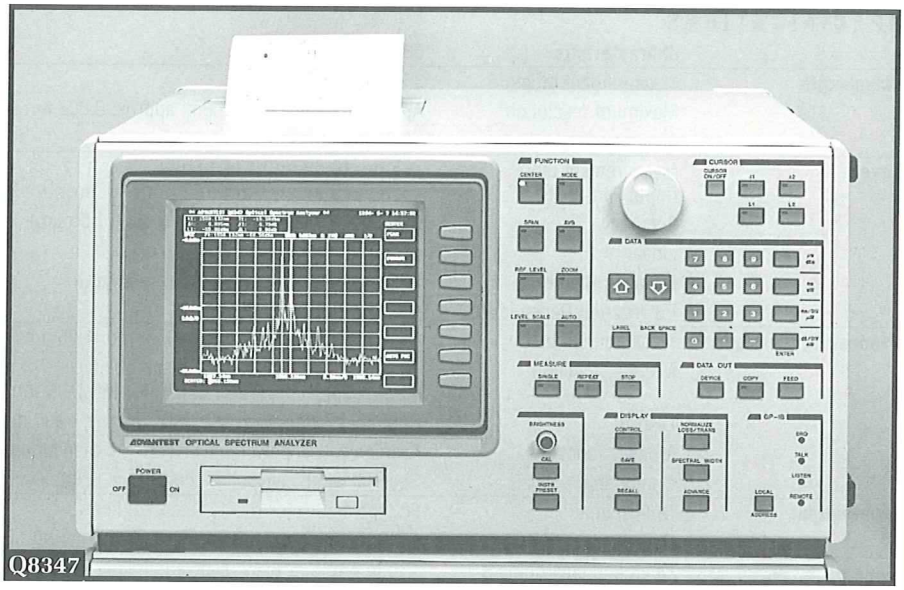
Features

Q8347

- Michelson Interferometer Type Measurements
- High Wavelength Resolution
  – 0.01 nm at 1.55 µm
  – 0.001 nm at 0.5 µm
- Enhanced Wavelength Accuracy
- Direct Coherence Length Analysis
- Wide Wavelength Range
- High Accuracy Wavelength Setting Resolution
- Color LCD Display
- Friendly User Interface

Applications

- WDM Transmission Analysis
- Analysis of Source Coherence Length
- Characterization of Narrow-band Optical Filters
- Communications Laser and LED Transmitter Characterization
- Manufacturing Test of Optical Sources and Components
- Optical Transmission Standards Compliance
- Short Wavelength Laser Characterization



Advantest Q8347

The Q8347 makes use of a Fourier spectrum analysis approach based on a Michelson interferometer. Because of this the Q8347 can measure optical coherence that cannot be obtained directly using diffraction type optical spectrum analyzers which use monochromators to make their measurements. The Q8347 provides a high wavelength resolution measurement capability in the 350 nm to 1750 nm wavelength band. This instrument achieves a wavelength resolution that is ten times that of conventional optical spectrum analyzers.

With its high wavelength resolution and enhanced accuracy, the Q8347 is an advanced and powerful optical spectrum analysis tool providing the unique measurement capabilities needed in the design, development, and manufacture of wavelength division multiplexed (WDM) communication equipment, as well as related assemblies and components utilizing very closely spaced optical carriers.

The Q8347 also provides unique measurement capabilities when characterizing narrow band passive optical filters and wavelength selective couplers. Also, because of its short wavelength capabilities, the Q8347 is useful in the optical coherence length analysis required for research on shorter wavelength laser diodes.

These features make this analyzer very effective for the evaluation of laser diodes used in optical data storage equipment, fiber optic gyroscopes, and related applications, as well as high speed communications equipment. This instrument is exceptionally well suited to the measurement of coherence length of laser diode and LED optical sources.

A standard rackmount set is available for both the Display Unit and Optical Unit making up the Q8347.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488

Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

ADVANTEST

Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.

High Resolution Optical Spectrum Analyzer
Q8347

SPECIFICATIONS

	Characteristic	Q8347
Wavelength	Measurement range	350 nm to 1750 nm
	Maximum resolution*1	Approx. 0.01 nm at 1.55 µm; approx. 0.003 nm at 0.85 nm
	Accuracy	±0.01 nm or less
Level	Measurement range (input sensitivity)*2	–65 to +10 dBm (0.7 to 1.6 µm) –52 to +10 dBm (0.45 to 1.7 µm); –42 to +10 dBm (0.35 to 1.75 µm)
	Accuracy	≤ ±2.0 dB (at 0.85 µm, 1.31 µm, and 1.55 µm)
	Linearity	≤ ±1.0 dB/25 dB; ≤ ±0.5 dB/10 dB
	Dynamic Range	≥30 dB (±0.5 nm from peak wavelength)
	Polarization Dependence	≤ ±0.8 dB
Processing functions	Measurement time	≤ 2.5 sec (high res. mode, 0.95 µm to 1.75 µm wavelength band)*3, ≤ 1 sec (normal mode)*3
	Memory function	16 screens of measured data and 10 screens of measurement conditions (with battery backup), 3.5 in. floppy disk (720 KB/1.2 MB, MS-DOS format)
	Display	Dual trace, super-impose, "3-D" display, trend monitor
	Monitor functions	Average optical power and wavelength monitoring and display
	Computing/Analysis	Spectral width calculation, coherence length analysis (±165 mm), normalize function, auto peak search
Input/output	Optical input	FC type connector (50/125 internal fiber)
	Data output	GPIB IEEE 488 control interface. Built-in printer (≤8 sec print time) Direct plotter output*4
General	Operating environment	+10 to +40°C, ≤ 85% relative humidity (non-condensing)
	Power supply	100 to 120/240 V AC, 48 to 66 Hz
	Dimensions	Approx. 424 (W) x 221 (H) x 500 (D) mm (main unit); approx. 424 (W) x 132 (H) x 500 (D) mm (optical unit)

**1 Performance in high resolution mode.*

**2 The minimum level is measured over a 50 nm span with 16 averages.*

**3 On SINGLE measurement, one average is performed. Measuring time is from triggering to completion of display.*

**4 Compatible plotters: Advantest R9833, HP 7475A, HP7440A, and HP7470A.*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

Q8347
Advantest High Resolution Optical Spectrum Analyzer.
Includes: Instruction Manual, Power Cable (A01402), Fuse (2 ea.); Interconnection Cable; Printer Paper (100-0688-00); 3.5 in. Floppy Disk.

A09075
Thermal Printer Paper for Built-in Advantest Printer (5-roll Box).

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

ADVANTEST *Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.*

Optical Power Multimeter
Q8221

Features

- Two Independent Plug-in Channels
- Optical Sensor and Source Plug-ins
- Simultaneous Channel Measurements
- Dual Channel Displays
- High Power Input
- High Sensitivity and High Accuracy
- High Speed Measurements
- Low Polarization Dependence
- On-board Recorded Data Memory
- GPIB Controllable

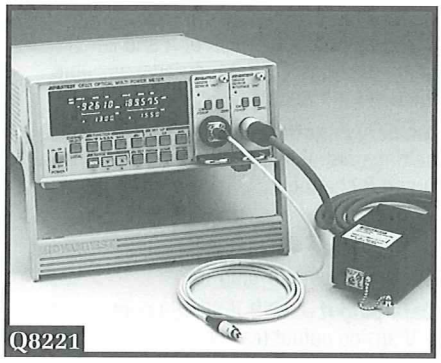
Applications

- General Optical Power Measurements
- Fiber Optic Manufacturing Test
- Optical Communications Equipment R&D
- Insertion Loss Measurements
- Optical Equipment Calibration and Repair

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

ADVANTEST *Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.*



Application Description

This bench-top instrument and its related family of plug-ins are intended for use by engineers and skilled technicians in the design, evaluation, manufacture, or service of fiber optic equipment and systems. This class of product is one of the most widely applicable fiber optic test and measurement instruments used in engineering, manufacturing, and service organizations. Typical applications include such things as:

- General purpose measurement of optical power in fibers and free-space beams
- Loss measurements in optical fiber and related components
- Characterization of laser and LED source output power and stability
- Fiber amplifier testing and characterization
- Calibration and repair of other optical instruments including power meters

Product Description – General

The Q8221 is a compact lab instrument providing both precision optical power measurement and stable light source capabilities. It is a small bench-top unit weighing less than 3.9 kg (with plug-ins). The Q8221 mainframe accepts two small plug-ins that can be either power sensors (detectors) or optical sources. Five types of optical sensors and nine types of light sources are available.

KEY PRODUCT FEATURES AND BENEFITS

The Q8221 mainframe allows measurement of optical power on two channels simultaneously. These measurements can be ratioed, multiplied by a constant, or offset, thus allowing a wide variety of applications. The mainframe's on-board processor also provides automatic wavelength compensation for the power sensor being used. This processor also allows measurement averaging, identification of maximum values, storage of up to 400 data points and five front-panel set-ups for each of the two channels. Also the mainframe provides direct output of digital stored data to an external plotter, real-time analog voltage output proportional to measured optical power, and full instrument operation via a GPIB controller.

Both single and multimode LED and laser sources are available and can be used in either or both plug-in slots. These stable sources operate at 850 nm, 1310 nm, and 1550 nm wavelengths. Source output power levels cover a wide range from 0 dBm to –53 dBm depending upon the source's wavelength, type (laser or LED), and spectral width. For further technical information refer to the Q8221 Product Data Sheet (Tektronix Literature # 2HA-10187-0).

Characteristics

BASIC CAPABILITIES

Wavelength and Power Ranges – Depends upon plug-in.

Sensor Plug-in Channels – Two independent measurement channels (A & B).

Resolution – 0.001 dB (dBm readout), 0.0001 dB (GPIB).

Display – Five and one half digits (7 segment FL device) with brightness adjustment, 11 segment measurement level bar-type meter.

Sensor Wavelength – If wavelength is entered, an internal wavelength compensation constant for the sensor is automatically applied.

Units Display – Watts (mW, µW, nW, pW), dBm, dB.

Range Switching – Automatic, manual, or remote.

Measurement Rate – Approx. 50 meas./sec (with integrate time of 7 msec), Approx. 9 meas./sec (with integrate time of 100 msec), 1 channel operation.

Optical Power Multimeter
Q8221

PROCESSING

Averaging – Can be set to any value from 2 to 256 (moving average).

Calculations – A/B, B/A, CF (in Watts mode; multiplication of measurement and constant value, in dBm mode offset can be added).

Other Measurement Functions – Maximum value hold, settable measurement integration time (100 msec, 20 msec, or 7 msec), relative value measurement (dBr, with 0.001 dB max. resolution), modes for CW or chopped light inputs.

Record Function – Memory storage of 400 data points for each of A and B channels (external data retrieval possible via GPIB interface).

Memory Function – Up to five instrument settings storable and readable for each of A and B channels.

INPUT/OUTPUT

Optical Input – Connector type determined by sensor head or plug-in.

Data Output – GPIB IEEE 488 control, 0 to 2 V analog output (each range) proportional to input optical power, direct output to external plotter.

GENERAL

Operating Environment – 0 to +40°C, ≤ 85% RH (noncondensing).

Power Supply – 100 to 230 V AC, 48 to 66 Hz.

Dimensions – 212 (W) x 88 (H) x 360 (D) mm, approximate.

Weight – Approximately 3.9 kg (including plug-in).

OPTICAL POWER SENSOR PLUG-IN SPECIFICATIONS

Characteristic	Q82214	Q82215	Q82216	Q82226	Q82208
Application type	Short wavelength, general purpose	Long wavelength, general purpose	Long wavelength, wide area, medium sensitivity	Long wavelength, high power	Long wavelength, high sensitivity
Wavelength range (nm)	400 to 1100	800 to 1750	800 to 1750	800 to 1750	800 to 1700
Power range (dBm)	–80 to +17	–60 to +10	–77 to +10	–57 to +27	–94 to +10
Photosensor type	Silicon	Germanium	Germanium (cooled)	Germanium (cooled)	InGaAs (cooled)
Optical input form*1	Beam or fiber	Beam or fiber	Beam or fiber	Fiber only	Fiber only
Measurement accuracy					
at calibration wavelength	±3.0%, 780 nm 1 mW, 0 to 40°C	±3.0%, 1300 nm 1 mW, 0 to 40°C	±2.5%, 1300 nm 1 mW, 0 to 40°C	±3.0%, 1300 nm 1 mW, 0 to 40°C	±2.5%, 1300 nm 1 mW, 0 to 40°C
Over wide wavelength range	±5.0%, 480 – 900 nm 1 mW, 23 ±3°C	±5.0%, 950 – 1600 nm 1 mW, 23 ±3°C	±4.5%, 950 – 1600 nm 1 mW, 0 to 40°C	±7.0%, 950–1600 nm 1 mW, 0 to 40°C	±4.5%, 1000–1650 nm 1 mW, 0 to 40°C
Linearity					
Over range 1	±0.5% ±10 pW, –54 to +17 dBm, 23 ±3°C	±0.5% ±1 nW, –37 to +10 dBm, 23 ±3°C	±0.5% ±20 pW, –47 to +10 dBm, 23 ±3°C	±0.5% ±2 nW, –27 to +27 dBm, 23 ±3°C	±0.5% ±0.4 pW, –72 to +10 dBm, 0 to 40°C
Over range 2	±1.0% ±10 pW, –57 to +17 dBm, 23 ±3°C	±1.0% ±1 nW, –40 to +10 dBm, 23 ±3°C	±1.0% ±20 pW, –50 to +10 dBm, 23 ±3°C	±1.0% ±2 nW, –30 to +27 dBm, 23 ±3°C	±1.0% ±0.4 pW, –75 to +10 dBm, 0 to 40°C
Noise level (one second average)	–80 dBm	–60 dBm	–77 dBm	–57 dBm	–94 dBm
Polarization dependence	–	0.03 dB p-p (typ)	0.03 dB p-p (typ)	0.06 dB p-p (typ)	≤0.02 dB p-p
Return loss	≥45 dB (with angled polished connectors), ≥30 dB (with A08186 adapter, depending upon specifications of fiber used), ≥14 dB (with flat polished connectors)				
Connection to Q8221 Mainframe	Q82202 interface plug-in required				Q82202 not required
Dimensions and mass	Approx. 60 mm (W) x 43 mm (H) x 110 mm (L), ≤270 g				Plugs into Q8221

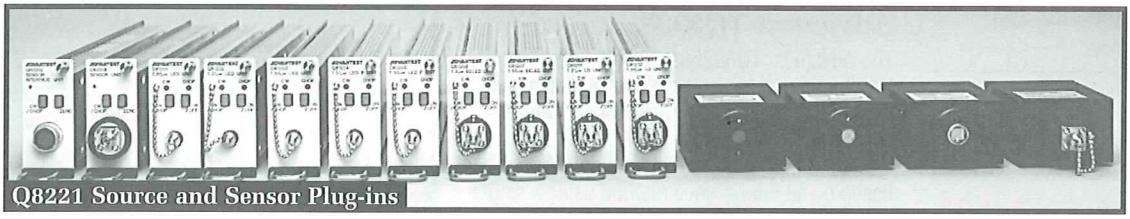
**1 Refer to connector-to-adaptor correspondence table following.*

CONNECTOR-TO-ADAPTER CORRESPONDENCE

Connector Type	Q82214	Q82215	Q82216	Q82226	Q82208
FC	A08012	A08012	A08012	dedicated to FC connector	A08161*1
SC	A08090	A08090	A08090	–	A08162
ST	A08096	A08096	A08096	–	A08163
D4	A08013	A08013	A08013	–	–
SMA	A08028	A08028	A08028	–	–
MT adaptor	–	A08187 (mating to 12-Pin SMF)	A08187 (mating to 12-Pin SMF)	–	–
Low return loss adaptor	A08186	A08186	A08186	A08186*1	A08186

**1 Standard accessory.*

Optical Power Multimeter
Q8221


Q8221 Source and Sensor Plug-ins

OPTICAL SOURCE PLUG-IN SPECIFICATIONS

Characteristic*5	Q81201	Q81202	Q81203	Q81204	Q81205	Q81206	Q81207	Q81211*4	Q81212*4
Photo emitting element type	LED	LED	LED	LED	LED	Edge Emitting LED	Edge Emitting LED	Laser diode (FP)	Laser diode (FP)
Wavelength (nm)	850 ±25	1310 ±40	1550 ±30	1310 ±10	1550 ±10	1300 ±30	1550 ±30	1310 ±10	1550 ±20
Spectral width (at half max. power)	≤55 nm	≤160 nm	≤210 nm	20 ±5 nm	20 ±5 nm	≤100 nm	≤140 nm	≤5 nm	≤10 nm
Output power	−15 ±1 dBm*1	−20 ±1 dBm*1	−43 ±1 dBm*2	−35 ±1 dBm*1	≤−53 ±1dBm*2	−14 ±1 dBm*2	−17 ±1 dBm*2	0 ±1 dBm*2	0 ±1 dBm*2
Output power attenuation (variable)	–	–	–	–	–	–	–	0 to −6 dB (0.1 dB steps)	0 to −6 dB (0.1 dB steps)
Temperature Stability 23±2°C/1 hrs. 0 to 40°C/8 hrs.	≤ ±0.02 dB ≤ ±0.2 dB	≤ ±0.02 dB ≤ ±0.2 dB	≤ ±0.04 dB ≤ ±0.2 dB	≤ ±0.02 dB ≤ ±0.2 dB	≤ ±0.04 dB ≤ ±0.2 dB	≤ ±0.02 dB*3 ≤ ±0.4 dB	≤ ±0.04 dB*3 ≤ ±0.4 dB	≤ ±0.01 dB*3 ≤ ±1 dB	≤ ±0.01 dB*3 ≤ ±1 dB

*1 *At the emitting end of 2 m fiber (Graded index, 50/125 fiber type).*

*2 *At the emitting end of 2 m fiber (Single mode, 10/125 fiber type).*

*3 *Stability between 0 to 40°C ±2°C/1 hrs.*

*4 *Stability ≤ ±0.05 dB, within 0 to 40°C ±2°C/1 hrs.*

*5 *Output waveform: CW or chopped light (270 Hz, 2 kHz, 4 kHz), FC type output connector, Preheating time of 60 minutes after power on.*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

Q8221
Mainframe, Optical Power Multimeter.
Includes: AC Power Cable and Instruction Manual.

Q82202
Interface Plug-in.

Q82208
Power Sensor, High Sensitivity.

Q82214
Power Sensor, Short Wavelength, General Purpose.

Q82215
Power Sensor, Long Wavelength, General Purpose.

Q82216
Power Sensor, Large Area and Hi-sensitivity.

Q82226
Power Sensor, High Power.

Q81201
LED Source, 850 nm.

Q81202
LED Source, 1310 nm.

Q81203
LED Source, 1550 nm.

Q81204
LED Source, 1310 nm.

Q81205
LED Source, 1550 nm.

Q81206
EELED Source, 1300 nm.

Q81207
EELED Source, 1550 nm.

Q81211
Laser Source, 1310 nm.

Q81212
Laser Source, 1550 nm.

SERVICE ASSURANCE OPTIONS
(For the above products)

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

Depending upon the application and plug-in modules selected, one or more of the following fiber interconnection adapters may be needed:

A08012 – Connector Adapter, FC.

A08013 – Connector Adapter, D4.

A08020 – Bare Fiber Adapter (Requires A08021).

A08021 – Adapter Cap (Required by A08020).

A08028 – Connector Adapter, SMA.

A08090 – Connector Adapter, SC.

A08096 – Connector Adapter, ST.

A08161 – Connector Adapter, FC (Used with Q82208).

A08162 – Connector Adapter, SC (Used with Q82208).

A08163 – Connector Adapter, ST (Used with Q82208).

A08186 – Connector Adapter, Low Return Loss.

A08187 – Connector Adapter, FC (Used with Q82215 and Q82216).

RACK MOUNT KITS

A02463 – Rack Mount Set (EIA, single).

A02464 – Rack Mount Set (EIA, twin).

A02263 – Rack Mount Set (JIS, single).

A02264 – Rack Mount Set (JIS, twin).

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

ADVANTEST *Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.*

Optical Wavelength Meter
TQ8325

Features
- Michelson Interferometer Design
- High Accuracy
- High Resolution
- High Speed
- Frequency & Deviation Displays
- Built-In He-Ne Laser Standard
- Input Level Meter
- Analog Output
- GPIB Controllable
- Calibration of Optical Spectrum Analyzers
- Communications Laser & LED Transmitter Characterization
- Calibration of Tunable Lasers
- Testing of Wavelength vrs Drive Current or Temperature
- Laser & LED Parts Screening

Applications
- Use as Wavelength Standard in the Calibration of Lab Monochromators
- Tune Dye Lasers and Monitor the Wavelength Output of Tunable Laser Sources
- Use in Automated Measurement of the Wavelength-temperature or Wavelength-drive Current Characteristics of Laser Diodes
- Measure Wavelength Fluctuation of Laser and LEDs While Devices Under Modulation
- Screen Laser Diodes and LEDs in the Manufacturing Environment

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

ADVANTEST *Advantest's quality system complies with the DIN ISO 9002 standard and has been certified by TUV Product Service GMBH.*

Advantest TQ8325

The Advantest TQ8325 is a digital optical wavelength meter capable of making high accuracy, high resolution measurements of the central emitted wavelength of optical sources such as lasers and LEDs. Measurements are made based on an interference method using a single-pass Michelson interferometer working with an internal He-Ne laser wavelength standard.

This basic design allows a very high level of accuracy and resolution to be achieved and maintained over long periods of time without calibration. Wavelength measurement accuracies of 5 ppm and a resolution of 0.001 nm are achieved. Also the TQ8325 takes measurements at a rate of five per second thereby enabling the reliable measurement of changes in wavelength with changing temperature.

A switch selection enables measurements over the 0.6 to 1.0 µm or 1.0 to 1.6 µm wavelength bands. The TQ8325 can also measure the wavelength of modulated light sources for modulation rates of 3 MHz and above. An auto-resolution function automatically optimizes the resolution depending upon the spectral half-width of the source being measured.

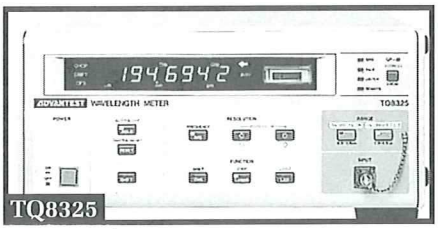
A simple switch operation determines whether measurements of wavelength or frequency are displayed. This feature is very useful when the frequency of a given light source must be read directly. The TQ8325 can also display the changing frequency deviation of a measured source from a reference frequency determined by pressing the deviation display key. This feature enables the continual wavelength changes (from temperature fluctuations) of a light source to be measured and displayed with high accuracy and resolution.

Characteristics

WAVELENGTH

Measurement Range – 600 nm to 1000 nm (short wavelength band). 1000 nm to 1600 nm (long wavelength band).

Display Resolution – 1 nm, 0.1 nm, 0.01 nm, 0.001 nm (10 digits). 100 GHz, 10 GHz, 100 MHz.



Accuracy – ±Full width (nm) at half maximum x 0.05 ± 5 ppm ± 1 count (at 25°C ± 10°C).

Stability – ± 1 count (in AVG mode)l.

LEVEL

Measurement Range (Input Sensitivity) –
–23 to +3 dBm (0.6 to 1.0 µm).
–20 to +3 dBm (1.0 to 1.4 µm).
–15 to +3 dBm (1.4 to 1.6 µm).

SAMPLING

Sample Period – 200 ms (5 samples/sec rate).

NON CW INPUTS

CHOP Mode – Chopping frequency must be 1 to 500 Hz.

Modulated Input – Modulation must be ≥ 3 MHz.

PROCESSING

Averaging – Moving average of 10 measurements is displayed (AVG mode).

Deviation Display – Deviation is displayed in reference to the standard determined by pressing the deviation display key.

INPUT/OUTPUT

Optical Input – FC type connector.

Data Output – GPIB and Analog output.

GENERAL

Operating Environment – –10 to +40°C, ≤ 85% RH (non-condensing).

Power Supply – 90 to 132 V AC (standard), 180 to 250 V AC (optional). 50 to 60 Hz, ≤ 52 VA.

PHYSICAL CHARACTERISTICS

Dimensions	mm
Width	300 mm
Height	132 mm
Depth	450 mm
	kg
Weight	12 kg

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TQ8325
Advantest Optical Wavelength Meter.
Includes: Instruction Manual, Power Cable (AO1402).

Opt. 4D – 180 to 250 V AC power.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

VXI

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Introduction

Over the past few years, VXI ("VME eXtensions for Instrumentation") has emerged as the principal force for open systems in the test and measurement market. From strong beginnings in the military/aerospace arena, the VXI presence in commercial applications has expanded dramatically since 1991. VXI is of extreme importance to the marketplace. Its growing popularity is based on three key factors:

- Potential users need access to a comprehensive selection of products that meet their application requirements
- New VXI offerings must achieve the performance levels and price points customers demand
- Open systems with standardized software interfaces for compatibility are essential

As one of the founding members of the VXI standards movement, Tektronix has responded to these requirements by providing a broad portfolio of VXI instrument modules, setting price/performance benchmarks, and driving the test industry to create and support open system architectures.

Through seven years of tremendous growth, much of the attention on VXI has focused on building pieces and parts. Now, with about 1000 VXI products on the market, the focus is on how end-users can best integrate multi-vendor pieces into complete systems. This introduction to VXI*plug&play* describes how leading suppliers are working together to make VXI easier for you to use.

VXI: THE CHOICE FOR OPEN SYSTEMS

VXI is a multi-vendor industry standard (IEEE 1155) for card-modular instrumentation. Never before has VXI had as many capabilities as it does today. VXI products cover a wide range of applications, with components such as instruments, mainframes, fixturing, computers, and system solutions. The success of VXI as an open, multi-vendor platform is a testament to the value of multi-vendor standards, and has made VXI the platform of choice for open instrumentation systems.

STANDARD FRAMEWORKS

VXI*plug&play* uses the concept of standard system frameworks to achieve *"plug&play"* confidence. Each framework has a name, so it can be easily identified, along with a list of the operating system software and application development software tools used in the framework. Users choose their framework based on their system software, and then use the framework designation when choosing the rest of their system components.

For more information on VXI*plug&play,* contact your local Tektronix representative.

VXI

Features

- VXI*plug&play*
- Broad Range of Instrument Choices
- Open Architecture Supports Multi-vendor System Configurations
- Standard Core System Integration
- Worldwide Service and Support

A Broad Product Portfolio

Today's Tektronix VXI product line includes a broad selection of VXI products capable of meeting widely varying customer needs and covering the entire spectrum of VXI market requirements. Many new Tektronix VXI products have completed the intense development process required for extremely high-performance products and are making important contributions to new markets. In its desire to provide complete VXI solutions to end-users, Tektronix has developed strategic partnerships with companies that provide complementary offerings such as LabWindows®/CVI and LabVIEW*1 software from National Instruments.

Customers include self-integrating end-users, third-party systems integrators, value-added resellers, and OEMs. VXI systems are now common in communications test equipment, computer and peripherals testing, avionics, automotive, ATE systems and medical manufacturing applications. Proven Tektronix VXI products include:

- Measurement Instruments: Waveform Digitizers/Analyzers, Digital Multimeters, Power Meters and Digitizing Counters
- Stimulus Instruments: Pulse Generators, Arbitrary Waveform Generators, Digital Pattern Generators, D/A Converters and Function Generators
- Switching and Scanning Instruments and Accessories
- Digital Test Products such as Boundary Scan Diagnostic Systems
- Mainframes
- Slot 0 Interfaces and Embedded Controllers
- Military and Commercial Aerospace
- Bus Testing and Avionics Test Systems

Every year since Tektronix entered the VXI market, it has broadened and improved its VXI product portfolio. For a brief look at its newest products, see the New Products section.

PRICE/PERFORMANCE LEADERSHIP

As a leader in the VXI instrument modules market, Tektronix identified the need to set the pace for price/performance VXI solutions. In the past, test engineers, unable to find key VXI instruments capable of handling their application needs at a price within their budget, have been forced to create hybrid systems that incorporate both VXI and GPIB equipment. Older VXI designs are limited in performance and functionality because they are often benchtop instruments shoehorned into a modular format. Unable to take advantage of the benefits of the open VXI architecture, they can neither offer high enough performance nor fulfill the price/performance expectations that VXI promises. Tektronix' new VXI products are developed exclusively for the VXI environment and designed to leverage every price and performance advantage in the architecture.

Examples of this are the new TVS600 Series of VXI waveform analyzers. The TVS600 combines traditional Tektronix high-acquisition technology with VXI resources that make up this native high performance/higher throughput VXI waveform analyzer.

Test system developers who have been able to create only partial VXI solutions, or new adopters seeking to replicate their old GPIB systems with VXI, can now find the performance they need in a smaller package with the VXI form factor. One excellent example of this trend is the VX4792 Arbitrary Waveform Generator. With a 250 MS/s clock rate providing up to 125 MHz waveforms, the VX4792 is five times faster than its closest competitor. Such dense functionality, industry-leading performance levels, and a highly competitive price, enable new Tektronix VXI products to make quantum leaps in performance, at excellent price/performance levels. That's the promise of VXI.

**1 LabVIEW is a registered trademark of National Instrument Corporation*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

VXI plug&play

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

VXI

Open Systems and an Open Market

As a founding member of the VXI Consortium, Tektronix established itself as a leader in defining today's VXI hardware compatibility standards. Though VXI is a well-established standard in the industry, software compatibility has been a limiting factor for overall industry acceptance of VXI. Due in large part to the efforts of Tektronix and other members of the VXI*plug&play* Systems Alliance, VXI today is a true open system with standardized software interfaces in place to make system integration easier. Tektronix is a founding member of the VXI*plug&play* alliance and a driving force in support of VXI's open architecture advantage. As leaders in the test industry's move from GPIB to VXI, Tektronix and its strategic partners provide a full market spectrum of VXI*plug&play*-compatible products and software to end-users and systems integrators.

In 1994, important new standards were approved by members of the alliance, creating true interoperability at both the hardware and system software levels. VXI*plug&play* is a term used to indicate conformance to new system-level standards produced by the alliance, including instrument drivers, soft front panels, I/O interface software, installation programs, documentation and fixturing support.

VXI*plug&play* instruments are now shipped with a standard diskette, including a driver matched to the user's operating system and application development environment. VXI*plug&play* software includes a stand-alone, executable soft front panel program enabling interactive control of the instrument from within the operating system. Because Tektronix actively participated in every committee involved in writing the new standards, the company is committed to the standard and can ensure that all new Tektronix products are fully VXI*plug&play*-compatible.

EXPERIENCED SYSTEM SPECIALISTS

For many test system development activities, "catalog shopping" is not the most efficient approach. Configuring the system, selecting components, and integrating the test system might be beyond the scope of many system users, and certainly outside the business charter of most. Often it is more economical to entrust these tasks to an experienced specialist – a system integrator.

Select the level(s) of integration services shown below, then let Tektronix help you select the right product and integrate your system components.

- VXI Integration and Startup
- Receiver Ready, or "Racking Service"
- Fixture Ready

Since the job of most test engineers is to create test strategy and test programs, not to build test systems, Tektronix can provide substantial economic savings. A typical system can require three months of development by several people. Tektronix will do this for you at nominal handling and racking charges. Tektronix offers a wealth of alternatives for system integration services.

Whatever your hardware or software Test and Measurement requirements, Tektronix can help you solve your test problem with a powerful open solution. And, as with all its products, Tektronix guarantees uniform quality, compatibility, and long-term support on a global scale.

SERVICE & SUPPORT

Tektronix, renowned for world class service and support for oscilloscopes, logic analyzers, and spectrum analyzers, brings this experience to our full line of VXI modules and systems. All Tektronix VXI instruments come with a full three year warranty (unless specifically stated otherwise in product specifications), and for customers with special needs, a full offering of tailored service plans is available.

SUMMARY

Tektronix, as a leader in the VXI market, is committed to supporting the depth of product line that is critical to VXI's long-term success. Its new product releases in 1995 further expand the company's VXI portfolio, adding products with breakthrough performance and extremely low cost per function. In addition, recognizing that no single manufacturer can fulfill every possible test requirement, Tektronix continues to pursue an open systems approach that protects customers from being locked into proprietary architectures. New levels of product availability, price and performance, combined with the ease of use created by open systems standards, are rapidly establishing VXI, and Tektronix VXI products, as the preferred solution for automated test applications that demand high throughput and performance in a small package.

SCS 9000 SYSTEM INTEGRATION SERVICES

- VXI Integration and Startup
- Receiver Ready Racking Services
- Fixture Ready Solutions
- System Verification/Acceptance

MAINFRAMES

- VX1410 Intelliframe™, Intelligent, VXI*plug&play* Compliant, 13-slot
- VX1401 Low Cost 13-slot
- VX1406 Portable 6-slot

COMPUTERS/CONTROLLERS

- NI-599/566 100/66 MHz Embedded
- NI-MXI Kits
- NI-GPIB Kits
- EPC-7 100/50 MHz Embedded

MEASUREMENT

- 4.5/6.5 Digit DMMs
- 10 MHz/100 MHz/2.5 GHz Counters

DIGITIZERS

- 250 MHz/1 GS/s and 1 GHz/5 GS/s High Performance
- 10 MS/s High Throughput
- 200/400 KS/s High Resolution

SOURCES

- 25/250 MHz Arbs/Function Generators
- D/A Modules
- Relay/High Voltage Driver
- Dual Programmable Resistance

SWITCHING/SCANNING

- 32/64 Channel I/O Module
- Medium and High-density Matrixes
- Medium and High-density Switches
- 1.3 GHz Switching

DIGITAL

- Boundary Scan
- Memory Backed Digital I/O
- Basic Functional Test

AVIONICS

- ARINC 429 Mil-Std-1553
- ARINC 629 with Error Insertion

TELECOM

- SDH/Sonet Generator/Receiver
- Optical Attenuator

SCS 9000 System Integration Services

SYSTEM INTEGRATION SERVICES

As a leading supplier of computer controlled test equipment, Tektronix understands that test equipment suppliers must provide additional support and service to allow you to bring your test system to market in a timely, cost effective manner.

Tektronix, in its many years of providing computer controlled test equipment solutions, has established a very successful system integration service to assist in the design and integration of our "Standard Core System." The SCS 9000 System Integration Services provide the following:

- System Design Consulting
- Scalable Service to Meet Your Needs
- Single Purchase Order
- Timely Delivery
- Core System Documentation
- Tektronix Worldwide Support and Service

THE DESIGN PROCESS

Trained Tektronix System Consultants come to your facility to guide you through the complex task of defining the test system requirements.

From a firm set of requirements, the Tektronix test system consultant guides you through the equipment selection process. This is followed by a firm quotation for the equipment and services provided and a statement of the services provided by Tektronix.

THE SCS 9000 SERVICE PROVIDED

The SCS 9000 is a standard integration service offered by Tektronix. The services provided are targeted at the integration of the core of your test system.

The SCS 9000 includes the following services:

- VXI and GPIB Configuration
- VXI Mainframe Integration
- Equipment Integration
- Computer and Software Integration
- System Racking Services (Receiver Ready)
- Receiver Configuration (Fixture Ready)
- System Loopback Self-test Hardware and Software

Open Systems Architecture

Open Systems Architecture gives you the means to create an uncompromised system for your most challenging test problems.

UNLIMITED FLEXIBILITY IN SYSTEM COMPONENTS

The Tektronix VXI Architecture helps you choose the ideal test-and-measurement components for your needs. It allows you to choose products from a wide range of manufacturers of test-and-measurement technology, with confidence that all the components will work together. You can use the ideal computer hardware, the best software package, and the specific instruments that best suit your application.

MORE WAYS TO INTEGRATE SYSTEMS

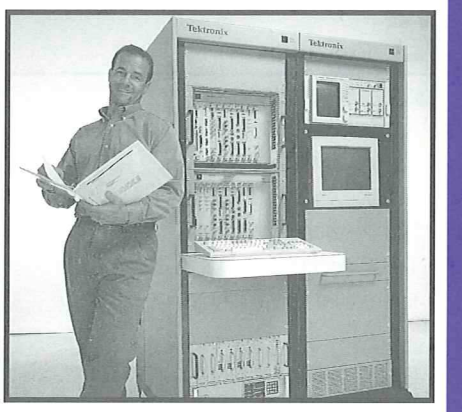
Whether you have full system integration capabilities within your company or contract to other suppliers, the open measurement environment gives you a convenient, cost-effective means to integrate systems. This is a low-cost service that provides VXI Integration "Receiver" and "Fixture" Ready Services for test engineers or system integrators worldwide.

MULTIPLE CHOICES IN HARDWARE AND SOFTWARE

The open measurement environment makes it easy to combine Tektronix instruments with the optimum hardware platform for cost-effective performance. You can use PCs or embedded VXI controllers. And you can take many approaches to software design: coding in C, BASIC, ATLAS, or using interactive, graphical development environments like LabVIEW*[1] and LabWindows®.

Component compatibility and connectivity is simplified by the wide variety of hardware and software VXI*plug&play* drivers available for various computer platforms, software packages, and instruments from Tektronix and other manufacturers.

With these services, you fill in a simple workbook and configure a one or two bay, one to four mainframe system of five or seven feet in height.



You simply use "check boxes" to choose receiver-ready wired UUT power supplies, controller types, software, and other options to the rack. Using this approach, Tektronix has been able to forge new tools that make VXI system purchases flow quickly and easily – whether you are a system integrator, Synergy Partner, test engineer, or third party applications development house. Not only is this service a breakthrough, it is dramatically lower in price…as much as one fourth the cost of integration hardware and services costs in the industry today.

Prices for the SCS 9000 System Integration Services are based on the total price of the Core VXI system hardware and software you configure, plus ten percent. In most cases, using funnel cards to interface with receivers, this ten percent charge will never be exceeded. If you do have system requirements that go beyond SCS 9000 scope, Tektronix can respond to these separately at reasonable rates.

[1] LabVIEW is a registered trademark of National Instrument Corporation

System Software

LabWindows® • CVI for Windows and Solaris

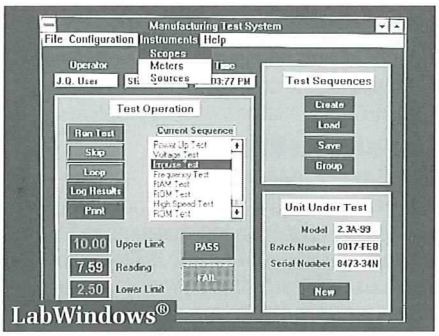
Features

LabWindows®/CVI

- Interactive C Program Development
- Automatic Code Generation
- Acquisition, Control, and Analysis Libraries
- GUI Development Tools
- Test Executive
- Instrument Driver Library

LabVIEW*1

- Graphical Programming for Instrumentation
- Modular Program Development
- Acquisition, Control, and Analysis Libraries
- Test Executive
- Instrument Driver Library



LabWindows®/CVI for Windows

LabWindows®/CVI is a multiplatform data acquisition and instrument control development system for C programmers. Whether you are a casual developer or an experienced C programmer, you can reduce your system development time, and improve the functionality of your system with LabWindows®/CVI. The tools in LabWindows®/CVI simplify time consuming tasks of creating and controlling custom graphical user interfaces (GUIs), controlling test and measurement instruments, and developing and maintaining test programs.

TEST PROGRAM DEVELOPMENT

LabWindows®/CVI

LabWindows®/CVI has a complete set of standard C development tools integrated in an interactive programming environment. The standard tools include a compiler, linker, variable display, and numerous debugging utilities. The built-in C compiler automatically catches any syntax errors in your code. During program execution, you can insert breakpoints, view variables, and single-step through your source code. The LabWindows®/CVI environment even protects you from memory violations and runtime errors.

LabWindows®/CVI saves development time by automatically generating code for your instrument control, data acquisition, data analysis, and data presentation operations. All of the functions in the LabWindows®/CVI libraries have graphical function panels that generate code for your programs. Using a function panel, you simply set the values of each parameter to build the function call interactively. You can execute the function by itself, and then paste the function call into your program automatically. You save time bypassing the tedious process of typing and editing function calls in your program.

CREATING A GRAPHICAL USER INTERFACE

LabWindows®/CVi has easy-to-use tools for creating sophisticated graphical user interfaces. In the User Interface Editor, you can select from push buttons, pull-down menus, knobs, graphs, strip charts, or your own graphics images to design a GUI for your project. Your entire user interface is created interactively, without a single line of code. To control the user interface, you select functions from the User Interface Library to hide and display panels, get user events, and set and retrieve values on the controls of your panel. The User Interface Library makes creating and operator interface easy – you do not need to be a programming expert to create your own custom GUI.

BUILT-IN LIBRARIES FOR TEST AND MEASUREMENT

When developing your programs with LabWindows®/CVI, you will have access to functions for all of your test and measurement operations:

- **GPIB –** The GPIB Library contains functions for complete programmatic control of IEEE 488 instruments. With the GPIB 488.2 Library, you can use any of the National Instruments IEEE 488.2 Controller boards and the standard NI-488.2 device driver.
- **VXI –** As part of the VXI Development System, the VXI Library has functions to control VXI instruments from either embedded VXI controllers or external computers equipped with a MXI interface. The library has functions for programming both message-based and register-based devices.
- **Instrument Library –** The Instrument Library with over 400 instrument drivers for GPIB, RS-232, and VXI devices are available for LabWindows®. You can interactively operate your instruments with the LabWindows®/CVI function panels, and automatically generate instrument control code for your application program. A list of supported Tektronix instruments is shown following.
- **Data Analysis –** The LabWindows®/CVI Analysis libraries include over 150 functions for signal processing, filters, windows, statistics, curve-fitting, array manipulations, and matrix algebra.

LabWindows® FOR DOS

The DOS version of LabWindows® includes an environment for programming in C or BASIC in which you can generate programs that can be compiled with Microsoft or Borland compilers.

**1 LabVIEW is a registered trademark of National Instrument Corporation.*

See Tektronix on the World Wide Web: http://www.tek.com

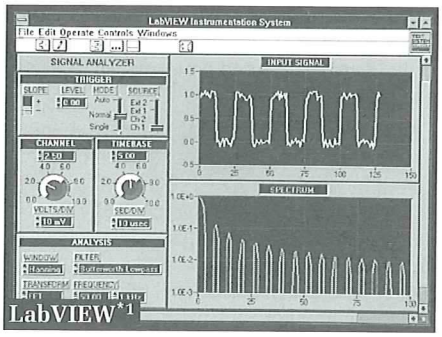
ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

VXI plug&play

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

System Software
LabVIEW®



LabVIEW*1 for Windows

LabView*1 is a graphical programming system for data acquisition and control, data analysis, and data presentation. LabVIEW*1 offers an innovative programming methodology in which you graphically assemble software modules called virtual instruments (VIs). You build VIs to acquire data from plug-in boards and programmable instruments and then analyze the data and present the results through graphical user interfaces (GUIs).

LabVIEW*1 gives you an alternative to traditional text-based programming. If you are looking for an innovative way to program your instrumentation system without sacrificing performance – LabVIEW*1 is exactly what you have been looking for.

DEVELOPING A COMPLETE INSTRUMENTATION SYSTEM

You can access VI libraries to control and acquire data from GPIB, VXI, RS-232 instruments, and plug-in data acquisition (DAQ) boards. LabVIEW*1 offers over 400 instrument drivers – eliminating the low-level programming of the instruments. After you have acquired the data, you use the analysis VI libraries to convert your raw data into meaningful results. Finally, you can control your software system and present results through interactive front panels. These panels create a standard familiar interface regardless of your system hardware.

With LabVIEW*1, you build VIs instead of writing programs. You quickly create front panel user interfaces, giving you interactive control of your software system. To specify the functionality, you intuitively assemble block diagrams – a natural design notation for engineers. But with LabVIEW*1, the block diagram is the actual program, so you avoid the time-consuming task of converting ideas into traditional code.

The LabVIEW*1 VI is an ideal paradigm for building your software system. VIs, with their pictorial representation, are easy to modify and maintain, and are completely self-documenting. More importantly, they are building blocks you can incorporate as icons in other block diagrams to create sophisticated software systems.

PERFORMANCE

In test and measurement applications, execution speed is critical. LabVIEW*1 is the only graphical programming system with a compiler that generates optimized code with execution speeds comparable to complied C programs. Consequently, you can increase your productivity with graphical programming without sacrificing execution speed.

FLEXIBILITY

Instrumentation software packages promising ease of use often have too narrow a focus and lack the flexibility to meet your needs. Through LabVIEW's*1 hierarchy, you can easily ad your own VIs to the already extensive acquisition and analysis VI libraries. And for those routines that can be written more efficiently in a traditional language, you can link in external code.

THE LabVIEW*1 TEST EXECUTIVE TOOLKIT

The LabVIEW*1 Test Executive Toolkit automates the sequencing of the test programs you develop in LabVIEW*1. The toolkit comes with a full-function Test Executive that can incorporate your suite of test VIs, along with a sequence Editor for developing test sequences with dependencies. The toolkit comes in block diagram source code with high-level modules, making it easy to modify to meet your application needs.

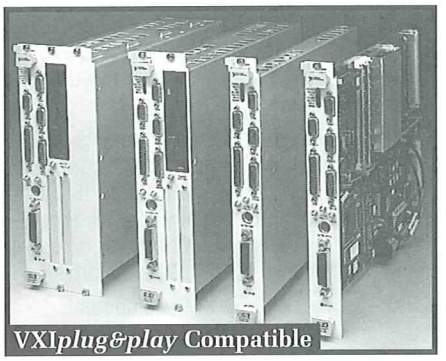
THE LabVIEW*1 VI LIBRARIES

The LabVIEW*1 has a complete set of VI Libraries for all of your test and measurement operations.

- **GPIB –** The GPIB VI Library contains functions for complete programmatic control of IEEE 488 instruments. With the GPIB 488.2 VI Library, you can use any of the National Instruments IEEE 488.2 Controller boards and the standard NI-488.2 device driver.
- **VXI –** As part of the VXI Development System, the VXI VI Library has functions to control VXI instruments from either embedded VXI controllers or external computers equipped with a MXI interface. The library has functions for programming both message-based and register-based devices.
- **RS-232 –** The RS-232 VI Library has functions for performing serial communication using multiple RS-232 ports under interrupt control.
- **Instrument Library –** The Instrument Driver VI Library contains drivers for more than 400 GPIB, VXI, and RS-232 devices. The drivers consist of intuitive, high-level functions that make it easy for you to control your instruments.
- **Analysis VI Libraries –** The Analysis VI Libraries deliver the latest technologies in analysis software. The libraries are rich in statistics, evaluations, regressions, linear algebra, signal generation algorithms, time and frequency-domain algorithms, windowing routines, and digital filters.
- **Interprocess Communication –** To communicate with other applications you can use DDE under Windows and Windows NT™; TCP/IP under Windows NT™ and Solaris.

**1LabVIEW is a registered trademark of National Instrument Corporation.*

Controllers/Interfaces


VXI*plug&play* Compatible

The Right Choice

Certainly no single architecture will be right for all users. Let us work with you to guide you through the choices and assist you in arriving at the right solution for your situation.

Tektronix offers a suite of controllers, interface hardware and software for automated instrumentation control. Whether the test requirement calls for GPIB, VXIbus, or a combination thereof, Tektronix can provide a powerful, cost-effective controller or interface perfectly matched to your needs.

As a strong advocate of the open systems approach, Tektronix is a leader in furthering the development of standards for instrumentation systems. Tektronix evaluates all of its system controllers and interfaces for adherence to standardized interface rules. This evaluation ensures straightforward system integration and gives the system designer the latitude to use the most appropriate instrumentation and programming tools, regardless of the vendor.

EMBEDDED VS. EXTERNAL CONTROLLERS

Depending upon its instrument configuration, cost constraints, and throughput requirements, a test system might best be controlled from either an external PC-type controller or an embedded VXI controller.

Of the two alternatives, external controllers are typically the more flexible and cost less. Within this format, it is possible to achieve either minimum cost, or massive but cost-effective compute power. Embedded controllers, on the other hand, provide an optimized high-performance interface to VXI instruments and require the least physical space.

EMBEDDED CONTROLLERS

Tektronix offers the widest choice of embedded controllers of any vendor. Again demonstrating "openness" in the industry, Tektronix System architecture supports both National Instruments and RadiSys controllers. The VXI566 66 MHz 486DX2 Controller and VXI599 100 MHz 486DX4 Controller from National Instruments offer many different system configurations ranging from 4 MB RAM, 80 MB hard disk to 32 MB RAM, 1GB hard disk. These embedded controllers give you direct control of VXI registers, memory and triggers while maintaining compatibility with the scores of software packages and tools available for general market desktop PC computers. Tektronix also offers the RadiSys EPC-7 Embedded Controller with configurations ranging from 4 MB RAM, 240 MB hard disk to 64 MB RAM, 500 MB hard disk. Industry standard EPConnect® software development and run-time environments are available for the EPC-7.

EXTERNAL CONTROLLERS

Tektronix offers a range of external controllers with different price and performance levels and physical formats.

External controllers interface to instruments in one of several ways. Among the most common interfaces are GPIB and MXI. GPIB is the lowest cost method to control VXI instruments. Many customers already have a GPIB interface for their computer. MXI offers higher performance while still utilizing an external computer.

Tektronix offers PC and VXI interface cards in each of these formats. The S3FG210 GPIB PCII/IIA and S3FG220 AT-GPIB/TNT cards interface with the VXIGPIB slot 0 Resource Manager. The interface for the MXIWIN Standard VXI-MXI AT2010 is included with the VXI module.

SYSTEM SOFTWARE

System software includes several kinds of software packages. Using our experienced help, you select the combination that will work best for you. Our controllers support various operating systems and related system software. Because we emphasize an open systems approach, the capabilities you need are probably already available in a standard package.

Instrument	RAM	Hard Disk	MHz	Microprocessor
VXI566	4 MB to 32 MB	80 MB to 1 GB	66	80486DX2
VXI599	16 MB to 32 MB	240 MB to 1 GB	100	80486DX4
EPC-7	4 MB to 64 MB	240 MB to 500 MB	33 to 100	80486 DX2/DX4

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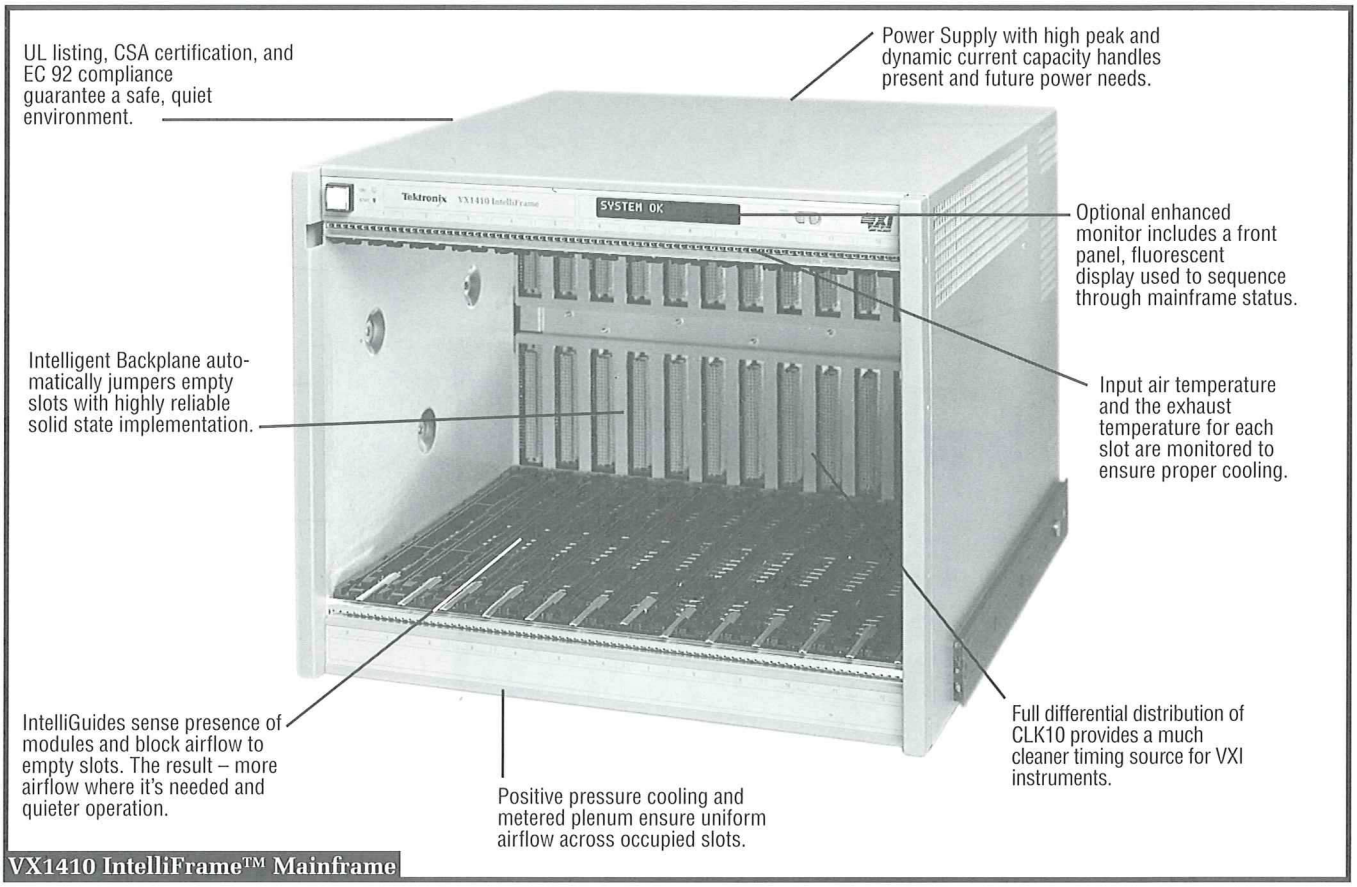
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VXI plug&play

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

Mainframes



VX1410 IntelliFrame™ Mainframe

VXI Mainframes

The mainframe can be viewed as the most important VXI instrument in a system. It is responsible for the complete environment for VXI modules: power, cooling, EMI, mechanical, and backplane communication and timing. The performance of the mainframe directly impacts the performance of the modules:

- More available power allows greater flexibility for future instrument selection.
- Better mainframe cooling extends the life of the instruments.
- More EMI protection improves measurement accuracy.
- Better mechanical design makes maintenance and system integration easier.
- Superior backplane CLK10 distribution improves system timing accuracy.

Tektronix has a family of VXI mainframes to cover a broad range of applications. The VX1410 IntelliFrame™ mainframe is the latest product and represents breakthroughs in each of the areas listed above. It can be configured as a benchtop or rackmounted instrument. The IntelliFrame™ also has superior fault isolation capability.

The VX1401 is an excellent, low cost, full size VXI mainframe that meets most application needs. It includes all rackmount hardware and a tough Lexan™ front door at a very attractive price.

The VX1406 rounds out the Tektronix family of mainframes. It is a six slot VXI mainframe that is good for portable applications or engineering development.

All Tektronix VXI mainframes have Options A1 through A5 for non-U.S. power cords.

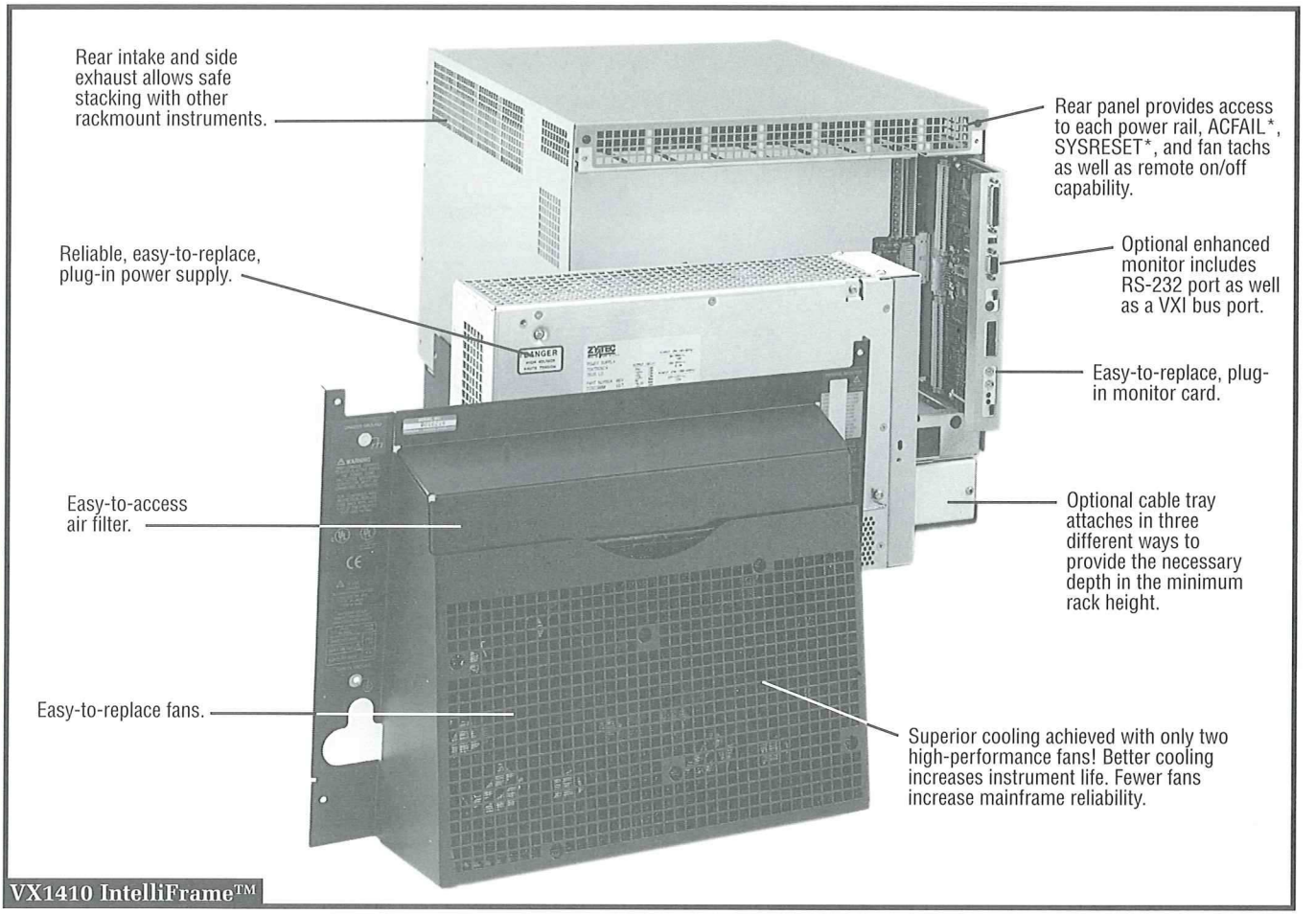
- Enhanced Monitor
  - Provides Readout of:
    Input temperature
    Exhaust temperature for each slot
    Each voltage rail
    Fan speeds
    Hours of operation timer
    Air filter cleaning timer
  - Allows user selection of interrupt (alarm) conditions
  - Communicates as a message-based instrument and RS-232
  - VXI*plug&play* software driver
  - Bright front-panel fluorescent display

VX1410 OPTIONS NOT SHOWN ABOVE:

- Rack Kit
  - VXI*plug&play*-compatible, accepts VXI*plug&play* receivers without need for expensive adapters.
  - Adjustable recess accommodates cables with large bend radii.
  - Lexan™ door is stronger than acrylic, providing better protection while allowing visibility of instrument front panels.
  - Top and bottom vertical cable access allows for shorter cables to instruments above and below the mainframe, improving signal fidelity.

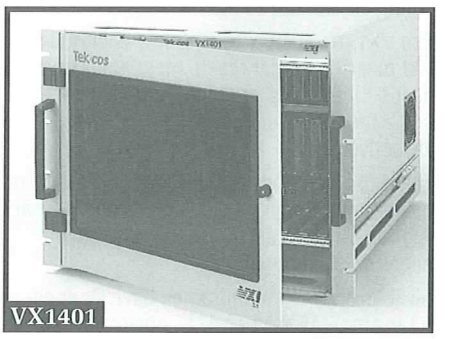
Products summary/order information is on page 378.

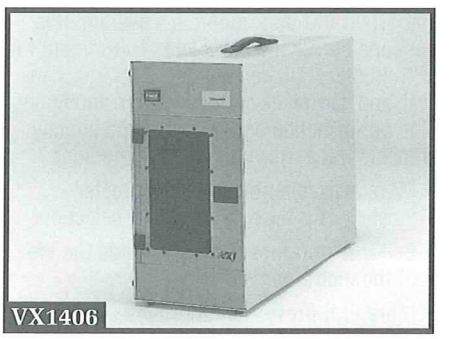
Mainframes Summary



VX1410 IntelliFrame™


VX1410


VX1401


VX1406

VX1410 INTELLIFRAME™
- 13 Slots
- Intelligent Cooling
- Easy Maintenance
- Powerful (Opt.) Enhanced Monitor
- Adjustable (Opt.) VXI*plug&play*-compatible Rack Kit

VX1401 LOW COST MAINFRAME
- 13 Slots
- Rack Kit and Cable Tray Included
- Vertical Cable Access
- Reliable Backplane
- Rugged

VX1406 PORTABLE MAINFRAME
- 6 Slots
- Removable Side Panel for Instrument Access
- Optional Rackmount Kit

Digitizers

Features

DIGITIZERS

- Breakthrough in Price/Sample Rate!
- Breakthrough in Price/Bandwidth!
- Breakthrough in Price/Resolution!
- Breakthroughs in Record Lengths at Low and High Sample Rates!
- Industry's First VXI*plug&play* VXI Waveform Analyzer

Applications

- Very High Volume/High Test Throughput
- Multi-channel Data Acquisition
- Audio to Very High Speed Signal Analysis
- Signal Quality – Audio, Voice, Telephony

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VXI plug&play

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

Digitizers/Waveform Analyzers

WIDEST RANGE OF SOLUTIONS IN VXI

When your application requires analog measurements, Tektronix offers the widest range of Analog to Digital Conversion (ADC) solutions. With these various ADC solutions, both acquisition memory (digitizer) and on-board Digital Signal Processing (DSP) (Waveform Analyzer) are scaled to best meet the application needs. This scalable solution offered by Tektronix allows you to choose the best instrument to meet your needs, at cost-effective prices.

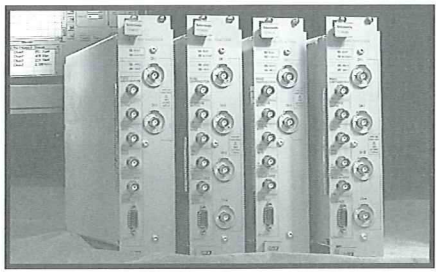
HIGHEST PERFORMANCE WAVEFORM ANALYZERS

New in 1996 are the Tektronix TVS600 Series of VXI Waveform Analyzers. The TVS600 Series are a family of 2 channel and 4 channel Waveform Analyzers that incorporate the proven Tektronix Digital Real Time (DRT) oversampling that reduces aliasing and enables single-shot capture at full bandwidth. The new TVS600 products offer two levels of performance:

- TVS621 and TVS641 offer 250 MHz bandwidth at 1 GS/s sample rate
- TVS625 and TVS645 offer 1 GHz bandwidth at 5 GS/s

HIGH VERTICAL ACCURACY AT HIGH SAMPLE RATE

Included in the vast portfolio of measurement solutions is the VX4240 Waveform Analyzer. The VX4240 is a versatile instrument used in many applications where general purpose measurements are required, such as



"Universal" and "General Purpose" Test Systems. The VX4240 offers 12 bits of vertical resolution (4,096 digitized levels), coupled with acquisition memory from 256 K points to 1 M points. The VX4240 includes on-board signal processing that allows you to process answers quickly, avoiding moving large amounts of data across the VXI backplane.

HIGH RESOLUTION SOLUTIONS

Rounding out the Tektronix VXI Digitizer/Waveform Analyzer portfolio are the high resolution digitizers. These digitizers are called high resolution because they have 16-Bit acquisition systems (65536 digitized levels).

The high resolution portfolio includes the VX4244, 16 synchronous channels at 200 K samples per second on each channel simultaneously. The DBS8700 and DBS8701 offer 200 and 400 K samples per second on 8 input channels. The DBS8700 and DBS8701 input channels are expandable by adding the DBS8710 or DBS8720 multiplexer/scanners.

VXI OSCILLOSCOPES, WAVEFORM DIGITIZERS, AND ANALOG TO DIGITAL CONVERTERS (ADC)

	Bandwidth	Channels	Sample Rate	Vertical Resolution	Record length
TVS621	250 MHz	2	1 GS/s	8	15 K
TVS641	250 MHz	4	1 GS/s	8	15 K
TVS625	1 GHz	2	5 GS/s	8	15 K
TVS645	1 GHz	4	5 GS/s	8	15 K
VX4240	5 MHz	1	10 MS/s	12	256 K to 1 M
VX4244		16	200 kS/s	16	64 K
		8	200 kS/s		128 K
		4	200 kS/s		256 K
DBS8700		1	200 kS/s	16	1 K FIFO w/DMA
		8	25 kS/s		
		128 w/DBS8710*1	1.56 kS/s		
		256 w/DBS8720*2	0.78 kS/s		
DBS8701		1	400 kS/s	16	1 K FIFO w/DMA
		8	50 kS/s		
		128 w/DBS8710*1	3.125 kS/s		
		256 w/DBS8720*2	1.56 kS/s		

**1 The DBS8710 is a 16-channel, sample and hold MUX that is controlled by the DBS8700 and DBS8701.*

**2 The DBS8720 is a 32-channel MUX that is controlled by the DBS8700 and DBS8701.*

Measurement

Features

VXI MEASUREMENT

- Wide Range of General Purpose Instruments, All VXI*plug&play* Compliant
- All AC, DC, I, and Related Digital Multimeter Functions
- All Frequency, Time Interval, and Other Typical Timer Counter Functions
- DC to 400 kHz Low Frequency/ Audio Spectrum Support
- High Reliability/Excellent Repeatability of Measurements

Applications

- General Purpose AC/DC Measurement
- General Purpose Time/Freq to 2.5 GHz
- RF Power Measurement – Wireless Applications

MEASUREMENT INSTRUMENT SELECTION GUIDE

Instrument	Function	Key Specs	Key Features
VX4224	Timer Counter	200 MHz/2.5 GHz	9 digit res. high performance
VX4234	DMM	4.5 digits	Fast, fully guarded, AC & DC
VX4237	DMM	6.5 digits	High perf. 5 AC/5 DC ranges
VX4281	RF Powermeter	up to 40 GHz	–60 dBm to +13 dBm
VX4286	A/D Comparator	32 CH	Single-ended input
VX4287	A/D Comparator	32 CH	Differential input
73A-541	Timer Counter	10 MHz	General purpose, time tag

Measurement

Whether it's microamps or hundred volt signals, your measurement subsystem is the "workhorse" of your VXI test and measurement system. Easy programming, well behaved and predictable operation, accuracy, and repeatable measurement are the key requirements of this kind of equipment. With Tektronix' many years of experience with the vast range of user signals and demands, you are assured of satisfying performance in these areas, not to mention functions and specs that are hard to beat.

WHAT, WHEN, HOW

A key aspect of Tektronix' designs is highly evolved triggering, capture, and data manipulation architectures. Tektronix' established VXI leadership in high throughput measurement is based not only on the high speed "smarts" of these message based designs, but also on their ability to be set up, triggered, and read in a fast manner. Software plays a key role in this also: Tektronix' designs have pioneered the streamlined arming and "statusing" of these instruments. All this adds up to fast and repeatable test programs.

THE SYSTEM VIEW

You'll find that with Tektronix' VXI*plug&play* drivers, the integration of instruments into test systems and test program development is simplified and streamlined. Nothing is more frustrating than installing an instrument only to find you need to call the factory for "the latest" driver or firmware…a problem many customers have experienced with other vendors' non-compliant VXI*plug&play* equipment. With Tek, you will experience rapid system integration schedules, quick learning curves with the drivers and applications software, and – best yet – solid, predictable instrument measurements that you can write home about.

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VXI plug&play

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

Sources

Features

VXI SOURCES

- Wide Range of General Purpose Instruments, All VXI*plug&play* Compliant
- Low Noise, Stable Fixed and Programmable Outputs, from 16-Bit Precision Audio to 250 MHz Coded Formats
- VX4792 is Compatible with AWG 2021 Bench Units and Programming Software
- Fast and Easy Programming
- High Reliability/Excellent Stability and Accuracy

Applications

- General Purpose Signal Sources – Audio to RF
- Modulated and Coded Signal Source Requirements
- Resistance/Impedance Tests
- Voice, Modem, PCM, and Telephony Tests

SOURCES INSTRUMENT SELECTION GUIDE

Instrument	Function	Key Specs	Key Features
VX4342	Dual Resistance	4 decades/CH	200 value changes/s
VX4730	D/A High Output	12-CH	±16V, 400 mA
VX4750	Function Generator	25 MHz	Modulation, sweep
VX4790A	General Purpose Arb	25 MHz	±10V, with sine, sq, sawtooth
VX4792	Fast Arb	250 MHz	Versatile Software
DBS8750	Precision Arb	400 kHz	16-Bit with on board DSP
DBS8751	Precision D/A	4-CH	16-Bit, 3/6 V
DBS8752	Precision D/A	4-CH	16-Bit, 5/10 V

Sources

Like a lighthouse, a source is expected to be on the job, whatever conditions prevail – severe noise, low signal level, or dynamic loading. Tektronix mastery of signal source stability, built on the well known TM 5000/500 product series foundation, continues into the VXI products, some of which are already becoming legendary.

Introduced last year was the very powerful VX4792 250 MHz Arb, a breakthrough in moving VXI testing capabilities well beyond those of traditional 100 MHz units. Compatible with the AWG 2021's WaveWriter™ software (also works with the VX4790A general purpose Arb), this unit can open doors to testing complex low RF applications, high-speed logic tests, and cable/communications testing.

STUFFING THE WAVE

Because of the large amount of waveform data, and the many times a test program may need to configure the Arbs, it is critical that source instrument software quickly and easily load, arm, and fire the instruments. As with all of Tektronix VXI instruments, emphasis is placed at a system level, forcing designers to worry about:

- Making the instruments easy to program
- Making the instruments function as quickly as possible

Front ends of Tektronix sources are clean, accurate, and predictable. Stable, wide (in output) range UUT stimulus makes UUT interfacing easy and manageable.

NOTHING IS FIXED ANYMORE

Yesterday's sources are fine, but today's UUTs demand a diverse range of modulation. Tektronix' sources allow and support complex and traditional modulation without losses in instrument accuracies or stability. Just as signals continue their march toward more use of coding, demands on the instrument also increase in other areas: synchronization, triggering, and paging (of waveform memory). With many years of understanding the nature of complex signals from our years of experience in oscilloscopes, Tektronix has been able to apply technical agility in mastering these synchronization and triggering needs.

ON THE HORIZON

So when you're trying to stress that UUT with worst case signals programmed from a Tek source, you'll be able to trust those outputs – as did the mariners of old trust their lighthouses. Tektronix' commitment to VXI, as witnessed with the advent of the VX4792, marches attuned to the advancement of UUT technology – again!

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VXI plug&play

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Switching/Scanning

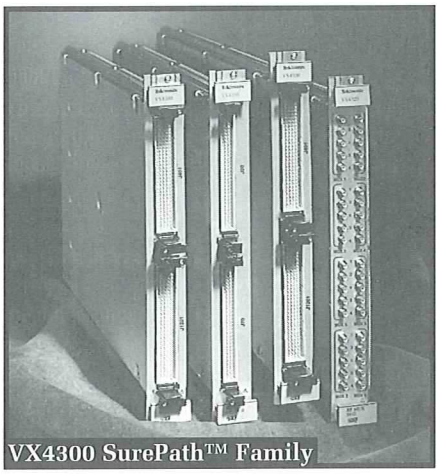
Features

VXI SWITCHING

- Relay Switching in SPST, SPDT, DPST, DPDT Configurations
- Relay Scanners Offer 1-wire, 2-wire, and 4-wire Configurations up to 240 Channels Per Module
- Relay Matrix with 256 and 128 Cross Points, Latching and Non-latching Configurations
- 1.3 GHz RF Multiplexer Offers Eight One x Four Muxes in a Single Slot
- Relay Drivers/Solenoid Controllers to 50 V DC and 300 mA

Applications

- RF MUX
- Scanner/MUX
- Relay Switch
- MATRIX



This VXI Interface and Slave Controller is installed on the first switch module. Additional modules are controlled from the Local Bus.

Switching

The SurePath™ switching family illustrates Tektronix' continued commitment to achieving greater levels of performance while driving the price of VXI below comparable GPIB rack and stack installations.

The initial introduction consists of four switching products:

- VX4320 1.3 GHz RF Mux usable to 2 GHz
- VX4330 120-CH Scanner/Mux
- VX4350 64-CH Relay Switching Module
- VX4380 256 Crosspoint Relay Matrix

LOWER COST LOCAL BUS COMMUNICATIONS
All relay modules are controlled via the Local Bus on the VXI chassis backplane by a VXI Interface and Slave Control daughter board. Only a single daughter board is required to control a full chassis of these new relay switching modules.

LOW NOISE MODE
A unique feature of the new family of switching modules is that the VXI interface and relay controller daughter board goes to a quiescent mode when not actively in use. This mode greatly lowers the risk that digital noise within your VXI system can disturb low level measurements.

IEEE-488.2/SCPI
Tektronix proves its commitment to open architecture and ease of use through the implementation of IEEE-488.2 commands and formats and SCPI programming structures. IEEE-488.2 and SCPI give the user an English language command set that self-documents the switching subsystem program.

VXI*plug&play* FRONT PANELS
Tektronix, a founding member of the VXI*plug&play* alliance, is committed to widespread availability of VXI*plug&play* soft front panels. There are easy-to-use soft front panels that enable the user to control each of these modules virtually right out of the box.

BACKWARD COMPATIBLE
The SurePath™ family can be used to control the VX4372 2-wire and VX4374 4-wire scanner slave modules. The VX4372 and VX4374 are lower cost/channel density modules that allow the user to tailor the switching configuration to the needs of the UUT.

EXPANDING ARCHITECTURE
The initial introduction of four SurePath™ switching modules is just the beginning. More switching modules are on the drawing board. New Tektronix non-switching modules will also implement the local bus control design for applications that will benefit from VXI switching.

LATCHING RELAY DESIGN
Thermal EMF errors can be caused by relay contact heating as a result of leaving the relay coil energized for extended periods. Tektronix' SurePath™ family uses latching relays that are pulsed on or off. Not only do latching relays contribute to lower thermal EMF errors, but they will reduce overall chassis power consumption and, in the event of a VXI chassis AC fail signal, the user can choose to open all relays, maintain their present state or open all relays when power is reapplied. This allows the user to select the option that will most likely reduce the risk of damage to the UUT.

INTERNATIONAL REGULATORY APPROVALS
Reduce your test system design risk by selecting VXI components that have been rigorously tested and certified. Don't jeopardize your system design with susceptible or radiating modules. A unique Tektronix shield and electrical design have allowed all members of the new family of switching modules to achieve:

- IEC 1010 Certification
- UL 1244/3111 Listing
- EC92 Compliance

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VXI plug&play

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

Switching/Scanning

VX4329
- 1.3 GHz 3 dBpt Usable to 2 GHz
- Eight Groups of 1 x 4 Muxes
- Each Mux Utilizes a Tree Configuration for Outstanding RF Characteristics
- Low Insertion Loss
- Excellent VSWR
- High Crosstalk Isolation

VX4330
Software Configurable Maximums:
- 120 CH 2-wire Scanner Multiplexer
- 1X240 1-wire
- 1X60 4-wire
- Simultaneously and Multiple 1-wire, 2-wire, 4-wire Configurations
- 10 MHz 3 dB point
- 2 A Continuous Switching
- 220 V AC or DC Switching

VX4350
- Low Cost, High Density
- 64 CH SPST or SPDT Switches
- Each Switch Individually Controlled
- 2 A Continuous
- 220 V AC or DC Switching

VX4380
- 256 Crosspoints
- Configure a Single Module as 2-wire or 4-wire
- No Unique Modules; Each VX4380 Can Be Configured As a 16 x 16 or 8 x 32 or 4 x 65
- Create Large Matrices by Easily Joining Modules in Either the X or Y Dimensions

VXI SWITCHING/SCANNING SELECTION GUIDE

Type	Configuration	No. of Channels	$I_{switch\ max}$	$V_{max\ DC/AC}$
Relay Switching				
VX4350	SPDT	64	2A	220/250
VX4353	SPST	32	5A	48/250
VX4355	DPST/SPDT	24	5A	48/250
VX4356	DPDT	20	5A	48/250
VX4357	SPDT	32	5A	48/250
Scanner/Multiplexer				
VX4330	Programmable	120 2-wire	2A	220/250
VX4372	2-wire	48	0.5A	200/240*[1]
VX4374	4-wire	24	0.5A	200/240*[1]
Matrix				
VX4380	Selectable	256-cross points	2A	220/250
VX4385	Programmable	128-cross points	1A	100/120
RF Switch				
VX4320	Tree	8 groups of 1 X 4	10 watts	28 V DC
Relay Control				
73A-308	Open Collector	80 outputs	300 Ma	50 V DC

*[1] *Requires balanced input and bleed resistors.*

Digital and Boundary Scan

Features

BSCAN

- First in the Industry with 1149.1 Support and ASSET VXI Tools. Compatible with TI's ASSET™ and Teradyne's Victory™ Products Through SVF File Format
- Cost Effective Boundary Scan Packages for the R&D Lab or for the Production Floor
- Serial and Parallel Tools
- Cost Effective Basic Digital Pin Instruments with Simple to Use VXI*plug&play* Driver Support

Applications

- General Purpose Digital I/O
- Boundary Scan R&D Development
- Digital Functional Test
- Functional Testing for IC, LCA, ASIC, etc.
- Functional PCB Module or Card Testing

DIGITAL AND BOUNDARY SCAN SELECTION GUIDE

Instrument	Function	Key Specs	Key Features
73A-270	Prog Generator	2 Fast Serial	Complex pulse trains
VX4801	Basic Pins	48TTL/CMOS	Byte-by-byte I/O programming
VX4802	Basic Pins	80TTL/CMOS	User masks
VX4820	Dynamic Pins	20 MHz	32/64-Pin groups/Pods
VX4491	Serial Test	JTAG/1149.1	2 TAPs
ASSET VXI	B-Scan Software	Supports VX4491	Automatic vector generation, interactive debugger, scan analyzer

It May Be Where You're Headed

Inevitably, test development grinds to a slow pace when confronted with complex programmable and standard VLSI devices. While growing modestly as a testability technique over the last years, boundary scan is soon to gain rapid acceptance as a methodology both "in the lab" and in production. Tektronix VX4491 and ASSET VXI software products allow you to implement your boundary scan testing philosophies or trials today – either as a "bench" configured VX1406 mini-system, or in a full-blown ATE Functional VXI system.

BURST AND STATIC

Digital pin requirements follow a never-ending highway of need, from the necessity to test simple latched I/O, to complex processor or state machine bursts. Tektronix' digital products allow you to match the instrument and price to your specific application. VXI*plug&play* drivers simplify the test program development. Tektronix' VX4820 is suited to larger testing requirements with its openness to slave additional VX4820s.

AND ONE BY ONE...

Tektronix' experience in serial avionics, automotive, and communications buses has been a basis for the design of the 73A-270, a very popular general purpose serial pattern generator. This instrument allows complex streams – of up to 1,600 events – to be programmed and burst, with additional facilities of triggering and synchronization readily available.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

VXI plug&play

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

Avionics

Features

VXI AVIONICS TEST

- MIL-STD-1553 Bus Simulators and Bus Monitors
- ARINC 429 Receiver/Transmitter
- ARINC 629 Multi-terminal Simulator
- Discrete I/O and Aircraft Transducer Simulation
- Avionics Test System Services

AVIONICS PRODUCT SELECTION GUIDE

Type	Description	Applications
VX4428	Quad ARINC 429 Transmitter and Receiver	Test and control LRUs via ARINC 429 Transmitter and Receiver
VX4469A	ARINC 629 Simulator with Enhanced Error Injection	Up to 3 terminals with full error injection Emulate multiple terminals in real time
73A-455	Dual-channel MIL-STD-1553	Simulate bus controller, remote terminal, or bus monitor
VX4457	MIL-STD-1553A/B Intelligent Bus Analyzer Monitor	"Logic Analyzer" for MIL-STD-1553 bus

Avionics

Tektronix has a long history of commitment to aerospace and avionics testing. This year, Tektronix offers a wide range of products and services tailored to the avionics community. Whether you are a self-integrator of avionics ATE systems or need avionics test system integration services and expertise, Tektronix has the experience, products, and services to get you off the ground quickly and reliably.

Tektronix offers the widest range of VXI-based instrumentation and communication interfaces specifically designed for avionics test and simulation. Our extensive catalog includes ARINC 429, ARINC 629, and MIL-STD-1553 VXI modules. These products are used by airlines and depot repair facilities worldwide. Tektronix card modular instruments are included in avionics ATE systems supplied by leading avionics and aircraft manufacturers worldwide.

ARINC 629

In support of Boeing's new jetliner, the B777, Tektronix is announcing the VX4469A ARINC 629 Simulator with Enhanced Error Injection.

The VX4469A is our third generation ARINC 629 tester whose enhancements are a direct result of our experience and customer feedback on our earlier products. The VX4469A combines all of the functions of the proven VX4469 with new error injection capability you need to get your test system flying. The VX4469A provides you an advanced tool for ARINC 629 communication, bus traffic simulation, and bit, word and message level error injection. The VX4469A provides the maximum visibility into your LRU's ARINC 629 interface.

MIL-STD-1553

Tektronix introduces a new addition to our MIL-STD-1553 product family. The VX4457 Intelligent Bus Analyzer/Monitor is an unsurpassed tool for monitoring and analyzing 1553 bus traffic. The VX4457 provides test engineers with "Logic Analyzer" functionality to help zero in on specific messages of interest. Knowledgeable application engineers are available to consult on your avionic test applications and solutions.

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VXI plug&play

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

Standard Product Summary

STANDARD PRODUCT SUMMARY

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

MAINFRAMES

VX1401 – Low Cost, 13-Slot Mainframe.

VX1406 – Portable, 6-Slot Mainframe.

VX1410 – IntelliFrame™, Intelligent 13-Slot Mainframe.

SLOT 0/RESOURCE MANAGER MODULES

VXIGPIB – GPIB-VXI/C Slot 0 Resource Manager.

VX4521 – High-speed slot 0 Device/Resource Manager.

GPIB INTERFACES

S3FG210 – GPIB-PCII/IIA I/O Card for PC.

S3FG220 – AT-GPIB/TNT I/O Card for PC.

S3FG222 – EXM 27 AT-GPIB for EPC-7.

MXI INTERFACES

MXIWIN – Standard VXI-MXI AT2010 without Cables.

MXIEXT – VXI-MXI Mainframe Extender.

MXICBLS – Cables for MXI.

EMBEDDED CONTROLLERS

VXI566 – 66 MHz Embedded 486 VXIbus Controller.

VXI599 – 100 MHz Embedded 486DX4 VXIbus Controller.

EPC-7 – 33/50 MHz Embedded 486 VXIbus Controller.

SOFTWARE

LVWIN – National Instruments LabVIEW*1 for Windows.

LWDOS – National Instruments LabWindows® for MS-DOS.

LWCVI – National Instruments LabWindows® CVI for Windows.

DIGITIZERS

TVS621 – Waveform Analyzer 2-CH, 250 MHz.

TVS625 – Waveform Analyzer 2-CH, 1 GHz.

TVS641 – Waveform Analyzer 4-CH, 250 MHz.

TVS645 – Waveform Analyzer 4-CH, 1 GHz.

DBS8700 – 8-CH, 200 kS/s Multiplexed Analog to Digital Converter/Digitizer.

DBS8701 – 8-CH, 400 kS/s Multiplexed Analog to Digital Converter/Digitizer.

DBS8710 – 16-CH, Differential Multiplexer with Sample and Hold.

DBS8720 – 32-CH, Differential Multiplexer.

VX4244 – 16-CH, 200 kS/s Simultaneous Digitizer.

VX4240 – 10 MS/s Waveform Digitizer/Analyzer.

MEASUREMENT

73A-541 – 10 MHz Universal Digitizing Counter.

VX4224 – 200 MHz High Performance Universal Counter.

VX4234 – 4.5-Digit Digital Multimeter.

VX4237 – 6.5-Digit Digital Multimeter.

VX4281 – RF Power Meter.

VX1811A – 18 GHz RF Diode Sensor.

VX1812A – 26.5 GHz RF Diode Sensor.

VX1813 – Remote Calibrator for VX4281.

VX1814A – 18 GHz RF True RMS Sensor.

VX1815A – 40 GHz RF Diode Sensor.

VX1817A – 18 GHz 5 W Power Sensor.

VX4286 – Single-ended, 32-CH, Analog/Digital Comparator.

VX4287 – Differential 32-CH, Analog/Digital Comparator.

SOURCES

VX4342 – Dual Resistance Programming Module.

VX4730 – 12-CH, 16-Bit D/AC.

VX4750 – 25 MHz Function Generator.

DBS8750 – 2-CH, 400 kS/s Arbitrary Waveform Synthesizer.

DBS8751 – (Low Output) 4-CH, 200 kS/s Digital to Analog Converter/Waveform Generator.

DBS8752 – (High Output) 4-CH, 200 kS/s Digital to Analog Converter/Waveform Generator.

VX4790A – 25 MS/s Arbitrary Waveform Generator.

VX4792 – 250 MHz Arbitrary Waveform Generator.

SWITCHING AND SCANNING

VX4320 – Six 1X4 RF Multiplexer.

VX4330 – 120-CH, Scanner/Multiplexer.

VX4372 – 48-CH, Two-wire Scanner Slave.

VX4374 – 24-CH, Four-wire Scanner Slave.

VX4350 – 64-CH, SPST/SPDT Switching Module.

VX4353 – 32-CH, SPST 5 A General Purpose Relay Switching.

VX4355 – 24-CH, DPST/SPDT 5 A General Purpose Relay Switching.

VX4356 – 20-CH, DPDT 5 A General Purpose Relay Switching.

VX4357 – 32-CH, SPDT 5 A General Purpose Relay Switching.

VX4380 – 256 Crosspoint Switch Matrix.

VX4385 – 128 Crosspoint Relay Matrix Switch.

73A-308 – Relay and High Voltage Logic Driver.

DIGITAL AND BOUNDARY SCAN

73A-270 – 2-CH, 10 MHz Arbitrary Serial Pulse/Pattern Generator.

VX4491 – Serial Test Module (Boundary Scan).

S59ADGS – ASSET™ VXI Boundary Scan Diagnostic System.

S59AITP – ASSET™ Interconnect Test Product.

S59ASFL – ASSET™ Scan Function Library.

S59ATVD – ASSET™ VXI Test Vector Development System.

VX4801 – 48-CH, Isolated Digital I/O.

VX4802 – 80-CH, Programmable Digital I/O.

VX4820 – 20 MHz Digital Test Module (64 Channels).

AVIONICS

ARINC

VX4428 – ARINC 429 Quad Transmitter/Receiver.

VX4469A – ARINC 629 Simulator with Enhanced Error Injection.

MIL-STD-1553/SYNCHRO

VX4457 – MIL-STD-1553A/B Intelligent Bus Monitor.

73A-455 – Dual Channel MIL-STD-1553A/B Bus Simulator.

TELECOMMUNICATIONS

See pages 326 to 329.

SX4610 – SDH/SONET Analyzer.

VX4610 – SDH/SONET Generator/Receiver.

VXOA41 – VXI Programmable Optical Attenuator.

ACCESSORIES

73A-451 – Wire-wrap Module with VXIbus Interface.

73A-452 – Blank Wire-wrap.

73A-850 – Extender.

73A-851 – VME to VXI Adapter.

**1 LabVIEW is a registered trademark of National Instrument Corporation.*

See Tektronix on the World Wide Web: http://www.tek.com

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VXI plug&play

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

Universal Signal Sources

Arbitrary Generators

Tektronix offers a wide variety of Arbitrary Waveform Generators that have the capabilities to earn the title of "Universal Signal Source." From the powerful and easy to use 2000 Series Benchtop to fast system VXI sources, Tektronix has an Arbitrary signal source to solve your application requirements.

Arbitrary waveform generators ("Arbs" for short) are used to generate "real world" signals. They can generate signals with all the glitches, drift, noise, and other anomalies that a device under test will encounter when it leaves the lab or manufacturing floor. Arbs are being used for disk drive testing, automotive anti-lock brakes and engine control modules, fax testing, biomedical simulations and more.

"What if" scenarios are easy since waveforms can be captured from a digital scope and then modified to see when a device under test fails. They also make it easy to simulate transducers that can be difficult or expensive to use.

Arbitrary Waveform Generators have evolved from simple B/A converters to sophisticated signal sources with powerful creation, editing and triggering capabilities.

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ARBITRARY GENERATORS

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DBS8750 ..... 371, 373

ARBITRARY WAVEFORM SOFTWARE

WaveWriter™ 381

Universal Signal Sources

SELECTION GUIDE

Vendor and Model	Tektronix AWG 2041	Tektronix AWG 2021	Tektronix AWG 2005
Maximum Clock Rate (Point Rate)	1 GS/s (1 ns/pt) (up to 10 ps timing resolution with Region shift)	250 MS/s (4 ns/pt) (up to 4 ps timing resolution with Region shift)	20 MS/s (50 ns/pt) (up to 50 ps timing resolution with Region Shift)
Output Channels	1	1 std.; 2 total opt.	2 std.; 4 total opt.
Ampl V p-p into 50 Ω	2 V p-p; 4 V p-p differential	5 V p-p	10 V p-p
Region Shift	10 ps	4 ps	50 ps
Vertical Resolution (bits)	8	12	12
Sine, Sqr, Tri, Ramp, DC	10 MHz Synthesized	2.5 MHz Synthesized	200 kHz Synthesized
Execution Memory	1 MB std. (4 MB Opt. 01)	256 KB/CH	64 KB/CH
Built-in Waveform Editing	Graphical, Equation. Digital Timing, Table, Autostep Sequencing, Enhanced Math	Graphical, Equation. Digital Timing, Table, Autostep Sequencing, Enhanced Math	Graphical, Equation. Digital Timing, Table, Autostep Sequencing, Enhanced Math
Direct DSO Transfer	Direct via GPIB	Yes	Yes
Parallel Digital Output	8-Bits ECL + 2 markers (Opt. 03)	12- or 24-Bit (TTL @ 100 MHz) 12-Bit (ECL @ 250 MHz) + 2 markers (Opt. 03 or 04)	24-Bit TTL + 2 markers (Opt. 04)
Software Support	WaveWriter™ LabVIEW®	WaveWriter™ IQSIMK; LabVIEW®	WaveWriter™ IQSIMK; LabVIEW®
Where to find more info.	Page 384	Page 386	Page 388

SELECTION GUIDE

Vendor and Model	Tektronix AFG 2020	Rohde & Schwarz ADS	VXI Tektronix VX4792	VXI Tektronix VX4790A	VXI Analogic DBS 8750
Maximum Clock Rate	250 MS/s (4 ns/pt)	25 MS/s (40 ns/pt)	250 MS/s (4 ns/pt)	25 MS/s (40 ns/pt)	400 KS/s (2.5 µs/pt)
Output Channels	1 std.; 2 total opt.	2	1	1	2
Ampl V p-p into 50 Ω	10 V p-p	10 V p-p	5 V p-p	±10.22 V	±10 V single-ended or ±5 V differential
Vertical Resolution (bits)	12	12	12	12	16
Sine, Sqr, Tri, Ramp, DC	DDS Synthesized 100 MHz – Sin 50 MHz – Sqr 31.2 – Other	5 MHz – Sine 100 kHz – Tri	2.5 MHz Synthesized	250 kHz	20 kHz – Sine
Execution Memory	1 KB/CH	64 KB	256 KB	256 K (std.) up to 1 MB option	32 KB
Waveform Editing	Built-in Graphical Pre-defined Sin, Sqr, Tri, etc., Math (+, –, *, "/")	Via Arbitrary Waveform Designer Software	Equation, Autostep Sequencing	None	Equation
Direct DSO Transfer	Yes	N/A	No	No	No
Parallel Digital Output	N/A	N/A	N/A	N/A	N/A
Software Support	WaveWriter™; LabVIEW®	IQSIMK	WaveWriter™	WaveWriter™	
Where to find more info.	Page 390	Page 392	VXI Catalog	VXI Catalog	VXI Catalog

Arbitrary Waveform Editing Software

WaveWriter™

Features

WaveWriter™ WAVEFORM CAPTURING AND EDITING SOFTWARE

- Create/Modify/Document Waveforms for DSOs and Arbitrary Generators
- Use WaveWriter™ Standalone or Integrated into Application Development Environments
- Create Waveforms by Freehand Drawing (or with Autolining Between Selected Points) by Editing Standard Functions, Writing Equations, or by DSO Acquisition.
- Edit Waveforms by Cut and Paste Methods; or Invert, Add, Subtract, Multiply, or Divide Whole Waveforms or Portions
- WaveWriter™ Automatically Scales Record Size, Resolution, Etc., to Single or Double Target Instruments
- Microsoft Windows-based User Interface
- Support GPIB or RS-232 Instruments
- Runtime Environment for Margin Testing

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

WaveWriter™ (AWE) Waveform Capturing and Editing Software

WAVEFORM GENERATION

WaveWriter™ is a software package for creating and modifying waveforms for the Tektronix Arbitrary Waveform Generators and Digital Oscilloscopes. WaveWriter™ represents a major step forward in allowing easy creation of the real world signals which are increasingly being used to test circuit tolerances, drive vibration/shake tables, and simulate other non-ideal or corrupted signals.

WaveWriter™ offers an easy to use alternative to general-purpose programming languages for waveform definition. Its user interface is based on Microsoft Windows, with pull-down menus and mouse-selected icons. (Alternatively, you can use a command-driven interface.) It can operate independently, or as an integral part of a system program.

ACQUIRE OSCILLOSCOPE SIGNALS

Signals may be acquired from a variety of Tektronix TDS Series, DSA Series, 11000 Series, 2200 Series, 2400 Series digital oscilloscopes. The signals may then be modified, stored, or recreated with an arbitrary waveform generator.

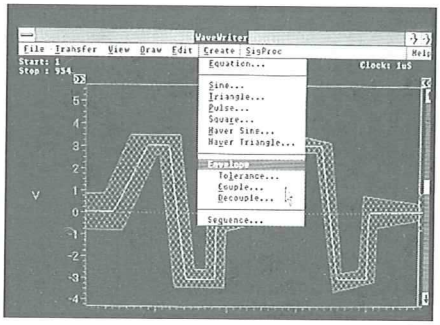
CREATE CUSTOM WAVEFORMS

Define waveforms by:

- Entering equations, polynomial expressions, and limits
- Drawing them freehand
- Selecting endpoints of straight line segments
- Editing standard functions, including sines, square pulses, triangles, and haver functions
- Uploading captured functions from a suitable digital oscilloscope

EDIT WAVEFORMS GRAPHICALLY

By defining sections of a waveform with WaveWriter™'s markers (which work like the cursors on an oscilloscope display), you can perform mathematical functions, including inversion; scale vertically and horizontally; and cut and paste. For example, you can add harmonically related sinusoids to construct a signal from its Fourier components. Or, starting with a signal captured by an oscilloscope, you can add glitches and distortion to test a circuit's response to specific kinds of signal aberrations.



Create the reference memory template waveform for pass/fail testing on 2400 Series Oscilloscopes.

PASS/FAIL LIMIT TESTING

WaveWriter™ also supports digital storage oscilloscopes with template generation for the Waveform Documentation. Therefore, with WaveWriter™, the user can create the exact tolerances of templates with which to capture a differentiated signal or automatically identify a failure. This is a great feature for margin test applications where fast test windows can be created in seconds.

WaveWriter™ now offers three different techniques for recording waveform data, including *.ADF, *.ISF, and *.CSV. Comma Separated Variable (CSV) is an ASCII format which allows the user to quickly and easily incorporate the waveform data into spread sheets, word documents and other math processing software packages.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

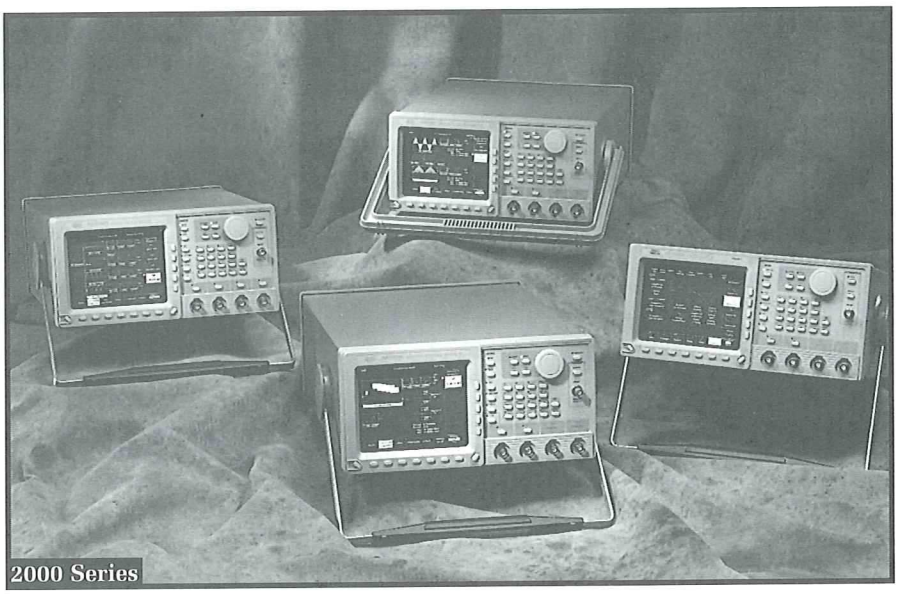
S3FT400
Tektronix WaveWriter™ System Software.
WaveWriter™ is provided on 1.44 MB 3.5 in. diskettes.

Universal Signal Sources
2000 SERIES

Features

2000 SERIES APPLICATIONS

- Simulate Wireless
  - I & Q
  - Complex Modulation
  - Spread Spectrum
  - FSK, PSK, AM
  - Jitter Modulation
  - Mobile Communication
  - Digital Cellular
- Simulate Media
  - Disk Drive Read/Write
  - Peak Shift
  - Bit Drop Out
  - Servo Control
  - Mixed Signal ASICs
- Simulate Bio-medical
  - Physiological Responses
  - Heart Fibrillation
  - Blood Gas Content
  - EEG and EKG
- Simulate Network Physical Layer
  - Token Ring
  - Ethernet
  - ATM
  - SONET
  - Fax and Modems
- Avionics Simulation
  - Flight Characterization Flight Data Recorders
  - Instrument Launching Navigation Systems (ILS/MLS/VOR)
- Automotive Simulation
  - Engine Control Modules
  - Ignition Systems
  - Mechanical Vibration Analysis
  - Anti-lock Braking
  - Safety Retraining Systems


2000 Series

2000 Series Arb Overview

Standard function generators offer limited capability when compared to the robust capabilities offered in modern Arbitrary Generators. Today, in fact, we can consider the powerful 2000 Series Arbs as truly Universal Signal Sources. In addition to the Arb's ability to replace conventional generators in applications, Arbs also provide other powerful capabilities.

For example, designers must test their products to operate under the actual conditions which their design will encounter in the "real world." However, real world test signals are often not ideal and may have undesirable components or impurities. These conditions may be observed as either repetitive or infrequent amplitude and/or frequency anomalies. Modern Arbitrary Generators are ideally suited to simulate all of the signal conditions encountered including both ideal and anomalies.

NEW REGION SHIFT FUNCTION!
A new function called Region Shift has been added to the 2000 Series AWGs. This capability provides an editing technique for simulating timing impairments for testing a design's response to a variety of frequency, timing or phase violations. This capability uniquely allows the 2000 Series AWGs to simulate shift phenomena with up to 2 orders of magnitude finer resolution than what was previously available with older Arb designs. Today, with the 2000 Series, up to 4 ps timing resolution is available! This powerful new capability should hold significant appeal to most designers but especially to designers of magnetic media, physical layer, wireless and other products requiring jitter tolerance or timing shift testing.

REAL TIME SEQUENCE EDITOR
All 2000 Series AWGs now uniquely support Real Time waveform sequencing capability. Older Arb designs offer a sequence or a loop compiler which limits the maximum effective output points to the maximum record length of the instrument.

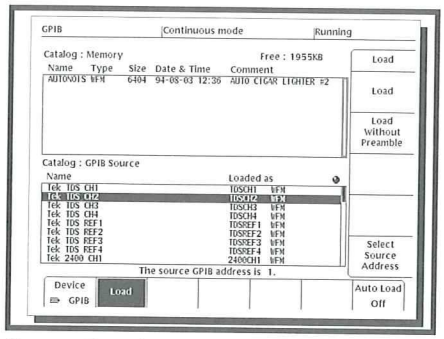
REAL TIME SEQUENCING
Sequencing extends the effective record length of the signal to over a billion points! Sequencing seamlessly transitions from one segment to the next with no discontinuities between segments. All segments in a sequence are executed from memory. Each segment can be repeated thousands of times with thousands of segments in a sequence. Using the Auto Step and Waveform Advance modes, users can modify the output of the arbitrary generator using an external event such as manual trigger, external trigger, GPIB, or RS-232.

Sequencer applications include serial or parallel pattern generation for digital test, building complex modulated signals such as FSK/PSK/PWM, magnetic media design/test, and filter design/test. The sequence editor is standard on the AWG 2040, AWG 2021 and AWG 2005.

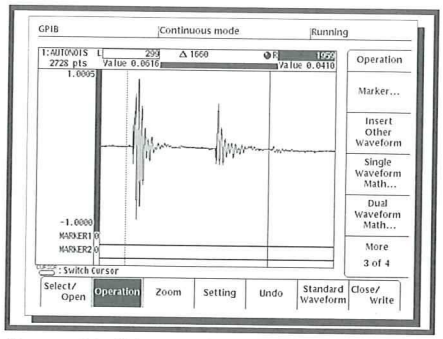
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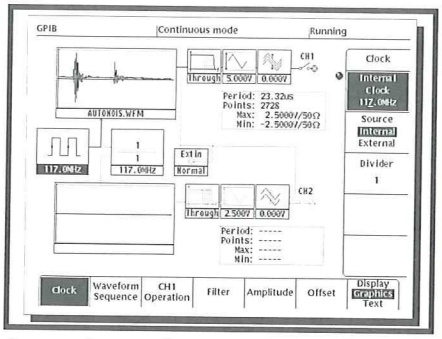
Universal Signal Sources
2000 SERIES



Step 1: Transfer waveform from a digital scope.



Step 2: Modify waveform using one of several built-in editors (in this example, the graphical editor).



Step 3: Output the signal with complete control over its parameters.

FFT EDITOR – (OPTION 09)
The FFT editor allows easy modification of waveform frequency and phase components. Six different FFT windows available include Rectangle, Triangle, Hanning, Hamming, Blackman, and Blackman-Harris. The filter menu allows the user to view the impact of a user-definable filter network on a waveform. The built-in limiter function provides noise-floor editing to eliminate frequency components below a user-definable magnitude level. Some examples where FFT capability is used are filter and motor control applications.

DIGITAL TIMING AND TABLE EDITOR
The combination of the timing and table editor with the optional AWG pattern generator port is ideal for digital circuit testing and control of ASICs, DACs, etc. The AWGs can perform as parallel Pattern Generators with data rates up to their full clock speed. The table editor allows the user to edit the signals in binary, hex, or decimal. The timing editor provides a "logic analyzer" style timing diagram for easy manipulation of digital data. The timing and table editor is standard on the AWG 2041, AWG 2021 and AWG 2005.

EQUATION EDITOR
The equation editor creates waveforms based upon polynomial formulas. This gives the user excellent flexibility to create waveforms based upon standard equations and to vary them easily by changing the formula. Examples of waveforms that can be created with the equation editor include 1F read head signals, SINX/X, damped sine waves, and exponential pulses. The equation editor is standard on the AWG 2041, AWG 2021 and AWG 2005.

MODULATION EDITOR
The built-in modulation editor makes creation of FSK, PSK, AM, FM or Offset modulated signals easy. For example, to create a 4-key FSK modulated signal, simply enter the frequencies and amplitudes of each key using a straightforward entry screen. The modulation editor is standard on the AFG 2020.

SWEEP EDITOR
The sweep editor allows generating linear logarithmic or user-definable sweeps by using a simple graphical editor. You see the effects of changing the parameters as you edit them. The sweep editor is standard on the AFG 2020 and is an option on the AWG 2005.

Common 2000 Series Characteristics

ENVIRONMENTAL
Temperature – Operating: +10°C to +40°C. Nonoperating: –20°C to +60°C.

Temperature Change – Operating: +15°C per hour (no condensation). Nonoperating: +30°C per hour (no condensation).

Humidity – Operating: 20% to 80% (no condensation). Nonoperating: 5% to 90% (no condensation).

Altitude – Operating: To 4.5 km (15,000 ft.). Maximum operating temperature decreases 1°C for each 300 m above 1.5 km. Nonoperating: To 15 km (50,000 ft.).

Vibration – Operating: 0.33 mm p-p, 10 Hz to 55 Hz for 15 minutes.

Shock – Nonoperating: 30 g (1/2 sine) 11 ms duration.

Bench Handling – Operating: Drop from 10 cm (4 in.) tilt or 45°, whichever is less.

EMC – Emissions: Within limits of FCC CFR 47, Part 15, Subpart B, Class A; VFG 243; EN55022, B; EN6055-2. Immunity: Within limits of IEC 801-3, IEC 801-2, IEC 801-4.

Electrical Discharge – Operating max test voltage: 15 kV (150 pF through 150 Ω).

Safety – Designed to meet UL 1244 and CSA 22.2 No. 231. EEC certified.

POWER
Source Power – Voltage Ranges: 90 to 127 V AC or 90 to 250 V AC. Line Frequency: 90 to 127 V, 48 to 440 Hz; 90 to 250 V, 48 to 63 Hz.

Maximum Current – 4 A at 50 Hz, 90 V.

Maximum Power Dissipation – 300 W.

Fuse Rating – UL 198.6 (3AG): 6 AFAST, 250 V. IEC 127:5 A (T), 250 V.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height (with feet)	164	6.4
Width (with handle)	362	14.3
Length (with front cover)	491	19.25
Length (with handle extended)	576	22.2
Weight	**kg**	**lb.**
Net	10.7	23.6

1 GS/sec Arbitrary Waveform Generator

New AWG 2041

Features

AWG 2041

- 1.024 GS/sec Clock Rate Provides up to 500 MHz Waveforms
- 1 MB Record Length (4 MB with Opt. 01)
- New Region Shift Function Provides 10 ps Edge Placement
- 8-Bit (1/256) Vertical Resolution
- Direct DSO Waveform Transfers
- Optional 8-Bit 1 GHz Digital Pattern Generator
- Built-in 1.4 MB PC-compatible 3.5 in. Floppy Disk for Storage and Transfer
- FFT Editor (Option 09) – Allows Editing in the Frequency Domain Real Time Waveform Sequencer
- Easily Create Automatic Test Sequences or Extremely Long Patterns
- Formula Entry of Parameters for Mathematically Precise Waveforms
- Fully Programmable from Front Panel, RS-232, or GPIB (IEEE 488.2)
- CE Certified

Applications

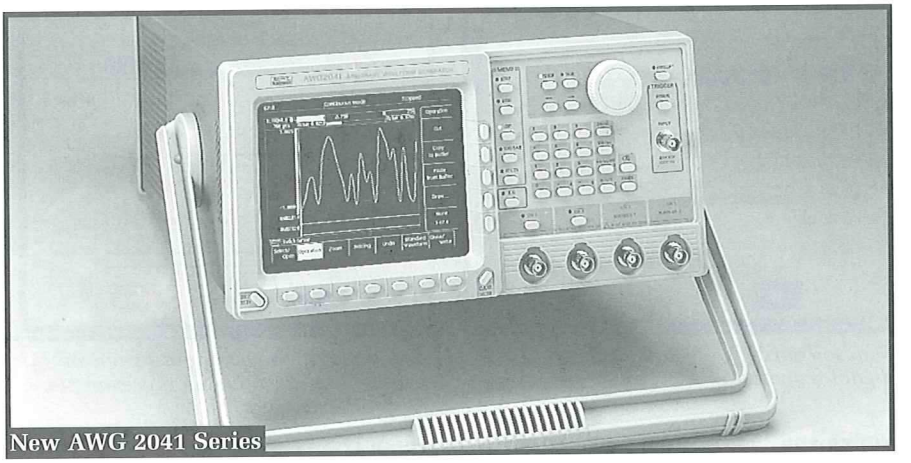
- Wireless Test
- Video
- Network Physical Layer Test
- Navigation
- Radar
- Computer Peripherals
- Electronic Warfare Simulation
- Converter Testing
- Filter Design

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488

All 2000 Series Arbs comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

See Tektronix on the World Wide Web: http://www.tek.com



New AWG 2041 Series

AWG 2041 Series Arbitrary Waveform Generator

The AWG 2041 is the world's fastest and deepest memory Arbitrary Generator with its 1 GS/s sample rate and 1 MB execution memory (4 MB, Option 01). As with the entire 2000 Series family, the graphical user interface allows on-screen viewing of waveform editing and simplifies "what-if" test scenarios by easily allowing the creation of composite signals.

The standard AWG 2041 configuration provides up to 2 V output or 4 V with the complementary output, each with 8 bits vertical resolution. Option 03 adds a 8-Bit-wide ECL digital port which can be used in conjunction with the marker outputs for pattern generation up to 10 bits wide at up to 1 GHz. The AWG 2041 now supports Real Time Sequencing capability similar to the AWG 2021.

The New Real Time waveform sequencer extends the effective record length output to over a billion points! The built-in frequency domain (FFT) editor (Option 09) is a perfect addition for customers performing modulation simulations, filter design or testing physical layer jitter tolerance, or for pulse mask testing.

The AWG 2041 easily simulates signals where fine point definition and long records are required for simulating very complex waveform conditions. Direct waveform transfer capability makes the AWG 2041 the perfect accessory for Tektronix DSOs or other vendor supplied DSOs.

Characteristics

STANDARD WAVESHAPES
Sine, square, triangle, ramp, pulse, arbitrary, linked sequence, and DC.

ARBITRARY WAVEFORMS
Execution Memory – Waveform: 1 Mwords (4 Mwords with Option 01). Marker: (2) 1 Mwords (4 Mwords x 2-Bits with Option 01). Waveform size: 32 points to 1 M (4 M with Option 01) in multiples of 32.

Real Time Sequencer Memory – 8 K individual waveforms.

Loop Counter –
Waveform: 1 to 64 K
Sequence: 1 to 64 K repeats.

CATALOG MEMORY CLOCK
Frequency Range – 1.000000 kHz to 1.024000 GHz.

Resolution – 7 digits.

Stability – 1 ppm/year (+15°C to ±25°C).

OPERATING MODES
Continuous – Output waveform/sequence continuous at programmed waveshape, frequency, amplitude, and offset.

Triggered – Output quiescent until triggered by an external, GPIB, or manual trigger; generates a waveform/sequence only one time.

Burst – Output quiescent until triggered by an external, GPIB, or manual trigger; then generates a waveform/sequence up to 65,536 times.

Gated – Same as continuous mode except period is executed only for the duration of the gated signal until the sequence started is completed.

Waveform Advance – Output quiescent until triggered by an external, GPIB, or manual trigger, then generates the waveform/sequence in the Sequence file. When the scan count reaches value, output stops and waits for next trigger.

1 GS/sec Arbitrary Waveform Generator

New AWG 2041

Auto Step – Continuously outputs the waveform/sequence in the Auto Step file; the next Auto Step Trigger (rear panel) advances the waveform/sequence.

Slave – Receives clock from a master arbitrary waveform generator for parallel operation.

MAIN OUTPUTS – CH 1 & COMPLIMENT

Digital-to-Analog Converter Resolution – 8-Bits.

Output Impedance – 50 Ω.

Output Voltage – –2.0 V to +2.0 V into 50 Ω (L/V differential).

Amplitude – Range: 20 mV to 2 V into 50 Ω. Resolution: 1 mV.

Offset – Range: –1.000 V to 1.000 V into 50 Ω. Resolution: 1 mV. Accuracy (20 mV Amplitude, 7F waveform data): ±(1% of offset + 5 mV).

Rise Time – Amplitude >1.0 V, ≤2.5 ns; Amplitude ≤1.0 V, ≤1.5 ns.

Fall Time – Amplitude >1.0 V, ≤2.5 ns; Amplitude ≤1.0 V, ≤1.7 ns.

Aberrations (at full BW) – Amplitude >1.0 V, within ±10%; Amplitude ≤1.0 V, within ±7%.

Flatness – Within ±3% after 50 ns from rise/fall edges.

Sinewave Characteristics (1 GHz clock, 32 waveform points, 31.25 MHz frequency, 1.0 V amplitude, no offset, no filter) – Harmonics: ≤45 dBc, DC to 400 MHz. Noise: ≤50 dBc, DC to 400 MHz. Phase Noise: –90 dBc/Hz at 10 kHz offset.

FILTERS

Type – Bessel low pass.

Risetime – 10 MHz: 35 ns, 20 MHz: 17 ns. 50 MHz: 7.0 ns. 100 MHz: 3.5 ns.

Delay from Marker – 10 MHz: 42 ns. 20 MHz: 22 ns. 50 MHz: 12 ns. 100 MHz: 7.0 ns. Through: 2.5 ns.

AUXILIARY OUTPUTS

Marker – Number of Markers: 2. Level: Hi/Lo, –2.0 V to 2.0 V into 50 Ω, –4.0 V to 4.0 V into 1 MΩ; Resolution, 0.1 V Accuracy: within ±0.1 V. Rise/Fall Time: <1 ns (at 1 V p-p). Connector: BNC.

Busy – Level: Positive TTL pulse (0 V to 5.0 V into 1 MΩ). Delay: <60 ns from Ext. Trig; <150 ns from CH 1. Output Resistance: 51 Ω. Connector: SMB.

Sync – Level: Positive TTL pulse (0 V to 5.0 V into 1 MΩ). Delay: <60 ns from Ext. Trig. Duration: 100 ns. Output Resistance: 51 Ω. Connector: SMB.

Master Clock – Level: ECL compatible (–1.620 to –0.810 into 50 Ω). Connector: SMB.

8-Bit ECL Digital Out (Option 03) – Output Signals: D0 to D7, Clock. Level: ECL compatible (–1.81 V to –0.810 V into 50 Ω). Skew Between Data: ±250 ps. Delay: Data to Marker: 2.0 ns; Clock to Data: 2.5 ns. Connector: SMB.

AUXILIARY INPUTS

Trigger – Threshold: Level, –5 V to +5 V; Resolution: 0.1 V; Accuracy: –(5% x Level + 0.1 V). Pulse Width: 10 ns minimum (0.2 V amplitude). Sensitivity: 0.2 V minimum (1 MHz square wave). Maximum Input: ±10 V p-p when 1 kΩ selected; ±5 V when 50 Ω selected. Impedance: 1 kΩ or 50 Ω. Trigger Holdoff: 500 ns maximum.

Stop Trig – Threshold Level: TTL Level. Pulse Width: 100 ns minimum. Maximum Input Volts: +5 V to 0 V. Delay: 100 ms maximum. Impedance: 10 kΩ. Connector: SMB.

Auto Step Trig – Threshold Level: TTL Level. Pulse Width: 100 ns minimum. Maximum Input Volts: +5 V to 0 V. Delay: 100 ms maximum. Impedance: 10 kΩ. Connector: SMB.

External Clock – Sensitivity: 400 mV p-p (–4.0 dBm). Maximum Input Volts: 1.0 V p-p (+4.0 dBm) DC ±20 V. Frequency: 10 MHz to 1.0 GHz. Delay External Clock to Marker: 13 ns.

Slave Clock – Threshold: ECL compatible (100 K). Maximum Input Volts: –2.0 V to 0.0 V. Frequency: 650 MHz to 1.0 GHz. Delay External Clock to Marker: 13 ns.

FUNCTION GENERATOR

Waveform Shape (predefined 100-point waveforms) – Sine, Triangle, Square, Ramp, Pulse (50 MHz filter is inserted when Sine is selected). Frequency: 1.000000 Hz to 10.00000 MHz. Accuracy: 1 ppm. Amplitude: 20 mV to 2 V into 50 Ω. Offset: –1.000 V to 1.000 V into 50 Ω. Polarity: Normal, Invert. Duty Cycle: 0% to 100%, Pulse only. Sine Flatness: Within –1 dB referenced to 100 kHz.

PROGRAMMABLE INTERFACE

GPIB – IEEE 488.2-1987 compatible.

RS-232 – 9-Pin D connector.

See page 383 for Environmental Characteristics.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

AWG 2041
1 GS/s Arbitrary Waveform Generator.
Includes: User/Programmer's Manual 070-8657-04, GPIB Programming Examples Disk, Sample Waveform Library Disk, Power Cable.

Opt. 01 – Increase Memory to 4 Mwords.
Opt. 03 – ECL Level Digital Output.
Opt. 09 – Add FFT Editor. Allows Editing Waveforms in the Frequency Domain.
Opt. 1R – Rackmount. Floppy Drive Access Moved to Front.
Opt. 1S – Adds WaveWriter™ Software.
Opt. B1 – Service Manual.
Opt. 95 – Cal Data Report.
Opt. 96 – Cal Certificate.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Opt. A5.

ACCESSORIES

Accessory Pouch – Order 016-1159-00.
Front Cover – Order 200-3232-00.
RS-232-C Cable – 9-Pin to 25-Pin. Order 174-1453-00.
Service Manual – Order 070-8963-00.
GPIB Cable – Order 012-0991-00.
SMB to BNC Cable – Order 012-1459-00.
SMB to BNC Adapter – Order 015-0554-00.
SMB Cable – Order 012-1342-00.

Upgrade Kits.

4 MB Memory – Order 040-1446-00.
FFT – Order 040-1445-00.
Rackmount Kit – Order 040-1444-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

250 MS/sec Arbitrary Waveform Generator

AWG 2021

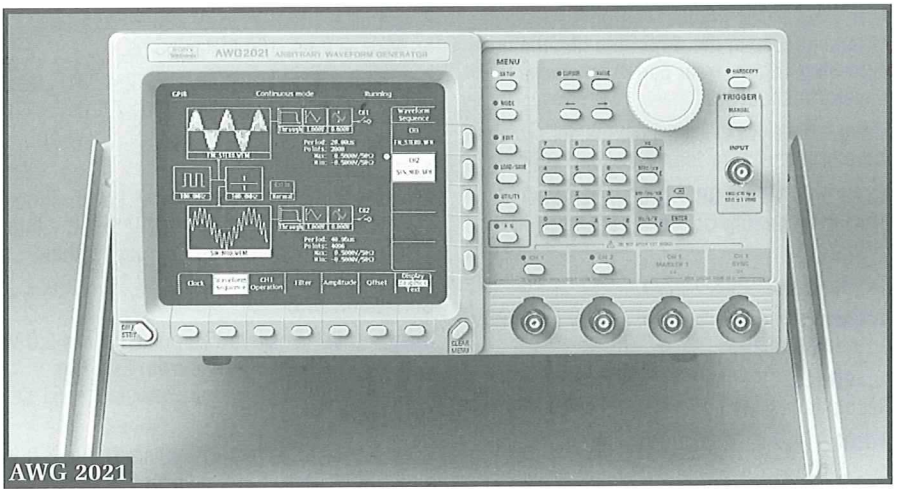
Features

AWG 2021

- 250 MS/s Clock Rate Provides up to 125 MHz Waveforms
- 256 K (262,144 Points) Record Length
- 12-Bit (1/4096) Vertical Resolution
- Direct DSO Waveform Transfers
- New Region Shift Function Provides 4 ps Edge Placement Capability
- Optional 12-Bit 250 MHz (ECL) or 12/24-Bit 100 MHz (TTL) Digital Pattern Generator
- Built-in 1.4 MB PC-compatible 3.5 in. Floppy Disk for Storage and Transfer
- FFT Editor (Opt. 09) Allows Editing in the Frequency Domain
- Real Time Waveform Sequencer
  – Easily Create Automatic Test Sequences or Extremely Long Patterns
- Formula Entry of Parameters for Mathematically Precise Waveforms
- Fully Programmable from Front Panel, RS-232, or GPIB (IEEE 488.2)
- CE Certified

Applications

- Analog & Digital Modulation
- Wireless Telecom
- Navigation
- Audio
- Video
- Computer Peripherals
- Automotive
- Converter Testing
- Filter Design



AWG 2021

AWG 2021 Arbitrary Generator

The AWG 2021 is our median performance product offering fast (250 MS/s) and deep memory (256K). As with the entire 2000 Series family, the graphical user interface allows on-screen viewing of waveform editing and simplifies "what if" test scenarios by easily allowing the creation of composite signals.

The standard AWG 2021 configuration provides one 5 V output or a second independent 5V output (Option 02) each with 12 bits vertical resolution. Frequency of channel 2 is also independently programmable. Option 03 adds a 12-Bit-wide differential ECL digital port which can be used in conjunction with the marker outputs for pattern generation up to 14-Bits-wide at up to 250 MHz. Or if you prefer, Option 04 provides TTL digital levels with up to (2) 12-Bit, 100 MS/s ports for a total of 28 bits wide.

The built-in frequency domain (FFT) editor (Option 09) is a perfect addition for customers performing proprietary or standard modulation simulations, filter design or in testing physical layer. Real time waveform sequencing extends the effective record length output to over a billion points!

The AWG 2021 easily simulates signals where moderate point definition and long records are required for simulating very complex waveform conditions. Direct waveform transfer capability makes the AWG 2021 the perfect accessory for Tektronix DSOs or other vendor supplied DSOs.

Characteristics

STANDARD WAVESHAPES
Sine, square, triangle, ramp, pulse, arbitrary, linked sequence, and DC.

ARBITRARY WAVEFORMS
Execution Memory – Waveform: 256 Kwords. Marker: 256 Kwords x 2-Bits. Data Points of Waveform Size: 64 to 256 K in multiples of 8.

Real Time Sequencer Memory –
8 K individual waveforms.
Loop Counter: 1 to 65,535 repeats.
Burst Mode Counter: 1 to 64 K cycles.

CATALOG MEMORY CLOCK
Frequency Range – 10 Hz to 250 MHz.

Resolution – 4 digit.

Accuracy – 50 ppm (+15°C to +30°C).

Skew between CH 1 and CH 2 (Option 02 only) – Within 4 ns.

OPERATING MODES
Continuous – Output continuous at programmed waveshape, frequency, amplitude, and offset.

Triggered – Output quiescent until triggered by an external, GPIB, or manual trigger; then generates a sequence only one time.

Gated – Same as triggered mode except period is executed only for the duration of the gated signal until the sequence started is completed.

Burst – Output quiescent until triggered by an external, GPIB, or manual trigger; then generates "n" sequences or cycles.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

250 MS/sec Arbitrary Waveform Generator

AWG 2021

Waveform Advance – Continuously generates the waveform in a predefined sequence; the next trigger advances to the next waveform in sequence.

Autostep – Generates the predefined waveform once in the Autostep File; the next trigger advances the waveform.

MAIN OUTPUT

Amplitude (excluding ADD and Multiply operation) – Digital-to-Analog Resolution: 1/4096 (12-Bits). Range: 0.05 V to 5 V p-p into 50 Ω. DC Accuracy: 0.05 V to 0.5 V, ±(0.5% of amplitude +5 mV); 0.501 V to 5 V, ±(1% of amplitude +25 mV).

Offset – Range: –2.5 V to +2.5 V into 50 Ω, (–100 mA to +100 mA). Resolution: 0.2 mA. Accuracy: ±(1% of offset +0.2 mA).

Pulse Response – +15°C to +30°C: Flatness, within 3% after 20 ns from rise/fall edges; Aberrations, within 7% +10 mV. +10°C to +40°C: Rise/Fall Time, <4.2 ns; Flatness, within 5% after 20 ns from rise/fall edges; Aberrations, within 9% +10 mV.

Impedance – Typically 50 Ω.

Sinewave (amplitude 1 V, 100 kHz reference) – Flatness: Within 4%. THD: 1.0 V, ≤50 dBc, 0.5 V, ≤66 dBc; Spurious: ≤66 dBc.

CHANNEL SUMMING (Option 02 only)

AM (Multiply) – Output: Within 5%. Frequency Response: DC to 30 MHz.

External AM – Sensitivity: 2 V p-p (±5%) signal produces 100% modulation. Frequency Response: CH 1, DC to 30 MHz; Ext. Signal, DC to 4 MHz.

Add – Output: Within 5%. Frequency Response: DC to 30 MHz.

FILTERS

3 dB Cutoff Frequency – 1 MHz: Within 20%. 5 MHz: Within 20%. 20 MHz: Within 20%. 50 MHz: Within 20%.

Delay – 1 MHz: Typically 390 ns. 5 MHz: Typically 78 ns. 20 MHz: Typically 18 ns. 50 MHz: Typically 11 ns.

AUXILIARY OUTPUTS

Markers 1 and 2 – Amplitude: 1 V ±0.3 V into 50 Ω. Impedance: 50 Ω. Marker to Signal Delay: Within 15 ns.

Sync – Amplitude: 1 V ±0.3 V into 50 Ω. Impedance: 50 Ω. Sync to Signal Delay: Within 15 ns.

Clock – Amplitude: 1 V ±0.3 V into 50 Ω. Impedance: 50 Ω.

Digital Data Out (Option 03) – Level: Differential ECL compatible. Output Signals: Data (D0 to D11). Skew Between Data: Within 1 ns. Clock to Data Delay: Within 3 ns. Connector: 68-Pin mini-D sub.

AUXILIARY INPUTS

Trigger – Threshold Level: –5 V to +5 V. Resolution: 0.1 V. Accuracy: ±(5% x Level + 0.1 V). Pulse Width: 15 ns minimum. Input Swing: 0.2 V minimum. Maximum Input Volts: 10 V p-p when 1 MΩ selected; 5 V RMS when 50 Ω selected. Impedance: 1 MΩ with 30 pF max. Trigger to Output Signal Delay: External Clock, 100 ns maximum +1 clock.

Trigger Holdoff – 5 µs maximum.

AM (Option 02 only) – Range: 2 V p-p (–1 V to +1 V) for 100% modulation. Maximum Input: ±5 V p-p, 10 kΩ impedance.

System Clock – Threshold Level: 0.3 V ±0.1 V. Input Swing: 0.8 V minimum. Pulse Width: 2 ns minimum. Maximum Input Voltage: ±2 V p-p. Impedance: 50 Ω. Frequency Range: Up to 250 MHz phase coherent.

PROGRAMMABLE INTERFACE

GPIB – IEEE 488.2-1987 compatible.

RS-232 – 9-Pin D connector.

See page 383 for Environmental Characteristics.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

AWG 2021
250 MS/s Arbitrary Waveform Generator. Includes: User/Programmer's Manual 070-9097-01/070-8657-04, GPIB Programming Examples Disk, Sample Waveform Library Disk, Power Cable.

Opt. 02 – Independent, 256 K Second Channel.

Opt. 03[*1] – 12-Bit, ECL Level Digital Out.

Opt. 04[*1] [*2] – 12/24-Bit, TTL Level Digital Out.

Opt. 09[*1] – Add FFT Editor. Allows editing waveforms in the frequency domain.

Opt. 1R – Rackmount. Floppy moved to front.

Opt. 1S – Adds WaveWriter™ Software.

Opt. 95 – Cal DAT Report.

Opt. 96 – Cal Certificate.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – United Kingdom 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.

ACCESSORIES

Accessory Pouch – Order 016-1159-00.

Front Cover – Order 200-3232-00.

RS-232-C Cable – 9-Pin to 25-Pin. Order 174-1453-00.

Rackmount Kit – Order 040-1444-00.

12-Bit Digital Cable (Opt. 04) – Order 174-3192-00.

12-Bit ECL 174 (Opt. 03) – Digital Cable.

GPIB Cable – Order 012-0991-00.

*[*1] Options 03, 04, and 09 are mutually exclusive.*

*[*2] 12-Bits with single channel, 24-Bits with dual channel (Opt. 02).*

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

20 MS/sec Arbitrary Waveform Generator

AWG 2005

Features

AWG 2005

- 20 MS/s (50 ns) Clock Rate Provides up to 10 MHz Waveforms
- Up to Four Channels of 64 K Record Length
- 12-Bit (1/4096) Vertical Resolution
- Direct DSO Waveform Transfers
- New Region Shift Provides 50 ps Edge Placement
- 24-Bit Channel, TTL Digital Data Pattern Generator (Opt. 04)
- Linear Log and User Definable Sweep Generation (Opt. 05)
- Built-in 1.4 MB PC-compatible 3.5 in. Floppy Disk for Storage and Transfer
- FFT Editor (Opt. 09) Allows Editing in the Frequency Domain
- Real Time Waveform Sequencer
  – Easily Create Automatic Test Sequences or Extremely Long Patterns
- Formula Entry of Parameters for Mathematically Precise Waveforms
- Fully Programmable from Front Panel, RS-232, or GPIB (IEEE 488.2)
- CE Certified

Applications

- Analog & Digital Modulation
- Sonar Testing
- Proprietary Modulation
- Transducer Simulation
- Motor Control
- Automotive
- Industrial
- Sensors



AWG 2005 Arbitrary Waveform Generator

The AWG 2005 is our best value product and offers 20 MS/s and 64 K deep memory. As with the entire 2000 Series family, the graphical user interface allows on-screen viewing of waveform editing and simplifies "what if" test scenarios by easily allowing the creation of composite signals.

The standard AWG 2005 configuration provides two independent 10 V outputs or a third and fourth 10 V output (Option 02) each with 12 bits vertical resolution. Option 04 adds TTL digital levels with (2) 12-Bit, 100 MS/s ports and combines with the marker outputs to provide a total of 28 bits wide.

The built-in sweep generator provides even more flexibility by offering linear and logarithmic swept frequencies, but even more significantly the AWG 2005 has user definable sweep capability. This allows creation of digitally modulated signals at IF frequencies.

The built-in frequency domain (FFT) editor (Option 09) is a perfect addition for customers performing proprietary or standard I & Q modulation simulations, filter design or in testing physical layer. Real time waveform sequencing extends the effective record length output to over a billion points!

The AWG 2005 easily simulates signals where moderate point definition and long records are required for simulating complex waveform conditions. Direct waveform transfer capability makes the AWG 2005 the perfect accessory for Tektronix DSOs or other vendor-supplied DSOs.

Characteristics

STANDARD WAVESHAPES
Sine, square, triangle, ramp, noise, arbitrary, linked sequence, and DC.

ARBITRARY WAVEFORMS
Execution Memory – Waveform: 64 K (65,535) for each channel. Marker: 64 K for each channel. Waveform Size: 16 to 64 K in multiples of 16.

Real Time Sequence Memory – 8 K individual waveforms.

Loop Counter – Waveform: 1 to 64 K repeats. Sequence: 1 to 64 K repeats.

Catalog Memory – 2 MB.

CATALOG MEMORY CLOCK
Frequency Range – 0.01 Hz to 20 MHz.

Resolution – Standard: 4 digits. With Option 05: 7 digits.

Accuracy – Standard: 50 ppm (+15°C to +30°C). Option 05: 5ppm (+15°C to +30°C).

OPERATING MODES
Continuous – Output waveform/sequence continuous at programmed parameters.

Triggered – Output quiescent until triggered by an external, GPIB, or manual trigger; generates a waveform/sequence only one time.

Gated – Same as continuous mode except period is executed only for the duration of the gated signal until the sequence is completed.

Seq/Wfm Advance – Continuous: Continuously outputs the waveform/sequence in the Sequence file. The next trigger advances to the next waveform/sequence. Step: Output quiescent until triggered; then execute the next waveform/sequence in the Sequence file. When the loop count reaches its value, output stops and waits for next trigger.

Auto Step – Continuous: Continuously outputs the waveform/sequence in the Auto Step file. Step: Output quiescent until triggered.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

20 MS/sec Arbitrary Waveform Generator

AWG 2005

Master – Provides Point Rate Clock and Trigger to a slave arbitrary waveform generator for phase synchronous parallel operation.

Slave – Receives Clock and Trigger from a system clock for parallel operation.

MAIN OUTPUT

Digital-to-Analog Resolution – 12-Bits.

Output Impedance – 50 Ω.

Amplitude (1 MHz clock, 000 and FFF waveform data, norm, no filter, no offset, excluding and ADD operation) – Range: 0.05 V to 10 V p-p into 50 Ω. Resolution: 1 mV (4 digits). DC Accuracy: 0.050 V to 0.999 V, ±(0.5% of amplitude + 5 mV); 1.000 V to 10.000 V, ±(1% of amplitude + 50 mV).

Offset – Range: –5.0 V to +5.0 V into 50 Ω (–200 mA to +200 mA). Resolution: 5 mV (4 digits). Accuracy (1 MHz clock, 7FF waveform data, norm, no filter, amplitude range 0.05 V): –±(1% of offset + 10 mV).

Pulse Response (20 MHz clock, 000 and FFF waveform data, norm, no filter, amplitude 5 V, no offset) – Rise/Fall Time: <35 ns. Flatness: Within ±3% after 150 ns from rise/fall edges. Aberrations: Within ±7%.

Cross Talk Between Channels – 512-point sine, 20 MHz clock, norm, no filter, amplitude offset. <70 dBc.

Noise Floor – 20 MHz clock, 7FFF waveform data, norm, no filter, no offset. 0.5 V: ≤110 dBm/Hz at 1 MHz. 5.0 V: ≤95 dBm/Hz at 1 MHz.

Sinewave Characteristics – Function Generator mode, 100 Hz to 200 kHz, no offset. Flatness (1 V amplitude, 1 kHz reference): Within –4%. T.H.D. (Including up to 4th harmonics): ≤55 dBc at 5.0 V.

AUXILIARY OUTPUTS

Marker – Amplitude: >2 V into 50 Ω. Impedance: 50 Ω. Marker to Signal Delay: 35 ns.

Clock – Amplitude: >2 V into 50 Ω. Impedance: 50 Ω.

Control Sig. – Amplitude: >2 V into 50 Ω. Impedance: 50 Ω.

Sweep (Option 05) – Waveshape: Same waveshape as selected sweep. Amplitude: 0 to 5 V (amplitude is dependent upon start and stop frequencies with a 5 V maximum limit). Impedance: 600 Ω.

24-Bit TTL Digital Out (Option 04) – Output Signals (CH 1 and CH 2): D0 to D11, Clock. Level: TTL. Amplitude: >2 V into 50 Ω. Skew Between Data: Within ±10 ns. Clock to Data Delay: Within ±10 ns. Impedance: 50 Ω.

AUXILIARY INPUTS

Trigger – Threshold Level: –5 V to +5 V. Resolution: 0.1 V. Accuracy: ±(5% of Level + 0.1 V). Minimum Pulse Width: 150 ns. Minimum Input Swing: 0.2 V p-p. Maximum Input Volts: ±10 V (DC + peak AC). Impedance: 10 kΩ. Trigger to Signal Delay: Internal Clock, 400 ns (excluding clock sweep mode).

AM (512-point sine, 20 MHz clock, AM, no filter, 5 V amplitude, no offset) – Range: 2 V p-p (–1 V to +1 V) for 100% modulation. Amplitude Accuracy: Within 5%. Maximum Input Volts: –5 V (DC + peak AC). Impedance: 10 kΩ.

ADD (512-point sine, 20 MHz clock, ADD, no filter, 5 V amplitude, no offset) – Range: 10 V p-p (–5 V to +5 V). Amplitude Accuracy: Amplitude specification plus 5%. Maximum Input Volts: –5 V (DC + peak AC). Impedance: 50 Ω.

Control Sig. – Threshold Level: TTL level (0.8 V to 2.0 V). Minimum Pulse Width: 40 ns. Maximum Input Volts: 5 V to 0 V. Impedance: 10 kΩ.

Clock – Threshold Level: TTL level (0.8 V to 2.0 V). Minimum Pulse Width: 20 ns. Maximum Input Volts: 5 V to 0 V. Impedance: External Clock, 330 Ω; Slave Mode, 10 kΩ. Frequency Range: 1 Hz to 20 MHz.

Sweep (Option 05 only) – Type: Linear, log, arbitrary. Mode: Continuous, triggered, gated. Update Rate: 1 s to 65,535 ms. Points per Sweep: 8 K maximum.

FUNCTION GENERATOR

Waveform Shape – (Predefined 100 pt. waveforms). Sine, Triangle, Square, Ramp, Pulse (1 MHz filter is inserted when Sine is selected).

Frequency – 1.000 Hz to 200 kHz.

Duty Cycle – 0% to 100%, Pulse only.

PROGRAMMABLE INTERFACE

GPIB – IEEE 488.2-1987 compatible.

RS-232 – 9-Pin D connector.

See page 383 for Environmental Characteristics.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

AWG 2005
Programmable Arbitrary Waveform Generator.
Includes: User/Programmer's Manual 070-8958-00/070-8657-03, GPIB Programming Examples Disk, Sample Waveform Library Disk, Power Cable.

Opt. 02 – Add Two Channels (Four Total).
Opt. 04 – 24-Bit, TTL Level Digital Out*[1].
Opt. 05 – Add Clock Sweep.
Opt. 09 – Add FFT Editor.
Allows editing waveforms in the frequency domain*[1].
Opt. 1R – Rackmount. Floppy Drive Access Moved to Front.
Opt. 1S – Adds WaveWriter™ Software.
Opt. B1 – Service Manual.
Opt. 95 – Cal Data Report.
Opt. 96 – Cal Certificate.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Opt. A5.

ACCESSORIES

Accessory Pouch – Order 016-1159-00.
Front Cover – Order 200-3232-00.
RS-232-C Cable – 9-Pin to 25-Pin. Order 174-1453-00.
Service Manual – Order 070-8958-00.
Rackmount Kit – Order 040-1444-00.
GPIB Cable – Order 012-0991-00.
50 Ω BNC Cable – Order 012-1342-00.
12-Bit Word Generator Cable (Opt. 04) – Order 174-3192-00.
SMA to BNC Adapter – Order 015-0544-00.
50 Ω Termination – Order 011-0049-01.

[1] Opt. 04 and 09 are mutually exclusive.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

Arbitrary Function Generator

AFG 2020

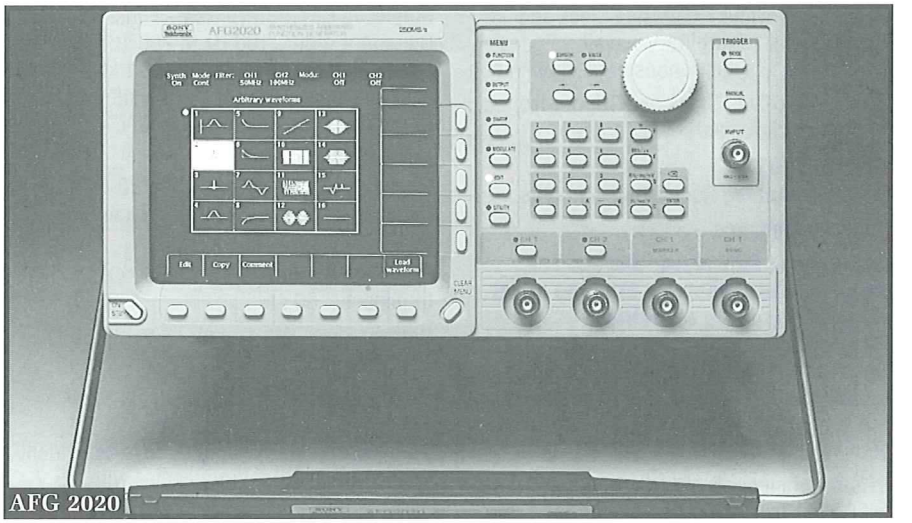
Features

AFG 2020

- 250 MS/s (4.0 ns) 1 ppm Clock
- DDS Synthesized Function Generation
- 10 Digits Frequency Resolution
- 100 MHz Sinewave
- 50 MHz Square Wave
- 31.2 MHz Triangle, Ramp, and Pulse
- Built-in Modulation Capabilities Including:
  – AM/FM/PSK/FSK Amplitude and Offset Modulation
- Linear/Log Sweep
- Optional Second Channel (Opt. 02)
- Sixteen Separate User-definable Waveforms with 1 K (1024 Points) Record Length
- Direct DSO Waveform Transfers
- CE Certified

Applications

- Wireless Telecom
- Complex Modulation Simulation
- Standard Signal Generation (e.g., Sine, Square, etc.)
- Agile Frequency Stimulus
- Phase Shift Key
- Frequency Shift Key
- Amplitude Shift Key



AFG 2020 Arbitrary Generator

The AFG 2020 (Arbitrary Function Generator) differs from the AWGs because it is an excellent function generator first, with some arbitrary capabilities built in. It uses DDS (direct digital synthesis) to create extremely pure standard sine, square, ramp and triangle signals at higher frequencies, resolution and stability. The AFG 2020 has PSK, FSK, AM, FM and Offset modulation and sweep built in. The AFG 2020 is targeted at Telecom users or users who need an excellent function generator first and an arbitrary generator second.

Characteristics

STANDARD WAVESHAPES
Sine, square, triangle, ramp, pulse, and arbitrary.

FREQUENCY/PHASE
Clock – 250 MHz, 4.0 ns, 1 ppm.

Frequency – 10 digits.

Range – Sine, 0.5 Hz to 100.00 MHz (Synthesizer on). Square, 0.500 Hz to 50.00 MHz; Other, 0.500 Hz to 31.2 MHz (Synthesizer off).

Resolution – 0.5 Hz. Accuracy: ±(Reference Oscillator Accuracy + 0.12 Hz).

Period – 2.0 sec to 4.0 ns (Synthesizer on).

Phase – 4 digits.

Range – ±360°. Resolution: 0.1°.

AMPLITUDE/OFFSET
Amplitude – 4 digits.

Resolution – 0.4 V p-p, 1 mV p-p; 2 V p-p, 2 mV p-p; 10 V p-p, 10 mV p-p.

Max. Amplitude – 10 V p-p into 50 Ω; 20 V p-p open circuit.

DC Accuracy – Range: 0.4 V p-p, ±(1.0% of setting +1 mV p-p); 2.0 V p-p, ±(1.0% of setting +5 mV p-p); 10 V p-p, ±(2.5% of setting +50 mV p-p).

Resolution – 0.4 V p-p, 1 mV; 2 V p-p, 2 mV; 10 V p-p, 10 mV.
Max. Offset: ±5 V into 50 Ω; ±10 V open circuit. Accuracy: 0.4 V p-p, ±(1.0% of setting +1 mV), 2.0 V p-p, ±(1.0% of setting +5 mV); 10 V p-p, ±(2.5% of setting +50 mV).

Noise Floor – Range: 0.4 V p-p, –128 dBm/Hz at 10 MHz; 2.0 V p-p, –114 dBm/Hz; 10 V p-p, –100 dBm/Hz.

SSB Phase Noise – Synthesizer on: –90 dBc/Hz. Synthesizer Off: –80 dBc/Hz.

Harmonics – See Data Sheet.

SQUARE
Accuracy – DC accuracy ±2% + Flatness.

Rise/Fall Time – With 50 MHz LPF: Within 9.0 ns. With Full Pass: Within 4.0 ns.

Aberrations – With 50 MHz LPF: 0.4 V p-p and 2 V p-p, within 5% + 2 mV p-p; 10 V p-p, within 7% + 10 mV p-p. With Full Pass: 0.4 V p-p and 2 V p-p, within 7% + 2 mV p-p; 10 V p-p, within 12% + 10 mV p-p.

TRIANGLE
Amplitude – Flatness with 50 MHz LPF: ≤100 kHz, ±2.0%; ≤2.5 MHz, –7.0%; ≤15.6 MHz, –20%; ≤31.2 MHz, –40%.

RAMP
Timing – Rise/Fall: 4 digits, 0% to 100% of period.

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GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

Arbitrary Function Generator

AFG 2020

Amplitude – Flatness with 50 MHz LPF: ≤100 kHz , ±2.0%; ≤2.5 MHz, –8.0%; ≤15.6 MHz, –25%; ≤31.2 MHz, –45%.

PULSE

Pulse Width – 20% to 50.0% of period.

Transition – 0% to 35.0% of pulse width.

Amplitude – Flatness with 50 MHz LPF: ≤100 kHz , ±2.0%; ≤2.5 MHz, –5.0%; ≤15.6 MHz, –5.0%; ≤31.2 MHz, –20%.

ARBITRARY

Maximum Points – Any periodic waveform described with 12-Bits and 1024 points.

Number of Waveforms – 16.

SWEEP

Type – Linear, log.

Frequency – 5 digits. Start, stop: Sine, 1.0 Hz to 100 MHz; Others, 1.0 Hz to 2.5 MHz.

Step (Linear) – Within 2.5 MHz, 5 digits.

Dwell Time – 4 digits. Sweep: 0.5 µs to 100 sec. Return: 0.5 µs to 100 sec.

Marker – Number: 3. Frequency: Between Start and Stop. Time: 0.5 µs to 100 sec.

Maximum Period – 2048 seconds ≤Sweep + Return Time.

MODULATION

Amplitude Modulation (Internal and External) – Amplitude: 4 digits, –10.00 V p-p to +10.00 V p-p. External CH 2 Amplitude: 1 V p-p. Depth: 3 digits, 0 to 100%. Double Sideband Suppressed Carrier: ON/OFF. Modulation Rate: Period, 10 µs to 1 sec every 0.2 µs. Accuracy: ±0.1%. Rise Time: Within 2 µs. AM Noise: Within 1% of range.

Offset Modulation (Internal) – High, Low: 4 digits, –5.000 V p-p to +5.000 V p-p. Modulation Rate: Period, 10 µs to 1 sec every 0.2 µs; accuracy, ±0.1%. Rise Time: Within 2 µs. Modulation Noise: Within 1% of range.

Frequency Modulation (Internal) – Center Frequency: 9 digits. Deviation: 6 digits. Modulation Rate: Period, 10 µs to 1 sec every 0.2 µs; accuracy, ±0.1%.

Frequency Shift Keying (FSK) (Internal) – Key: Number of Keys, 2 to 256: Frequency, within 100 MHz (sine); Amplitude, within 10 V p-p; Offset, within ±5 V. Data: Number of Data, 2 to 2,048. Frequency Transition Time: 4 ns. Data Rate: 1 to 2,500,000; Period, 1 sec to 0.4 µs, every 0.1 µs.

Phase Shift Keying (PSK) (Internal) – Key: Number of Keys, 2 to 256: Phase, within ±360.0°; Amplitude, within 10 V p-p; Offset, within ±5 V. Data: Number of Data, 2 to 2,048. Phase Transition Time: 800 ns (200 clocks). Data Rate: 1 to 50,000; Period, 1 sec to 20 µs, every 0.1 µs.

MAIN OUTPUT

Filters – 100 MHz Brick Wall: Within 1 dB to 100 MHz; less than –40 dB, 125 MHz to 1 GHz. 50 MHz Linear Phase: –3 dB ±0.5 dB at 50 MHz.

Output Impedance – 50 Ω.

AUXILIARY OUTPUTS

Sync Output – Positive TTL level. Min. Pulse Width: 400 ns. Output Impedance: 51 Ω nominal.

Marker Output – Positive TTL level. Min. Pulse Width: 100 ns. Output Impedance: 51 Ω nominal.

10 MHz Clock Output – TTL level square wave. Duty Cycle: 50% to 75%. Output Impedance: 51 Ω nominal.

AUXILIARY INPUTS

Trigger/Gate In – Sensitivity: 200 mV p-p min. Bandwidth: DC to 10 MHz. Amplitude: 30 ns, 200 mV p-p amplitude. Input Impedance: 1 kΩ ±5%. Max. Input Voltage: ≤10 V DC + peak AC. Range: ±9.90 V. Resolution: 0.1 V. Accuracy: ±10% ±100 mV.

AM Input – Input Impedance: 10 kΩ ±5%. Max. Input Voltage: 10 V DC + peak AC.

REF CLOCK IN – TTL compatible. Range: 10 MHz ±10 kHz. Input Impedance: 10 kΩ ±5%. Max.

OPERATING MODES

Continuous – Generates the waveform continuously.

Triggered Continuous – Output quiescent until triggered by an external, GPIB, or manual trigger; then generates a sequence after pre-defined delay and stops by STOP command or GPIB command.

Gated – Same as triggered mode except period is executed after the pre-defined delay for the duration of the gated signal. The last sequence started is completed.

Time Burst – Output quiescent until triggered by an external, GPIB, or manual trigger; then generates sequences or cycles for defined time duration.

PROGRAMMABLE INTERFACE

GPIB – IEEE-488.2-1987 compatible.

See page 383 for Environmental Characteristics.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

AFG 2020
Programmable Arbitrary Function Generator.
Includes: User/Programmer's Manual 070-8659-00/070-8660-00, GPIB Programming Examples Disk, Power Cable.
Opt. 02 – Add Second Channel.
Opt. 1R – Rackmount Configuration.
Opt. 1B – Service Manual 070-8661-00.
Opt. 1S – Adds WaveWriter™ Software.
Opts. A1 - A5 – International Plug Options.
Opt. 95 – Cal Data Report.
Opt. 96 – Cal Certificate.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of Repair Protection.
Opt. C5 – Adds five years of Calibration Services.

ACCESSORIES

Accessory Pouch – Order 016-1159-00.
Front Cover – Order 200-3232-00.
GPIB Cable – Order 012-0991-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

Signal Sources
ADS

Features

ADS

- Two Independently Programmable Synthesis Channels
- 12-Bit Amplitude Resolution
- 64 K-point Waveform Memory per Channel
- 25-MHz Read Clock
- Output Voltage of 0.1 mV to 10 V p-p into 50 Ω
- –5 V to +5 V DC Offset
- Sine Synthesis with High Spectral Purity (0.1 Hz to 5 MHz)
- Triangle Wave Generation with High Linearity (0.1 Hz to 100 kHz)
- User-programmable Waveforms Comprising 2 to 65,536 Points
- Arb Sequence Mode for Generating Signals with Extremely Long Periods
- User-programmable Frequency Sweep Covering a Maximum of 8191 Arbitrary Frequencies
- Non-volatile Memory for Storing 20 Instrument Setups as Well as up to 99 Arb Signals, Arb Sequences, and Arb Sweeps
- Memory Card
- Digital Output
- IEC/IEEE Bus (SCPI)

Applications

- Digital Modulation
- Communications
- Automatic Test Equipment
- Component and Materials Testing
- Audio and Acoustics Measurements
- Ultrasound Measurements
- Filter Design
- Video Applications
- Control and Automotive Engineering
- Sensors



Precise Signal Simulation

The signals required for effective tests on highly sophisticated electronics – from ICs to complete systems – often cannot be produced by conventional function generators, or if they can, they only approximate the real-world signal. The synthesis capabilities of the ADS provide the means of generating exact replicas of those signals which are encountered under real conditions. This means that products can be tested under conditions that are as close to real-world as possible. So, problems which might otherwise be missed can be ironed out.

The ADS has a second independent channel. Consequently, it is ideal for developing and testing modern communication equipment which requires two precise signals for driving I/Q modulators. For digital modulation, the ADS is the ideal signal source, as it has a high clock frequency, high amplitude resolution, and precise channel synchronization. Application software such as IQSIM provides flexible digital filtering, making the provision of hardware filters unnecessary.

WAVEFORM EDITOR

The waveform editor is a highly convenient tool for handling synthesis and modifying any waveform or application-specific sweep. Previously, this could only be done using external computers with the appropriate software. The complete waveform library stored by the user in internal memory can be accessed and is available for editing.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Signal Sources
ADS

SEQUENCE MODE
In this mode, Arb signals can be joined to give a single continuous programmed sequence. By assigning a repetition rate to any element in the sequence, it is possible to create sequences that use a fraction of the memory capacity required for conventional Arb synthesis. Each element in the sequence can be assigned an individual read-clock frequency; in this way, "stretched" Arb signals can be included in the sequence. The sequence editor is used for programming and modifying Arb sequences.

DRIVING I/Q MODULATORS
The ADS is a high-precision signal source which is ideal for driving I/Q modulators. It is particularly well suited for driving the I/Q modulator in the SMHU58 Signal Generator (see page 269). The advantage of the ADS over modulation-specific coders is that all modulation parameters – especially filter parameters – can be varied via software.

VHF STEREO SIGNALS
Precise signal synthesis enables the generation of complex stereo multiplex signals. Stereo multiplex signals can be calculated very easily using the optional AWD-K1 Application software and transferred to the ADS via the IEC/IEEE bus.

VIDEO TEST PATTERNS
The ADS offers the means to generate virtually any type of video signal. All parameters such as line-repetitive, field-repetitive, and color subcarrier frequency can be freely selected. ADS thus allows measurements to be made on video systems that deviate from existing standards or testing of new systems during the development phase.

Characteristics

SIGNAL OUTPUT
Output Impedance – 50 Ω.

Output Voltage (AC) –
Range V_{p-p}: 0 to 20 V (EMF, I_{max} = ±100 mA); 0 to 10 V (into 50 Ω).
Resolution: 3 1/2 digits, 0.1 mV minimum.
Error at 1 kHz, V_{p-p} > 10 mV: <±0.2 dB (±0.1 dB typical)/50 Ω.
Non-interrupting Level Setting Range: >40 dB typical.

DC Offset –
Setting Range: –5 to +5 V (into 50 Ω).
Resolution: 3 digits, 10 mV minimum.
Error: <±0.2 dB + residual offset.
Residual offset <±20 mV ±1% of level setting.

WAVEFORMS
Standard Waveforms – Sine, triangular.

User-definable Waveforms – Single Arb curves or composite Arb curves.

Sine –
Frequency Range: 0.1 Hz to 5 MHz.
Frequency Resolution: 1 Hz.
Frequency Error (after 20 minute warmup): $<4 \times 10^{-5}$ + aging error.
Frequency Error Due to Aging: $<1 \times 10^{-5}$ per year.
Frequency Response Flatness: <0.5 dB.
THD: <–60 dB (–70 dB typical).
Harmonic and Non-harmonic Spurious Signals (100 kHz to 2 MHz, offset 0 V): <–60 dB.

Triangular –
Frequency Range: 0.1 Hz to 500 kHz.
Frequency Resolution: 1 Hz.

Phase Setting –
Setting Range CH 1/CH 2: –180° to +180°.
Resolution: 0.02° minimum.

Trigger Operating Modes – Frequency shift keying (FSK), phase shift keying (PSK), pulse modulation (PM), reset, hold, hold/reset.

Sweep Modes – Digital, user-programmable frequency and phase sweeps, triggered internally, triggered externally, triggered manually.
Frequency Range: 1 Hz to 5 MHz with user-selectable step width, 1 Hz minimum.
Phase Range: –180° to +180° with user-selectable step width, 0.02° minimum.
Step Time: Internal is 1 µs to 2,000 s.
External is 100 ns minimum.
Sweep Marker: User-selectable within sweep limits.

User-programmable Waveforms –
Curve Length: 2 to 65,536 points, composite Arb sequences.
Amplitude Resolution: 12-Bits.
Rise/fall Time: <9 ns (10/90%).
Settling Time: <30 ns (1%) typical.
Overshoots: <5% (filter off).

Clock Source (CLK) –
Internal: Output impedance is 50 Ω. Signal is HCT/TTL compatible. Read frequency is 400 points/s to 25 Mpoints/s. Resolution is 40 ns minimum. Frequency error (after 20 minute warmup) is $<4 \times 10^{-5}$ + aging error.
Frequency error due to aging is $<1 \times 10^{-5}$ per year.
External: Input impedance is 50 Ω/600 Ω, selectable. Input signal is ±0.5 to ±5 V.
Frequency range is DC to 33 MHz.

Filters –
Modified Bessel Filters (3rd order): 10 kHz, 100 kHz, 1 MHz, 2.5 MHz.
Modified Chebishev Filters (7th order): 500 kHz, 5 MHz.

ARB SEQUENCES
Sequence Length – 2 to 8,191 Arb curves.

Repetition Rate for Single Arb Curves –
1 to 65,535, programmable for each curve.

Expansion Factor – (1 to 65,535) x clock period, programmable for each curve.

TRIGGER
Trigger Source – Internal, external, manual.

Internal Trigger Generator –
Output Impedance: 50 Ω.
Signal: HCT/TTL compatible.
Trigger Period: 1 µs to 2,000 s.
On/off Ratio: Adjustable, 1:6500 to 6500:1.
Resolution, ON/OFF time: 500 ns minimum.

External Trigger –
Input Impedance: 50 Ω/600 Ω, selectable.
Trigger Threshold: 0.2 V/2.0 V, selectable.
Trigger Edge: Rising or falling edge can be selected.
Trigger State: Switchable to active low or active high.
Frequency: DC to 25 MHz.
Manual Trigger – With MAN key.

MEMORY
Internal Memory –
Size: 320 KB, non-volatile.
Storage Capacity: 20 complete front-panel setups plus combination of 100 Arb curves maximum, 100 Arb sequences maximum, and 100 sweeps maximum.

Memory Card – Size: 128 KB.

Signal Sources
ADS

INPUTS/OUTPUTS
Front Panel –
OUTPUT 1: CH 1 signal output, 50 Ω impedance, over-voltage protection to ±40 V DC.
OUTPUT 2: CH 2 signal output, 50 Ω impedance, over-voltage protection to ±40 V DC.
MARK 1: Marker output for CH 1, BNC connector, 50 Ω impedance, HCT/TTL compatible.
MARK 2: Marker output for CH 2, BNC connector, 50 Ω impedance, HCT/TTL compatible.
CLK 1: Clock input/output for CH 1, BNC connector (see Clock specifications).
CLK 2: Clock input/output for CH 2, BNC connector (see Clock specifications).
TRIGGER 1: Trigger input/output for CH 1, BNC connector (see Trigger specifications).
TRIGGER 2: Trigger input/output for CH 2, BNC connector (see Trigger specifications).

Rear Panel –
DIGITAL OUTPUT 1: Digital waveform output for CH 1, 25-contact connector, 12-Bit + CLK, HCT/TTL compatible.
DIGITAL OUTPUT 2: Digital waveform output for CH 2, 25-contact connector, 12-Bit + CLK, HCT/TTL compatible.
Z-MARKER 1: Z-marker output for CH 1, BNC connector, output voltage ±15 V nominal, 1 kΩ impedance.
Z-MARKER 2: Z-marker output for CH 2, BNC connector, output voltage ±15 V nominal, 1 kΩ impedance.
LEV CTRL 1: Input for CH 1 external level control signal, BNC connector, 50 Ω impedance.
LEV CTRL 2: Input for CH 2 external level control signal, BNC connector, 50 Ω impedance.

REMOTE CONTROL
Remote-controllable Functions – All functions that can be set manually from the front panel except EDIT, power on/off, and variation knob.

POWER REQUIREMENTS
Line Voltage – 100/230 V AC, –10/+15%; 120/220 V AC, –15/+10%.

Line Frequency – 47 to 420 Hz.

Power Consumption – 150 VA maximum.

Safety – Class I to VDE 0411 (IEC 348).

ENVIRONMENTAL CHARACTERISTICS
Operating Temperature – 0 to +55°C.

Storage Temperature – –40 to +70°C.

Mechanical Stress – Shock tested to DIN 40046, part 7 (30 G, 11 ms) and vibration-tested to DIN 40046, part 8 (5 to 55 Hz, 2 g), meets IEEE Publ. 68-2-27 and 68-2-6.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Height	192	7.56
Width	435	17.1
Depth	350	13.8
Weight	**kg**	**lb.**
Net	14	30.9

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

ADS
25 ms/s Arbitrary Waveform Generator.
Includes: Power Cord, Protective Cover, Manual.

Opt. 1/ADS–B1 – Clock Generator. Read frequency, 200 points/s to 33,334 Mpoints/s; Resolution, 0.01% (10 ps minimum); Input/output frequency, 5 or 10 MHz selectable; Aging, $<1 \times 10^{-5}$/month; Temperature effect, $\leq 5 \times 10^{-6}$/°C; Output level, >0.2 V into 50 Ω; Input level, 0.2 V to 2 V into 50 Ω or HCT/TTL.

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – United Kingdom 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.

See Customer Information Section for additional description.

SERVICE ASSURANCE OPTIONS
Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

RECOMMENDED ACCESSORIES
See page 434 for complete selection information.

Memory Card – Order CMS-Z2.

ARB Application Software – Order AWD-K1.

Service Kit – Order ADS-Z2.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ
Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).

Logic Sources

Logic Sources

The concept of "real-world" signals has often been associated with Arbitrary Generators; however, digital applications also have a need to simulate both ideal and "real-world" conditions. For this reason, Tektronix offers a variety of Logic Sources. Each of these products is designed to provide digital signals with precise edge placement and amplitudes to meet a variety of digital stimulus needs.

HFS SERIES STIMULUS SYSTEM

These instruments offer the features of a high performance pulse generator and offer data generation capabilities as well. It is based on a Tektronix modular architecture which makes it easy to configure and maintain a digital stimulus system. This instrument supplants the need for switching matrices and DC power supplies. Logic levels are available directly at the outputs with no need for Auxiliary Pods. These programmable instruments allow more flexibility in pulse edge placement and control, including duty, period, repetition rate, and transition times. In addition, each channel has powerful independent skew control capabilities. This makes the HFS ideal for precise high performance characterization and evaluation applications.

DAS AND TLA SERIES TEST SYSTEM

The design and debug of new multiprocessor systems with faster clocks, wider buses, and longer memories require complete solutions to hard-to-find problems. These Tektronix modular architectures make it easy to configure and maintain a complete digital test system including controller, acquisition, probing and software. Multiple data acquisition and stimulus cards can be added to the system. Cards may be grouped to form subsystems which allow you to create virtual instruments or to increase channel widths. These instruments offer powerful analysis capability in non-workstation environments.

VXI

The VXI modular architecture makes it easy to design and maintain an application specific test system. In your test system you may choose from a wide array of products that provide the specific set of features you need without paying for unusable capabilities for your test stand. When it comes time to expand or modify your test system, the card modular format makes it easy to incorporate the new capabilities.

Tektronix offers a wide variety of other complementary instrument cards to fully satisfy both your stimulus and acquisition. Whatever your application requires, either analog or digital, Tektronix has the solution.

TEKTRONIX

	92S16 Pattern Generator Module	92SX109 Pattern Generator Module	HFS 9DG2 Data Time Generator
Package Style	TLA 500 Module	TLA 500 Module	HFS 9003 Module
Max. Data Rate	50 MBPS	100 MBPS	630 MBPS
Period	20 ns~	10 ns~	1.6 ns~20 µs
Resolution	(1-2-5 step)	–	–
Output Channels	18/Module (max: 36)	9/Module (max: 18)	4/Module (max: 16)
Pattern Depth	1 K	2 K	64 K
Looping	Yes 2 kstep/256 segment	Yes	No
Ext. Jump	Yes	Yes	No
Output(V)(Open)	max: 5.2 V p-p	max: 5.2 V p-p	max: 5.50 V
Tr/Tf	<3.5 ns	TTL (<3.5 ns) ECL (<2.2 ns) <note:20~80%>	800 ps~6 ns
Output Connector	Pin header	Pin header	SMA
Timing Control	Full	Full	Full
Resolution	1 ns	1 ns	1 ns

CONTENTS

HFS 9003 396
HFS 9009 396
DAS Series 134
TLA Series 130
VXI Series 371, 373

Programmable Stimulus System

HFS 9003 • HFS 9009 • HFS 9DG1 • HFS 9DG2

Features

HFS 9000 SERIES

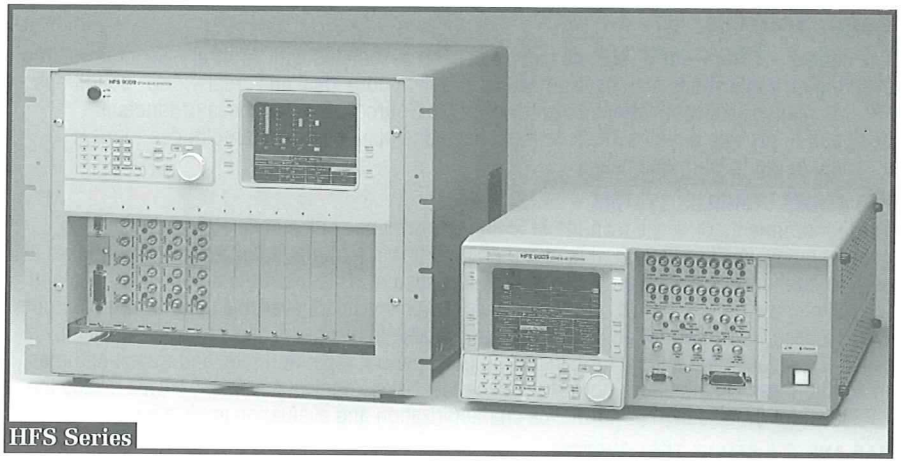
- Complete Stimulus Setup in Just Minutes
- Specify Data and Timing on Every Pin
- Up to 630 MHz Repetition Rate
- Fully Digital Implementation
- Multi-channel Architecture
  – Up to 640 or More Phase-locked Channels
- Independent Edge Placement
- Channel Deskew
- Precision Channel-to-channel Timing Alignment
- 1 ps Timing Resolution
- GPIB (IEEE 488) Programmable
- Modular Construction

BENEFITS

- Upgrade Capability
- Maximum Control and Flexibility

Applications

- Characterize CMOS, ECL, ACL, BiCMOS, and GaAs Devices



HFS Series

HFS 9000 STIMULUS SYSTEM

When product designs were simple, and time-to-market not so critical, designers could afford the days, or even weeks, necessary to assemble, program, debug and characterize the various elements of a stimulus system and its fixturing. As product design complexity and market pressures have increased, however, designers of high-speed, high-performance circuits simply cannot afford this expenditure in time.

Now there's a solution. With Tektronix HFS 9000 Stimulus Systems we've taken the features of a high-performance pulse generator, made them better, and added complete data generation capabilities as well. We've eliminated the need for a switch matrix since we have data and timing on every pin. And the need for a separate power supply is gone, as the HFS 9000 has the ability to produce the DC levels needed to drive logic lines directly. Finally, all these capabilities are present on every pin simultaneously, so you get extremely flexible formatting. Now you can set up a complete stimulus system in minutes, rather than hours or days, and test products more thoroughly throughout the development cycle.

DIGITAL ARCHITECTURE

The HFS 9000 Series products were designed as completely programmable digital instruments rather than being based on traditional monostable analog architecture. This allows more capability and flexibility in pulse edge placement without the restrictions that analog instruments commonly impose. Now you can adjust both Delay and Width from 0 to 20 µs over all frequencies.

MODULAR DESIGN

You can build a stimulus system with from four to 36 channels in one mainframe, and 640 or more channels across multiple phase-locked mainframes. Choose from the HFS 9003 mainframe with three-slot, 12-Channel capability, or the HFS 9009 mainframe with nine-slot, 36-Channel capability. Both systems can include the 4-Channel HFS 9DG1 and HFS 9DG2 Data Time Generator cards in any combination.

All channels are slaved to a common clock, resulting in highly accurate channel-to-channel edge placement. This makes the HFS 9000 ideal for precise characterization and evaluation of synchronous devices having multiple, and possibly interactive, inputs.

FULL CHANNEL DESKEW CAPABILITY

All HFS 9000 channels have independent, wide deskew ranges to allow precise pulse alignment and timing at the device under test (DUT). Deskew compensates for the timing differences caused by cabling and fixturing so your analysis can be focused on the relative timing at the DUT.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 *Tektronix Measurement products are manufactured in ISO registered facilities.*

Programmable Stimulus System

HFS 9003 • HFS 9009 • HFS 9DG1 • HFS 9DG2

1 PS TIMING RESOLUTION

No other system lets you generate whatever combination of signals is required, with data and timing on every pin with 1 ps resolution. Now you can create data buses, clocks, strobes, gated clocks, logic level sources, pseudorandom bits and other stimuli with unequaled accuracy. You can perform setup and hold time margin tests by providing the clock, data, set and reset signals to the DUT. And you can hold inactive signals at programmable high or low logic levels, eliminating the need for external DC voltage sources and microwave switches.

630 MHZ REPETITION RATE

Accurate and repeatable AC measurements of prop delay, setup and hold time, and maximum operating frequency (fmax) require fast rep rates and edge speeds. With repetition rates up to 630 MHz, the HFS 9000 is ideal for characterizing the most advanced logic families, and it can be used for testing component compliance with the SONET telecommunications standard. Transition times as fast as 250 ps (20%–80%) enable repeatable and accurate testing of the highest-speed ECL and GaAs digital devices. Variable transition time control from 800 ps to 6 ns is also available with the appropriate output levels for testing advanced CMOS, BiCMOS and TTL logic families.

EASY EDITING OF SETUPS AND VECTORS

Edit setups and vectors easily with BitWriter™ Software. With this Microsoft® Windows based package you can build a complete test setup, including timing parameters, voltage levels, channel assignment and test vectors on your PC. Ideal for remote test development. Individual setups and test vectors can be uploaded and stored when the HFS 9000 has multiple users.

FULLY PROGRAMMABLE

Programmability is important in developing automated, repeatable tests in R&D, incoming inspection, and production of high-speed components. Therefore, the HFS 9000 offers full implementation of the new IEEE 488.2 standard and utilizes Tektronix Codes and Formats. GPIB/RS-232 ports provide for remote, fully programmable control. Coupled with a high-speed acquisition system, such as the 11801B Digital Sampling Oscilloscope, or the most advanced logic analysis system on the market – the Tektronix DAS 9200 Digital Analysis System – a fully automated test system can be developed with unequaled accuracy and repeatability.

PHASE LOCK MODE

Phase lock-in allows the internal time base to be phase-locked to an external frequency source. This "supercharger" capability can be used to augment the speed performance of automated component test systems by creating synchronized signals as fast as 630 MHz.

CONFIGURATION OPTIONS

Card-modular design lets you adapt to any logic family from within the same mainframe. Choose the HFS 9DG1 Data Time Generator card for 630 MHz bandwidth and <250 ps fixed rise time. The 9DG1 provides four channels of stimulus. This card is ideal for ECL and GaAs device characterization.

Or, choose the HFS 9DG2 Data Time Generator card for up to 315 MHz bandwidth and variable transition times from 800 ps to 6 ns. The 9DG2 provides four channels of stimulus. This card is ideal for simulating TTL, CMOS and BiCMOS logic signals.

Combine these cards in any combination for testing a broad range of components or systems with mixed logic families.

APPLICATIONS

From verifying critical parameters to full characterization, from developing manufacturing test vectors on the bench to phase-locked at-speed testing in conjunction with production test systems, the HFS 9000 Data Time Generator simplifies the process while adding unmatched capabilities. You can, for example, create complex stimuli that are impossible with other systems. Download test vectors and timing parameters to the HFS 9000 to set up worst-case conditions and to stimulate each pin in isolation. Vary voltage levels, pulse widths and timing relationships independently for each channel. Mix high-speed and variable transition time modules to fit your logic family, and obtain channel counts unavailable in any other discrete instrument.

The Data Time Generator also provides a new dimension of assistance in characterizing pattern sensitivity. It provides the data stream while also creating the varying signal levels, timing relationships or signal characteristics required to detect pattern sensitivity across worst-case operating conditions.

Capabilities like these allow you to perform full characterizations on the first run, lowering your development costs and reducing your time to market.

Characteristics

Level Resolution – 0.01 V.

HIGH Level Accuracy – ±2% of level ±50 mV.

LOW Level Accuracy – ±2% of HIGH level ±2% of amplitude ±50 mV.

Output Aberrations (200ps after 50% pt.) –
Overshoot: +15% +20 mV.
Undershoot: –10% –20 mV.

TIME BASE PERFORMANCE

Frequency Range – 50 kHz to 630 MHz.

Frequency Resolution – ≤0.1% of programmed value.

Frequency Accuracy – ±1% of programmed value.

RMS Jitter – 15 ps ±0.05% of interval.

PHASE LOCK IN Frequency Range – 6 MHz to 630 MHz.

PHASE LOCK IN Amplitude Range – 0.8 V to 1.0 V p-p.

Output Frequency Range – any 2^n multiple or submultiple of PHASE LOCK IN frequency. Must remain inside the allowed frequency range for installed cards.

FRAME SYNC IN – Initiates a burst when using PHASE LOCK IN external frequency reference.

Continued on next page.

Programmable Stimulus System

HFS 9003 • HFS 9009 • HFS 9DG1 • HFS 9DG2

OUTPUT PERFORMANCE

	HFS 9DG1	HFS 9DG2
Outputs	4 differential	4 single-ended
Maximum HIGH level	+5.00 V	+5.50 V
Minimum LOW level	–2.50 V	–2.00 V
Max p-p amplitude	3.00 V	5.50 V
Min p-p amplitude	0.01 V (10 mV)	0.01 V (10 mV)
Output transition time (20% to 80%)	<250 p (≤1 V p-p)	variable 800 ps to 6 ns

OUTPUT EDGE PLACEMENT PERFORMANCE

Channel Deskew Range – Minus 60 ns to 2.0 µs.

Channel Deskew Resolution – 1 ps.

DELAY Adjust Range – 0 to 20 µs.

DELAY Adjust Resolution – 1 ps.

DELAY Accuracy – 1% ±50 ps.

WIDTH Adjust Range – 0 to 65,536 times one period.

WIDTH Adjust Resolution – 1 ps.

WIDTH Accuracy – HFS 9DG1: 1% of width ±50 ps; HFS 9DG2: 1% of width +50 ps –250 ps.

TRIGGER INPUT PERFORMANCE

Input Resistance – 50 Ω.

Input Voltage Range – ±5 V maximum.

Programmable Threshold Range – –4.70 V to +4.70 V.

Programmable Threshold Resolution – 100 mV.

Programmable Threshold Accuracy – ±100 mV ±5% of level.

Minimum Input Pulse Width – 1 ns.

Input Rise/Fall Time Requirement – ≤10 ns.

Sensitivity – ≤500 mV.

POWER REQUIREMENTS

Line Voltage Ranges – 90 V AC to 130 V AC RMS, and 180 V AC to 250 V AC RMS; range switched automatically for HFS 9003 (factory configured for HFS 9009).

Line Frequency – 48 Hz to 63 Hz.

Power Consumption –

	HFS 9003	HFS 9009
Maximum	540 W	900 W
Typical	400 W	750 W

ENVIRONMENTAL

Temperature – Operating: 0° to +50°C (HFS 9003); 0° to +40°C (HFS 9009). Nonoperating: –40° to +75°C.

Humidity – –10°C to +30°C up to 95% relative humidity. 30°C to 40°C up to 75% relative humidity.

Altitude, Shock Nonoperating, Bench Handling – Meets MIL-T-28800C, Type III, Class 5.

PHYSICAL CHARACTERISTICS

HFS 9003	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	414	16.3	483	19.0
Height	178	7.0	178	7.0
Depth	629	24.75	629	24.75
Weight*1	**kg**	**lb.**	**kg**	**lb.**
Net	20.5	45.0	23.2	51.0
Shipping	27.3	60.0	30.0	66.0

**1 Maximum configuration.*

HFS 9009	Cabinet	
Dimensions	**mm**	**in.**
Width	426	16.75
Height	356	14.0
Depth	610	24.0
Weight	**kg**	**lb.**
Net	36.8	81.0
Shipping	45.5	100.0

HFS 9DG1, HFS 9DG2	Cabinet	
Dimensions	**mm**	**in.**
Width	51	2.0
Height	267	10.5
Depth	356	14.0
Weight	**kg**	**lb.**
Shipping	1.36	3.0

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

HFS 9003
3-Slot Mainframe.
Includes: User Reference Manual; Service Reference Manual; Power Cord; RS-232 Pigtail; SMA-BNC Adapter; Zip-Lock Pouch; Two Replacement Fuses; and One 50 Ω SMA Coaxial Cable.

Opt. 1R – Rackmount.

HFS 9009
9-Slot Mainframe.
Includes: User Reference Manual; Service Reference Manual; Power Cord; RS-232 Pigtail; SMA-BNC Adapter; Zip-Lock Pouch; Two Replacement Fuses; and One 50 Ω SMA Coaxial Cable.

ACCESSORIES
See page 434 for Cables, Adapters, and Terminators.

HFS 9DG1
Four differential data time outputs per card with <250 ps transition time, 630 MHz.
Includes: Installation Instructions and Two Clock Cables.

HFS 9DG2
Four single-ended data time outputs per card with 800 ps to 6 ns variable transition time.
Includes: Installation Instructions and Two Clock Cables.

S85HFS1 – BitWriter™ Software.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – United Kingdom 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

See Customer Information Section for additional description.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

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ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION *Tektronix Measurement products are manufactured in ISO registered facilities.*

Basic Bench Test Instruments

Tektronix has a complete line of low-cost bench test instruments for both basic and advanced test benches: triple output power supplies, digital and programmable multimeters, function generators, and multifunction counters.

Instrument and operator safety are all-important. Tektronix TM250 and TM2500 Series instruments comply with independent safety certification standards established by UL, CSA, or ETL.

The TM Series instruments are covered by a one year warranty.

Power Supplies

The CPS250 power supply is a versatile instrument with one fixed and two variable outputs. Two switchable analog meters and switchable outputs operating independently, in series, or in parallel, make this power supply ideal for lab and field work. If your needs require programmability, look at our PG2500 Series power supplies.

Digital Multimeters

Tektronix digital multimeters measure AC and DC voltage, current and resistance. The DM2510 and DM2510G Digital Programmable Multimeters provide exceptional accuracy and speed, especially in repetitive testing situations. The DM2510G has a GPIB interface for computerized remote operation and data capture.

Function Generators

Tektronix TM250 Series Function Generators produce TTL signals and square sine, and triangle waves for testing amplifiers, filters, and digital circuits. The frequency range of these Tektronix instruments runs from 0.1 Hz to 11 MHz. Sweep functions can be controlled internally or by an external signal.

The CFG280 includes a 1 Hz to 100 MHz integral counter.

Multifunction Counters

Tektronix benchtop counters accurately measure the frequency of sine, square and triangle waves. The counters span the frequency range from 1 Hz to 1.3 GHz; several counters also provide period, totalize, frequency ratio, and time interval measurements.

The CDC250 and CMC251 have a temperature-compensated time base to ensure accurate performance in changing ambient conditions. Service technicians will find these two meters useful as standards for calibrating other equipment.

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200 Series 108

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Handheld Digital Multimeters

New CMM150 • New DMM150 • DMM155 • DMM157

Features

NEW DMM150/NEW CMM150

- Autoranging
- Analog Bar Graph
- 3,200 Counts Display
- 0.7% Basic Accuracy
- Voltage and Resistance Measurement
- Current Measurement with CMM150

DMM155

- Autoranging
- 2,000 Counts Display
- 0.7% Basic Accuracy
- Current Measurement

DMM157

- Autoranging
- 2,000 Counts Display
- 0.5% Basic Accuracy
- Current and Capacitance Measurement



New CMM150/New DMM150/DMM155/DMM157

DMM150/CMM150
The DMM150 is great for one-handed operation and measurements in tight places. With the optional CMM150 Clamp Probe, it also measures AC current.

See page 402 for characteristics.

DMM155
The DMM155 is designed for indoor/outdoor service of electrical equipment. It has functions to satisfy the needs of most hobbyists.

DMM157
The DMM157 is ideal for the service technician or student who needs a rugged, multifunction product with good accuracy at a reasonable price.

See page 402 for characteristics.

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

Handheld Digital Multimeters

New DMM247 • New DMM249 • DMM252 • DMM254 • DMM353

Features

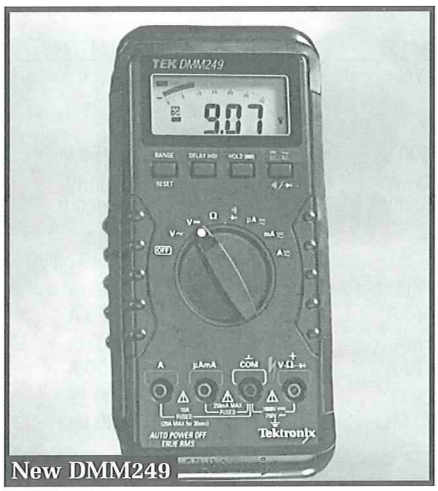
DMM247
- 3,200 Count Autoranging
- 0.3% Basic Accuracy
- Voltage and Resistance Measurement

DMM249
- True RMS Measurement
- 3,200 Count Autoranging
- 0.3% Basic Accuracy
- Voltage, Resistance and True RMS Measurement

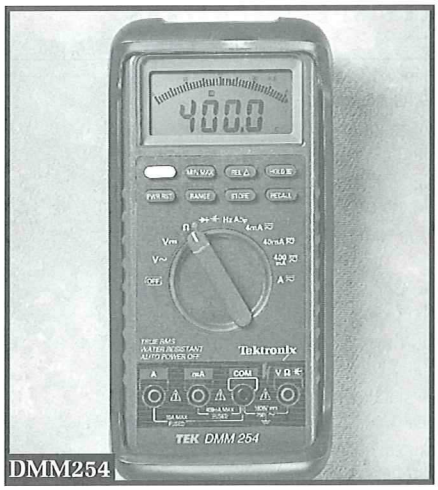
DMM252
- 4,000 Count Autoranging
- 0.1% Basic Accuracy
- Frequency Measurement
- Capacitance Test

DMM254
- True RMS Measurement
- 4,000 Count Autoranging
- 0.1% Basic Accuracy
- Frequency Measurement
- Capacitance Test

DMM353
- 0.5% Basic Accuracy
- Capacitance Measurement
- Resistance Measurement
- SCR Go/No-Go Test



New DMM249

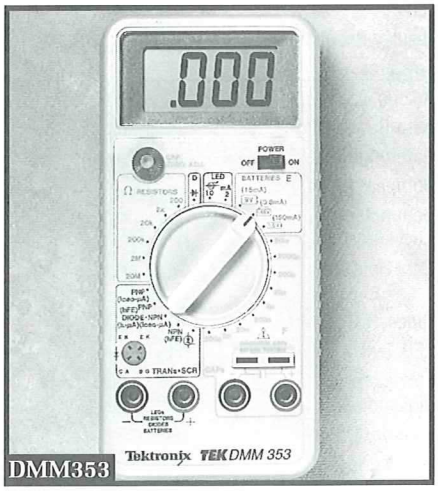


DMM254

DMM247/DMM249
The DMM247 and DMM249 are rugged state-of-the-art meters enclosed in dust and water resistant cases. The DMM249 also provides True RMS measurement function. See page 402 for characteristics.

DMM252/DMM254
The DMM252 and DMM254 are designed for the professional who needs full function capabilities with exceptional accuracy. The DMM254 also provides precise True RMS measurement of all AC signals. See page 402 for characteristics.

DMM353
The DMM353 Capacitance Meter and Component Checker is an indispensable tool for the electronic service technician. With several ranges for versatility, it tests capacitance, resistance, trimmers, URS, diodes, LEDs, transistors, SCRs, batteries and more. See page 402 for characteristics.



DMM353

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

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Tektronix Measurement products are manufactured in ISO registered facilities.

Handheld Digital Multimeters

CMM150 • DMM150/155/157 • DMM247/249/252/254

KEY SPECIFICATIONS

	CMM150/DMM150	DMM155	DMM157	DMM247/249	DMM252	DMM254	DMM353
Basic DC Volts Accuracy	0.7%	0.7%	0.5%	0.3%	0.1%	0.1%	(0.5% R & C)
AC Voltage Ranges	3 V to 600 V	2 V to 600 V	2 V to 600 V	3 V to 750 V	400 mV to 750 V	400 mV to 750 V	–
DC Voltage Ranges	300 mV to 600 V	200 mV to 600 V	200 mV to 600 V	300 mV to 1000 V	400 mV to 1000 V	400 mV to 1000 V	–
True RMS AC	–	–	–	Yes (DMM249 only)	–	Yes	–
AC Current Ranges	300 A max.	2 mA to 10 A	2 mA to 10 A	300 µA to 20 A	4 mA to 10 A	4 mA to 10 A	–
DC Current Ranges	–	2 mA to 10 A	2 mA to 10 A	300 µA to 20 A	4 mA to 10 A	4 mA to 10 A	–
Resistance Ranges	300 Ω to 30 MΩ	200 Ω to 20 MΩ	200 Ω to 20 MΩ	300 Ω to 30 MΩ	400 Ω to 40 MΩ	400 Ω to 40 MΩ	200 Ω to 20 MΩ
Capacitance Ranges	–	–	2 µF to 200 µF	–	4 nF to 40 µF	4 nF to 40 µF	200 pF to 20 mF
Frequency Ranges	– –	–	–	–	100 Hz to 1 MHz	100 Hz to 1 MHz	–
Display Resolution	3200 counts	2000 counts	2000 counts	3200 counts	4000 counts	4000 counts	2000 counts
Features							
Analog Display	Yes	–	–	Yes	Yes	Yes	–
Auto Power Off	Yes	Yes	Yes	Yes	Yes	Yes	–
Autoranging	Yes	Yes	Yes	Yes	Yes	Yes	–
Compare Mode	–	–	–	–	Yes	Yes	–
Continuity Check/Beeper	Yes	Yes	Yes	Yes	Yes	Yes	–
Data Hold	Yes	Yes	Yes	Yes (and Delay Hold)	Yes	Yes	–
Diode Test	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LED Test	–	–	–	–	–	–	Yes
Low Battery Indicator	Yes	Yes	Yes	Yes	Yes	Yes	–
Memory Offset	–	Yes	Yes	–	Yes	Yes	–
Overrange Indication	Yes	Yes	Yes	Yes	Yes	Yes	–
Safety Certification	Yes	Yes	Yes	Yes	Yes	Yes	NA
SCR Test	–	–	–	–	–	–	Yes
Transistor Leakage ICEO Test	–	–	–	–	–	–	Yes
Transistor hFE Test (PNP or NPN)	–	–	–	–	–	–	Yes
Water-resistant Case	–	–	–	Yes	Yes	Yes	–

Handheld Digital Multimeters

CMM150 • DMM150 • DMM155 • DMM157 • DMM252 • DMM254 • DMM353

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

DMM150
Pen Meter.
Includes: Test Leads, Battery, User Manual.

CMM150
AC Clamp Probe.

DMM247
Handheld Digital Multimeter.
Includes: Test Leads, Two AAA Batteries, User Manual, Holster.

OPTIONAL ACCESSORIES (DMM247 AND DMM249)
Fuses – Fast Blow.
1 A/600 V. Order 159-0337-00.
15 A/600 V. Order 159-0287-00.

DMM353
Component Checker.
Includes: Right-angle Test Leads, Spare Fuse, 9 Volt Battery, Operator's Manual.

OPTIONAL ACCESSORIES (DMM353)
Holster – Order 118-8733-00.
Soft Carrying Case – Order 118-8338-00.

DMM155/DMM157/DMM249/DMM252/DMM254
Handheld Digital Multimeter.

All Include: Test Leads, 9 V Battery, User Manual, Holster.

OPTIONAL ACCESSORIES (DMM155/DMM157/DMM147/DMM149/DMM152/DMM154)
Soft Carrying Case – Fits with holster removed. Order 016-1385-00.

SERVICE ASSURANCE OPTIONS
These products covered by the following service assurance options:

REP4100 – Provides one year of post-warranty Repair Protection.

CAL4100 – Provides one year of Calibration Services.

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

See Tektronix on the World Wide Web: http://www.tek.com

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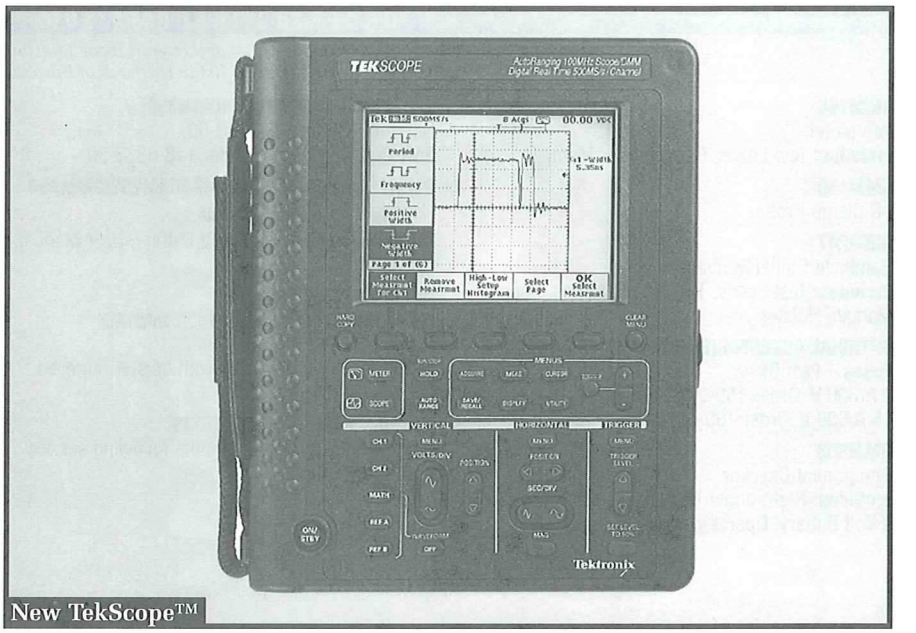
Handheld Digital Oscilloscopes

TekScope™ Series • New THS 720 • New THS 710

Features

THS 720 AND THS 710

- 100 and 60 MHz Bandwidths
- 500 and 250 MS/s per Channel
- Sampling Rates
- 2 Channels with 2 Digitizers
- 3-3/4 Digit DMM with Datalogger
- Hands-Free Autoranging
- Roll Mode
- Extra Bright Backlit Display
- 8 ns Glitch Capture
- Independently Floating Isolated Channels
- Pulse Width and Video Triggers
- NiCd Battery and AC Adapter
- 21 Automatic Measurements
- RS-232 Programmability
- Deluxe Soft Case



New TekScope™

THS 700 Series Handheld Digital Oscilloscopes

The TekScope™ Series combines a full-featured Digital Real-Time oscilloscope with a True RMS digital multimeter in rugged, battery-operated instruments. Scope and meter modes can operate simultaneously and independently on the same or separate signals. The high-resolution, backlit display and pop-up menus make it easy for users to take full advantage of the instrument's many features. These include cursors, video trigger, voltage and resistance measurements, and storage of waveforms, data, and instrument setups.

Characteristics

	THS 720	THS 710
Bandwidth	100 MHz	60 MHz
Sample Rate (Each Channel)	500 MS/s	250 MS/s
Time/Division Range	5 ns to 50 s/div	10 ns to 50 s/div

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Handheld Digital Oscilloscopes

TekScope™ Series • New THS 720 • New THS 710

OSCILLOSCOPE SPECIFICATIONS

Channels – 2.

Sensitivity – 5 mV to 50 V/div (to 500 V/div with 10X probe).

Position Range – ±10 div.

DC Gain Accuracy – ±2%.

Vertical Resolution – 8-Bits.

Record Length – 2500 points.

Horizontal Accuracy – ±200 ppm.

Roll Mode – ≥ 0.5 s/div.

Autorange – User-selectable.

Trigger Modes – Auto, Normal.

Trigger Types – Edge, Pulse, Video.

Video Trigger Formats and Field Rates – Triggers on Field 1, Field 2, or Lines.

Waveform Processing – Add, Subtract, Multiply, Calculate Watts = V x I.

Waveform Storage – 10 waveforms.

Acquisition Modes – Sample, Envelope, Average, Peak Detect.

Cursor Measurements – ΔVolts, ΔTime, and 1/ΔTime.

Cursor Types – Horizontal Bars, Vertical Bars, Paired (volts @ time).

Display System –
Interpolation: Sin(x)/x.
Mode: Vector, Dot, Vector Accumulate, Dot Accumulate.
Format: YT and XY.

Automatic Measurements –

Period	Frequency
+Width	Rise Time
–Width	Fall Time
+Duty Cycle	+Overshoot
–Duty Cycle	–Overshoot
High	Max
Low	Min
Peak-to-Peak	Amplitude
Mean	RMS
Cycle Mean	Cycle RMS
Burst Width	

DMM SPECIFICATIONS

DC Voltage Ranges – 400.0 mV to 880 V.

DC Volts Accuracy – ±(0.5% of rdg + 5 cts).

True RMS AC Voltage Ranges – 400.0 mV to 640 V.

Maximum Float Voltage – 600 V RMS each channel.*1

Resolution – 4000 count, 3-3/4 digits.

AC Volts Accuracy – ±(2% of rdg + 5 cts).

Resistance Ranges – 400.0 Ω to 40.00 MΩ.

Resistance Accuracy – ±(0.5% of rdg + 2 cts); 40 MΩ: ±(2% of rdg + 5 cts).

Diode Test Range – 0 to 2 volts.

Continuity Check – Audible tone when < 50 Ω.

Modes – Min, Max, ΔMax-Min, Avg, Hold.

Non-Volatile Storage – 10 DMM screenshots.

*1 *Probe-dependent.*

GENERAL SPECIFICATIONS

Setups – 10 front panel setups.

Safety Certification – UL 3111-1 Listed, complies with EN61010-1.

Power – NiCd rechargeable battery pack with AC adapter (both included).

Battery Life – Approx. 2 hours from full charge.

Display – Backlit LCD.

Display Resolution – 320 x 240.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	177	6.95
Height	217	8.53
Depth	51	2.00
Weight	**kg**	**lb.**
Net	1.45	3.2

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TEKSCOPE™
Handheld Digital Oscilloscopes. Order THS 720 and THS 710.
Includes: Two P6113B 10X Passive Probes, User Manual, Standard Meter Lead Set, NiCd Rechargeable Battery Pack, AC Power Adapter, Soft Carrying Case, Cable and Adapters for RS-232, and NIST-traceable Certificate of Calibration.

WARRANTY
Three year warranty covering all labor and parts (excluding probes).

PROBES
P5102 – 10X 100 MHz Passive Probe for Higher Voltage Application: 1000 V RMS Tip-to-ref.; 600 V RMS Ref.-to-earth Ground (float).

A621, A622, A605, and A610 – Current Probes.

P6113B –
Replacement 10X Passive Probe.

ADDITIONAL ACCESSORIES
Battery Charger – Order THS7CHG.
Rechargeable Battery – Order THS7BAT.
Hard Carrying Case – Order THS7HCA.
Standard Meter Lead Set – Order 012-1482-00.
Deluxe Meter Lead Set – Order 012-1483-00.
Soft Case – Order 016-1399-00.

Printer – Order HC411.
Documentation Software – Order S60DWAV.

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

See Tektronix on the World Wide Web: http://www.tek.com

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Tektronix Measurement products are manufactured in ISO registered facilities.

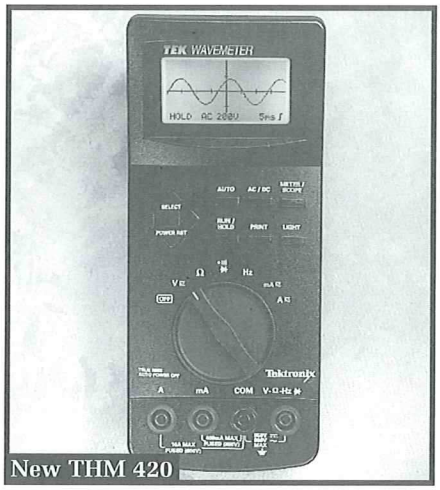
Digital Multimeter

TekWaveMeter™ • New THM 420

Features

THM 420

- Full-featured Autoranging DMM
- Backlight
- True RMS
- Analog Bar Graph
- Autoranging Digital Oscilloscope
- 5 MHz Bandwidth
- Scale, Position, Trigger
- UL, CSA, IEC Safety Design



New THM 420

Characteristics

DMM Resolution – 4000 counts, 3 3/4 digit.
Scope Resolution – 128 x 64.
Basic DC Volts Accuracy – 0.3%.
AC Voltage Ranges – 400 mV to 600 V.
DC Voltage Ranges – 400 mV to 850 V.
AC/DC Current Ranges – 4 mA to 10 A.
True RMS AC Measurement – Yes.
Resistance Ranges – 400 Ω to 40 MΩ.
Frequency Measurement Range – 100 Hz to 1 MHz.
Autoranging Digital Oscilloscope – Yes.
Digitizers – 6-Bit, 16 MS/s.
Waveform Bandwidth – 5 MHz.

THM 420 WaveMeter

The THM 420 WaveMeter DMM with Graphical Waveform Display is a multipurpose, multifunctional tool designed for a wide variety of applications, including trouble shooting, maintenance, installation, calibration, and repair of industrial, electronic, production, and medical equipment.

In meter mode, the analog bar graph display provides fast visual indication for viewing measurements. True RMS measurement is provided for making accurate measurements in the presence of harmonics.

In waveform mode, the autoranging scope displays a graphic picture of the measurement to show characteristics such as noise, waveform distortion, glitches, and intermittent failures. The waveform bandwidth is enough to cover almost all electrical and industrial electronic field service applications.

In-line current measurement and the ability to display a signal graphically (not just numerically) make it ideal for low-current sensor applications.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TekWaveMeter™
Digital Multimeter. Order THM420.
Includes: Test Leads, Instructions, Batteries, Battery Compartment, Fuses.

OPTIONAL ACCESSORY
Soft Carrying Case – Order 016-1385-00.

ADDITIONAL ACCESSORIES
Test Leads – Order 012-2138-00.

Fuses –
15 A, 600 V. Order 159-0390-00.
500 mA, 350 V. Order 159-0389-00.

Battery Compartment – Order 202-0347-00.

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

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Digital Multimeter

TekMeter® Series • THM 560 • THM 565

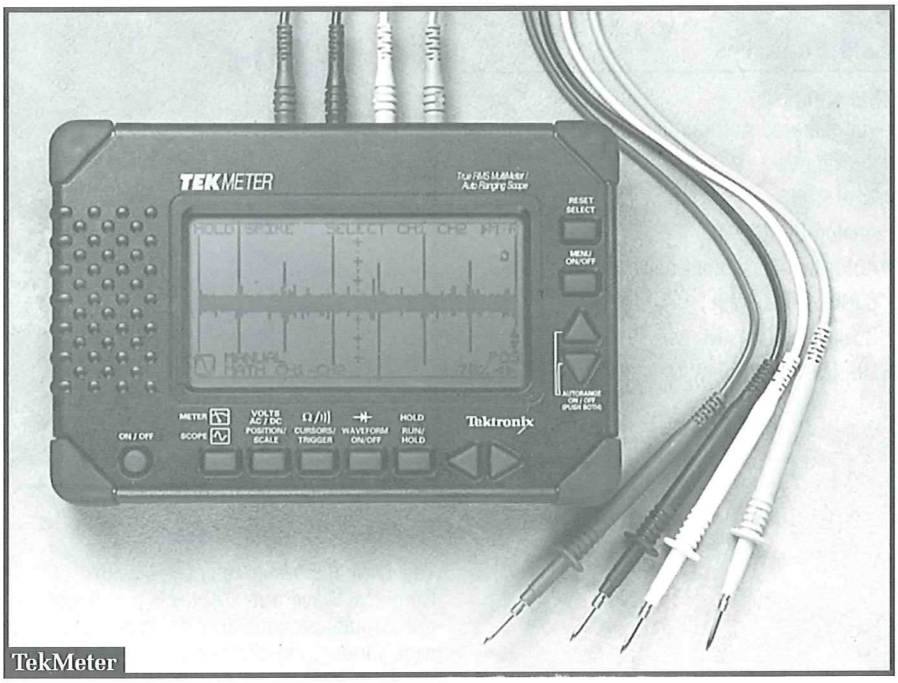
Features

THM SERIES TekMeter

- True RMS Multimeter
- 2 Channel Autoranging Oscilloscope
- ΔV, ΔT, and 1/ΔT Cursors
- Automatic Measurements
- LCD Display (Backlit on THM 565)
- UL and CSA Certified to 600 V AC RMS or 850 V DC
- 6 kV Surge Protected
- Powered by Six Standard AA Batteries, Optional Replaceable NiCd Pack or AC adapter
- Weighs Only 2.2 lbs. (990 grams)
- Works with Standard DMM Probes and Accessories

Applications

- Test Power Quality
- Verify Logic Circuitry
- Test Motor Drives
- Examine Video Signals



TekMeter

THM Series TekMeter

The TekMeter Series combines the power of a true RMS digital multimeter and a dual-channel, 25 MS/s autoranging digital storage oscilloscope in one compact, simple-to-use, rugged, battery-powered unit. Designed for a wide variety of industrial applications, the TekMeter measures and displays signals from a few millivolts to several hundred volts. Its unique, autoranging scope tracks the signal and adjusts the instrument automatically. There's no need to be an expert scope user to get immediate results.

The simple interface allows access to numerous powerful and time-saving features, such as automatic measurements, capturing and time stamping AC-line faults, calculation of transformer harmonic derating factor (THDF), stable triggering on complex AC-motor drive signals, measuring true power, plus several other DMM and scope functions.

A UNIQUE MULTI-FUNCTION DISPLAY

Unlike a traditional DMM, the TekMeter's large display tells you everything you need to know about what you're measuring. In addition to the numerical and analog bar readout you're used to seeing on a DMM, the display shows Max, Min, Max-Min, Hold, and ΔHold all at once. You get more information about the signal, all on a single display.

Switch to the scope mode and TekMeter provides a waveform display similar to a traditional oscilloscope. The scope-mode display is autoranging, so it automatically scales and tracks as the signal changes, giving you hands-free operation. You can concentrate on the measurement, not the instrument, making measurements easier and faster.

LOTS OF POWER IN A SMALL PACKAGE

Even though the TekMeter easily fits in your hand, it packs more power and features than instruments many times its size. Its simple interface allows quick access to a host of features: cursors, automatic measurements, true power measurements, Power Factor, Transformer Harmonic Derating Factor (THDF), and spike detect – all of which will help you get to the source of your problem more quickly. TekMeter can do anything you're doing now, and more. You get measurable results that get the job done.

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Digital Multimeter

TekMeter® Series • THM 560 • THM 565

KEY SPECIFICATIONS

	THM 560	THM 565
DIGITAL MULTIMETER		
Resolution	True RMS, 4,000 counts, 3 3/4 digits	True RMS, 4,000 counts, 3 3/4 digits
DC Voltage Ranges	400 mV to 850 V	400 mV to 850 V
DC Accuracy	±(0.5% of reading + 5 counts)	±(0.5% of reading + 5 counts)
AC Voltage Ranges	400 mV to 600 V, true RMS, crest factor of 3	400 mV to 600 V, true RMS, crest factor of 3
AC Bandwidth	1 Hz to 5 kHz	1 Hz to 5 kHz
AC Accuracy	±(2% of reading + 5 counts) @50 to 60 Hz	±(2% of reading + 5 counts) @50 to 60 Hz
	±(2% of reading + 5 counts) @500 Hz	±(2% of reading + 5 counts) @500 Hz
Resistance Ranges	400 Ω to 40 MΩ	400 Ω to 40 MΩ
Resistance Accuracy	±(0.5% of reading + 2 counts) all ranges except 40 MΩ which is ±(2% of reading + 5 counts)	±(0.5% of reading + 2 counts) all ranges except 40 MΩ which is ±(2% of reading + 5 counts)
DMM Measurements	Max, Min, Max-Min, Hold, ΔHold	Max, Min, Max-Min, Hold, ΔHold
Other DMM Features	Diode Tester, Continuity Tester, Current (with optional current probe)	Diode Tester, Continuity Tester, Current (with optional current probe)
AUTORANGING OSCILLOSCOPE		
Bandwidth	5 MHz	5 MHz
Sample Rate	25 MS/s	25 MS/s
Channels/Digitizers	2	2
Vertical Sensitivity	5 mV to 500 V/div	5 mV to 500 V/div
Resolution	8-Bits	8-Bits
Horizontal Time/Division Range	200 ns/div to 60 s/div	200 ns/div to 60 s/div
Record Lengths	256 points	256 points
Acquisition Modes	Sample, Spike Detect, Smooth, Roll, Dynamic Display DSP	Sample, Spike Detect, Smooth, Roll, Dynamic Display DSP
Automatic Measurements	Cursors (ΔV, ΔT, 1/ΔT), Frequency, Period, Max, Min, p-p	Cursors (ΔV, ΔT, 1/ΔT), Frequency, Period, Max, Min, p-p
Advanced Measurements	CH 1 + CH 2, CH 1 – CH 2, Current, Power, AC Line Test, THDF	CH 1 + CH 2, CH 1 – CH 2, Current, Power, AC Line Test, THDF, Motor Test
Memories	4 waveforms, 4 setups, 8 screens	8 waveforms, 8 setups, 1 screen

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TekMeter®
RMS Multimeter/Digital Storage Oscilloscope. Order THM 560/THM 565.
Includes: Test Leads, User Manual, Quick Reference Guide.

AVAILABLE ACCESSORIES

TXMDXPB – Deluxe Probe Set.
THM5SCA – Soft Case with Neck Strap.
THM5HCA – Transport Case.
THM5CHG – NiCd Battery Charger.
THM5BAT – NiCd Battery Pack.
THM5AC – AC Power Adapter.

THMCOM1
AC Adapter, DC Cigarette Lighter Adapter, RS-232 Interface, Cable, DocuWave™ Software, and Flip-out Stand.

A605 – 500 A AC Current Probe.
A621 – 2,000 A AC Current Probe.
A622 – 100 A AC/DC Current Probe.

SERVICE ASSURANCE OPTIONS
These products covered by the following service assurance options:

REP4100 – Provides one year of post-warranty Repair Protection.

CAL4100 – Provides one year of Calibration Services.

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TekTools Products Accessories

TekMeter® Series • 200 Series • Current Probes • DMMs

Features

- Rechargeable NiCd Battery Pack
- Quick Charge Battery Charger
- AC Power Adapter
- Transport Case
- Soft Case
- Communications Pack
- Deluxe Probe Set
- Parallel Printer Interface
- 1X/10X High Voltage Probe
- Current Probes
  - 150 A AC
  - 500 A AC
  - 500 A AC/DC
  - 2000 A AC
- Current Probes/BNC
  - 1000 A AC
  - 100 A AC

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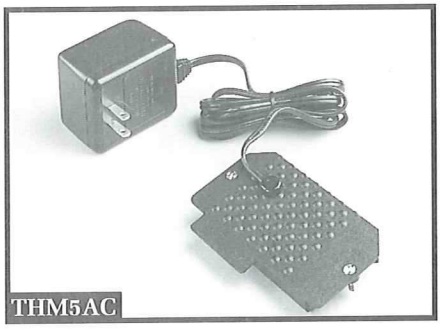
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RECHARGEABLE NICD BATTERY PACK
The Rechargeable NiCd Battery Pack is specially designed for the TekMeter®. With 800 milliamp hours of capacity, the TekMeter® Battery Pack has 50% more energy than regular NiCd batteries. Matched cells ensure that the battery pack delivers full power. Buy two battery packs and keep one ready to go with the THM5CHG charger.

QUICK CHARGE BATTERY CHARGER
Never be without power! Charge your TekMeter® THM5BAT NiCd Battery Pack in about one hour. The smart charger senses when the battery pack is fully charged and shifts into trickle charge mode to keep it fully charged, maximizing the life of your battery pack. A wall-mount transformer and a cigarette lighter adapter are included.



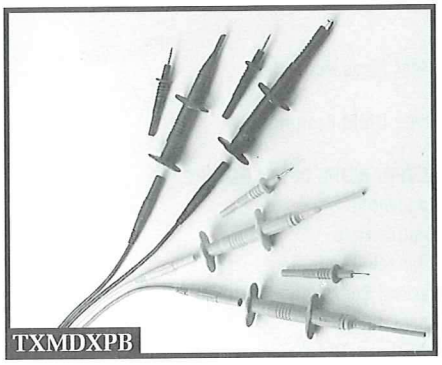
AC POWER ADAPTER
The AC Power Adapter allows continuous operation of the TekMeter® from an AC power source. The specially designed wall-mount transformer supplies power directly to the TekMeter® battery compartment while maintaining the 600 V/floatability specification.



PROTECTIVE TRANSPORT CASE
The Hard-sided Transport Case provides heavy duty protection for transport of your TekMeter® and all its accessories.

SOFT CASE
The Soft Case has an adjustable neck strap which frees you to make measurements that require both hands. A thumbscrew holds your TekMeter® securely in the padded case, so even if tipped upside down it won't fall out. The Soft Case is also a carrying case with handle. There's space inside for probes, probe attachments, and a pocket for notes or reference guides.

COMMUNICATIONS PACK
The Communications Pack provides an AC adapter, DC cigarette lighter adapter, RS-232 interface, RS-232 cable, DocuWave® software, and a flip-out stand.



DELUXE PROBE SET
The Deluxe Probe Set consists of four high-temperature, silicone-insulated probe leads with matching attachments. Each set includes a very sharp test point useful for piercing conformal coatings or corrosion that might interfere with accurate readings. The set also includes two mini-plunger clamps for hands-free operation, one red hook-style test clip, and one black wide-jaw alligator test clip for secure attachment to ground.

PARALLEL PRINTER INTERFACE (200 SERIES ONLY)
The Parallel Printer Interface allows the 200 Series Handheld Digitizing Oscilloscope to connect directly to an Epson-compatible printer. Just push a button and this battery-powered (9 V) unit instantly acquires and prints the displayed waveform. The interface automatically disconnects when not in use.

1X PROBE
The P400 1X Probe plugs directly into the 200 Series Handheld Digitizing Oscilloscopes. The P400 is UL listed and was specifically designed for making safe power measurements using the completely isolated floating input channels of the 200 Series.

TekTools Products Accessories

TekMeter® Series • 200 Series • Current Probes • DMMs

CURRENT PROBE SELECTION CHART

	COMPATIBILITY						APPLICATION	
	Current Range	Frequency Range	Handheld DMMs	TekMeter®	200 Series DSOs	TekBench™	Typical Application	Reasons To Choose
A603	≥2 A to 150 A	45 Hz to 1 kHz	Yes	–	–	–	General	Basic Measurements
A605	≥4 A to 500 A	48 Hz to 1 kHz	Yes	Yes	–	–	Plant Maintenance	Basic High Current
A610	≥2 A to 500 A	DC to 440 Hz	Yes	–	–	–	Equipment, Installation HVAC	Line Power, 3-Phase Power
A620	100 mA to 1,200 A	1 Hz to 50 kHz	–	–	Yes	–	Industrial Service Automotive Service	Versatility, Safety
A621	100 mA to 2,000 A	5 Hz to 50 kHz	Yes	Yes	–	Yes	Industrial Service	Versatility
A622	50 mA to 100 A	DC to 100 kHz	Yes	Yes	–	Yes	Equipment Maintenance	Full Spectrum

10X HIGH VOLTAGE PROBE
The P850 10X High Voltage Probe plugs directly into the 200 Series Handheld Digitizing Oscilloscopes. The P850 is UL listed and was specifically designed for making safe power measurements using the completely isolated floating input channels of the 200 Series.

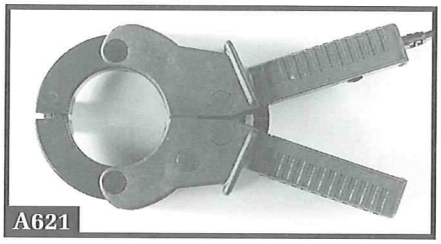
150 AMP AC CURRENT PROBE
This "clothes-pin" style clamp-on probe is a current transformer for digital multimeters having a mV input. The A603 can measure RMS AC currents ≥2 A and peak currents up to 150 A over a frequency range of 45 Hz to 1 kHz. It provides a 1 mV output for each Amp measured.

500 AMP AC CURRENT PROBE
This "busbar" style clamp-on probe is a current/voltage transformer for digital multimeters and TekMeter®. The A605 can measure RMS AC currents ≥4 A and peak currents up to 500 A over a frequency range of 48 Hz to 1 kHz. It provides a 1 mV output for each Amp measured.

500 AMP AC/DC CURRENT PROBE
This "busbar" style clamp-on probe uses a Hall Effect current sensor to provide a voltage output to digital multimeters. The A610 can measure RMS AC currents ≥2 A and peak currents up to 500 A over a frequency range of DC to 440 Hz. It provides a 1 mV output for each Amp measured.

1200 AMP AC CURRENT PROBE
This industrial style clamp-on probe is a current transformer for the 200 Series Handheld Digitizing Oscilloscopes. The A620 can measure RMS AC currents from 100 mA to 1200 A peak over a frequency range of 1 Hz to 50 kHz. It provides a 1 mV, 10 mV, or 100 mV output for each Amp measured. The A620 provides safe, easy, floating current measurements with no danger to you or your equipment.

2000 AMP AC CURRENT PROBE/BNC
This industrial style clamp-on probe has a BNC connector and a shrouded banana plug adapter so it can be used on digital multimeters, TekMeter®, and scopes. The A621 can measure AC currents from 100 mA to 2000 A



peak over a frequency range of 5 Hz to 50 kHz. It provides a 1 mV, 10 mV, or 100 mV output for each Amp measured.

100 AMP AC CURRENT PROBE/BNC
This "long nose" style clamp-on probe uses a Hall Effect current sensor to provide a voltage output to oscilloscopes. It has a BNC connector and a shrouded banana plug adapter so it can also be used on digital multimeters and TekMeter®. The A622 can measure AC/DC currents from 50 mA to 100 A peak over a frequency range of DC to 100 kHz. It provides 10 mV or 100 mV output for each Amp measured.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

THM5BAT – Rechargeable NiCd Battery Pack.
THM5CHG – Quick Charge Battery Charger.
THM5AC – AC Power Adapter.
THM5HCA – Protective Transport Case.
THM5SCA – Soft Case.
THMCOM1 – Communications Pack.
THMDXPB – Deluxe Probe Set.
WP200 – Parallel Printer Interface.

P400 – 1X High Voltage Probe.
P850 – 10X High Voltage Probe.
A603 – 150 A AC Current Probe.
A605 – 500 A AC Current Probe.
A610 – 500 A AC/DC Current Probe.
A620 – 1200 A AC Current Probe.
A621 – 2000 A AC Current Probe/BNC.
A622 – 100 A AC Current Probe/BNC.

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

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Digital Multimeters

CDM250 • DM2510 • DM2510G

Features

CDM250

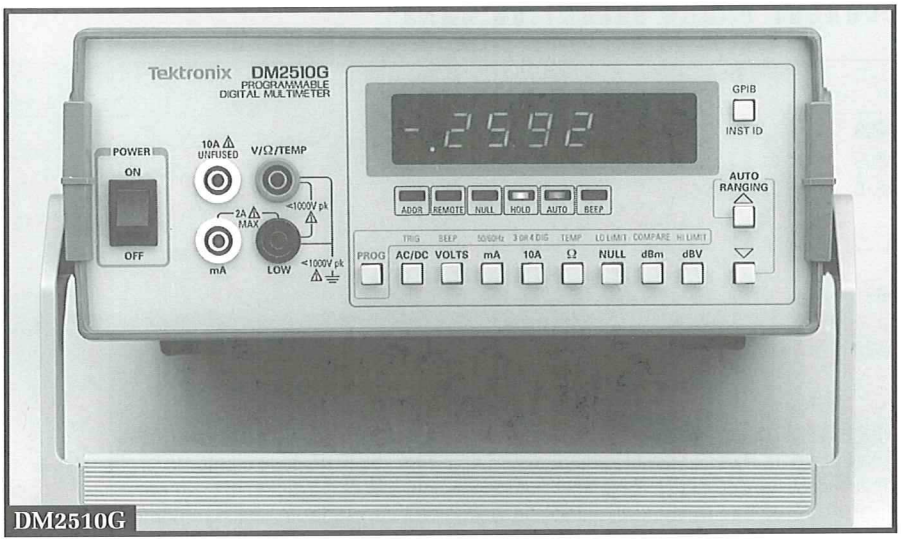
- AC/DC Volts (500 V Range)
- Resistance (20 MΩ Range)
- Current (10 A Range)
- Overload Protection

DM2510/DM2510G

- Programmable
- GPIB (DM2510G)
- 1000 V DC
- 500 V AC RMS
- dB Function (AC Voltage)
- 10 A DC/AC Current
- 20 MΩ Resistance
- Temperature
- Autoranging (Except Temperature)
- Null Function
- Hold Mode
- Trigger Function
- Compare Mode (High to Low Limits)
- Fast and Normal Modes

Applications

- Training
- Manufacturing Production Test
- Field Repair
- Bench Calibration and Repair
- Product Design



DM2510G

CDM250

The CDM250 Digital Multimeter measures and displays voltage, current, and resistance using a 3 1/2 digit LED display. Sine wave alternating voltages and currents are displayed in RMS values. The CDM250 is safe and easy to use in the classroom and on the job. This meter has overload protection and is UL listed and CSA certified. Test leads are included.

DM2510 Programmable Digital Multimeter

The DM2510 is a programmable, six-function, autoranging digital multimeter. You can use it to measure DC and AC voltage and current, plus resistance and temperature. It has a NULL function to make measurements with an offset value, plus a HOLD mode and a TRIGGER function. COMPARE mode compares a measurement with user-selected high and low limits; a beeper can be set to sound when the measurement is beyond the specified limits.

DM2510G Programmable Digital Multimeter with GPIB Interface

The DM2510G is a programmable, six-function, autoranging digital multimeter with a GPIB interface for computerized programming or remote operation and data capture.

The DM2510 and DM2510G Programmable Digital Multimeters are the first in a new series of programmable instruments which offer exceptional accuracy and speed, especially in repetitive testing situations. Other features of the DM2510G are the same as the DM2510.

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Digital Multimeters
CDM250 • DM2510 • DM2510G

KEY SPECIFICATIONS

	CDM250	DM2510/DM2510G
DC Volts		
Ranges	200 mV, 2 V, 20 V, 200 V, 500 V	200 mV, 2 V, 20 V, 200 V, 1000 V
Basic Accuracy	±(0.5% of reading + 1 count)	±(0.03% of reading + 0.015% of full scale)
Max Input Voltage	500 V DC (DC + peak AC)	1000 V DC
AC Volts		
Ranges	200 mV, 2 V, 20 V, 200 V, 500 V	200 mV, 2 V, 20 V, 200 V, 500 V (RMS)
Basic Accuracy	±(1.0% of reading + 4 counts)	±(0.6% of reading + 0.05% of full scale)
Max Input Voltage	350 V AC RMS; 500 V (DC + peak AC)	Front panel, V/Ω/Temp to LOW: 500 V RMS or 600 V DC; Front panel, V/Ω/Temp to GND and LOW to GND: 1000 V pk
dB (True RMS AC Volts)		
Basic Accuracy	–	±0.3 dB
DC Current		
Ranges	200 µA, 2 mA, 20 mA, 200 mA, 2 A, 10 A	200 µA, 2 mA, 20 mA, 200 mA, 2 A, 10 A
Basic Accuracy	±(1.0% of reading +1 count)	±(0.06% of reading + 0.01% of full scale)
Max Input Current	2 A fused, 10 A unfused	2 A any range, mA to LOW 10 A unfused, A to LOW
Max Floating Voltage	–	10 A, mA or LOW to GND: 1000 V pk
AC Current		
Ranges	200 µA, 2 mA, 20 mA, 200 mA, 2 A, 10 A	200 µA, 2 mA, 20 mA, 200 mA, 2 A, 10 A
Basic Accuracy	±(1.5% of reading + 4 counts)	±(0.8% of reading + 0.05% of full scale)
Max Input Voltage	650 V pk, A to COM	650 V pk, mA to LOW
Resistance		
Ranges	200 Ω , 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, 20 MΩ	200 Ω , 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, 20 MΩ
Basic Accuracy	±(0.75% of reading + 1 count)	±(0.05% of reading + 0.02% of full scale)
Max Input Voltage	500 V (DC + peak AC)	300 V pk (all ranges)
Temperature Measurement	–	–62°C to 240°C
Programmable	–	Yes
GPIB Interface	–	DM2510G only, on rear panel
Warranty	One year	One year
Safety Certification	UL Listed, CSA Certified	ETL, CSA Certified

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CDM250
Digital Multimeter.
Includes: Test Leads, Operator's Manual, US Power Cord, One Year Warranty.

DM2510
Programmable Digital Multimeter.
Includes: Test Leads, Operator's Manual, US Power Cord, One Year Warranty.

DM2510G
Programmable Digital Multimeter with GPIB Interface.
Includes: Test Leads, Operator's Manual, US Power Cord, One Year Warranty.

SERVICE ASSURANCE OPTIONS
These products covered by the following service assurance options:

CDM250
REP4100 – Provides one year of post-warranty Repair Protection.
CAL4100 – Provides one year of Calibration Services.

DM2510/DM2510G
REP4200 – Provides one year of post-warranty Repair Protection.
CAL4200 – Provides one year of Calibration Services.

AVAILABLE ACCESSORIES
Temperature Probe – For DM2510G. Order P6602.
GPIB Interface Cable – Order 012-0991-01.

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

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Counters

CFC250 • CDC250 • CMC250 • CMC251

Features

CDC250
- 1 Hz to 175 MHz
- Frequency Ratio
- Time Interval
- ±1 ppm Time Base
- Period Average, Period, Frequency, Totalize Self-test

CMC251
- 1 Hz to 100 MHz (CH 1)
  80 MHz to 1.3 GHz (CH 2)
- ±1 ppm Time Base
- Period Average, Period, Frequency, Totalize Self-test
- Display Hold
- Remote Start/Stop

CMC250
- 5 Hz to 100 MHz (CH 1)
  80 MHz to 1.3 GHz (CH 2)
- ±10 ppm Time Base
- Period Average, Period, Frequency, Totalize Self-test
- Display Hold
- Remote Start/Stop

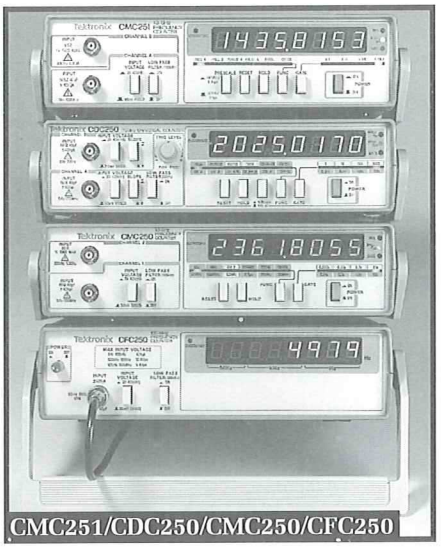
CFC250
- 5 Hz to 100 MHz
- Switchable Input Sensitivity
- 1 Hz Resolution

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CMC251/CDC250/CMC250/CFC250

CMC251

The CMC251 1.3 GHz Multifunction Counter measures the frequency of sine, square, and triangle waves from 1 Hz to 1.3 GHz. The CMC251 also provides period, totalize, and pulse width measurements. The counter has two input channels. Channel A is a standard 1 MΩ input for frequency measurements up to 100 MHz. Channel B is a 50 Ω terminated input for use in high-frequency systems. This counter is of interest to radio amateurs because of its ability to measure high-frequency systems. The temperature-compensated, crystal-controlled time base is stable to ±1 part per million per year.

CDC250

The CDC250 175 MHz Universal Counter measures frequency of sine, square, and triangle waves from 1 Hz to 175 MHz at input levels from 20 mV to 42 V peak. The CDC250 also provides period measurements, frequency ratio, time interval, and totalize measurement functions. The CDC250 has a ±1 ppm/year, temperature-compensated time base to ensure consistent accuracy. Service technicians will find the CDC250 useful as a standard for calibrating other equipment.

CMC250

The CMC250 1.3 GHz Multifunction Counter measures the frequency of sine, square, and triangle waves from 5 Hz to 1.3 GHz. The CMC250 also provides period measurements and totalize functions. Channel A is a standard 1 MΩ input for frequency measurements up to 100 MHz. Channel B is a special 50 Ω terminated input, prescaled to 1.3 GHz for easy RF measurements. The time base stability is ±10 ppm/year.

CFC250

The CFC250 100 MHz Frequency Counter measures the frequency of sine, square, and triangle waves from 5 Hz to 100 MHz at input levels from 30 mV to 42 V peak. Students will enjoy the simplicity of using the CFC250. Applications include adjustment, testing, and repair of electronic items, such as audio equipment, radios, televisions, computer clocks, and musical instruments.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CFC250
100 MHz Frequency Counter.
Includes: Operator's Manual, US Power Cord, One Year Warranty.

CDC250
175 MHz Universal Counter.
Includes: Operator's Manual, US Power Cord, One Year Warranty.

CMC250
1.3 GHz Frequency Counter.
Includes: Operator's Manual, US Power Cord, One Year Warranty.

CMC251
1.3 GHz Frequency Counter with High Stability Time Base.
Includes: Operator's Manual, US Power Cord, One Year Warranty.

AVAILABLE ACCESSORIES
10X Probe, 250 MHz. Order P6106A.

SERVICE ASSURANCE OPTIONS
These products covered by the following service assurance options:

REP4100 – Provides one year of post-warranty Repair Protection.

CAL4100 – Provides one year of Calibration Services.

Counters

CFC250 • CDC250 • CMC250 • CMC251

KEY SPECIFICATIONS

	CMC251	CDC250	CMC250	CFC250
Channel A				
Frequency Range	1 Hz to 100 MHz	1 Hz to 175 MHz	1 Hz to 100 MHz	5 Hz to 100 MHz
Sensitivity	20 mV RMS, 1 Hz to 30 MHz; 50 mV RMS, 30 MHz to 100 MHz	kHz/ms mode: 20 mV RMS, 5 Hz to 10 MHz; MHz/µs mode: 50 mV RMS, 5 MHz to 125 MHz; 100 mV RMS, 125 MHz to 150 MHz; 150 mV RMS, 150 MHz to 175 MHz	20 mV RMS, 5 Hz to 30 MHz; 50 mV RMS, 30 MHz to 100 MHz	30 mV RMS, 5 Hz to 30 MHz; 50 mV RMS, 30 MHz to 70 MHz 80 mV RMS, 70 MHz to 100 MHz
Attenuation	3 V to 42 V (HI); 50 mV to 5 V (LO)	3 V to 42 V (HI); 50 mV to 5 V (LO)	3 V to 42 V (HI); 50 mV to 5 V (LO)	3 V to 42 V (HI); 50 mV to 5 V (LO)
Max Input Voltage	1 Hz to 5 MHz: 42 V pk; 5 MHz to 100 MHz: 4.9 V pk	1 Hz to 5 MHz: 42 V pk; 5 MHz to 175 MHz: 4.9 V pk	5 Hz to 5 MHz: 42 V pk; 5 MHz to 100 MHz: 4.9 V pk	5 Hz to 100 kHz: 42 V pk; 100 kHz to 10 MHz: 13.8 V pk; 10 MHz to 100 MHz: 5.4 V pk
Low Pass Filter	–3 dB at 100 kHz	–3 dB at 10 kHz	–3 dB at 100 kHz	100 kHz
Impedance	1.0 MΩ, paralleled by 40 pF	1.0 MΩ, paralleled by 40 pF	1.0 MΩ, paralleled by 40 pF	1.0 MΩ, paralleled by 40 pF
Channel B				
Frequency Range	80 MHz to 1.3 GHz	1 Hz to 2 MHz	80 MHz to 1.3 GHz	–
Sensitivity	5 mV RMS, 80 MHz to 600 MHz; 15 mV RMS, 600 MHz to 900 MHz; 35 mV RMS, 900 MHz to 1.3 GHz	30 mV RMS, 5 Hz to 2 MHz	10 mV RMS, 80 MHz to 600 MHz; 25 mV RMS, 600 MHz to 900 MHz; 50 mV RMS, 900 MHz to 1.3 GHz	–
Impedance	50 Ω	1.0 MΩ, paralleled by 40 pF	50 Ω	–
Max Input Voltage	1 V RMS	42 V pk	1 V RMS	–
Period				
Range	Direct: 0.4 µs to 1.0 s; Prescale: 0.04 µs to 1.0 s	0.5 µs to 0.2 s	0.4 µs to 0.2 s	–
Resolution	Direct: 100 ps to 100 ns; Prescale: 10 ps to 10 ns	100 ps to 100 ns	100 ps to 100 ns	–
Min Pulse Width	Direct: 0.2 µs; Prescale: 20 ns	250 ns	250 ns	–
Frequency Range	Direct: 1 Hz to 2.5 MHz; Prescale: 1 Hz to 25 MHz	1 Hz to 2 MHz	5 Hz to 2.5 MHz	–
Events Averaged (N)	1, 10, 100, 1000, 10,000 cycles	1, 10, 100, 1000 cycles	1, 10, 100, 1000 cycles	–
Totalize Range	0 to 99,999,999	0 to 99,999,999	0 to 99,999,999	–
Pulse Width				
Range	0.25 µs to 0.5 s	–	–	–
Period Range	100 ps to 100 ns	–	–	–
Events Averaged (N)	1, 10, 100, or 1000 cycles	–	–	–
Time Base Stability				
Temperature	<1 ppm from 0° to 40°C	<1 ppm from 0° to 40°C	<10 ppm from 0° to 40°C	<10 ppm from 0° to 40°C
10% Line Voltage Change	<0.4 ppm	<0.4 ppm	<1.0 ppm	<1.0 ppm
Accuracy				
Frequency	±(time base error + 1 count)	±(time base error + 1 count)	±(time base error + 1 count)	±(time base error + 1 count)
Period	±(time base error + 1 count + trigger error)	±(time base error + 1 count + trigger error)	±(time base error + 1 count + trigger error)	–
Pulse Width	±(time base error + 1 count + trigger error + 10 ns)	–	–	–
Plus				
Selectable Slope	No	Yes	No	No
Ratio CH A: CH B	No	Yes	No	No
Display Hold	Yes	Yes	Yes	No
Remote Start/Stop	Yes	Yes	Yes	No
Time Interval CH A: CH B	No	Yes	No	No
Safety Certification	ETL, CSA	UL, CSA	UL, CSA	UL, CSA

Function Generators

CFG253 • CFG280 • CFG250

Features

CFG250

- 0.2 Hz to 2 MHz
- Square, Triangle, and Sine Waves; TTL Output
- 20 dB Attenuator
- Internal or External Frequency Sweep
- Variable Duty Cycle
- Variable Symmetry (20 to 80%)

CFG253

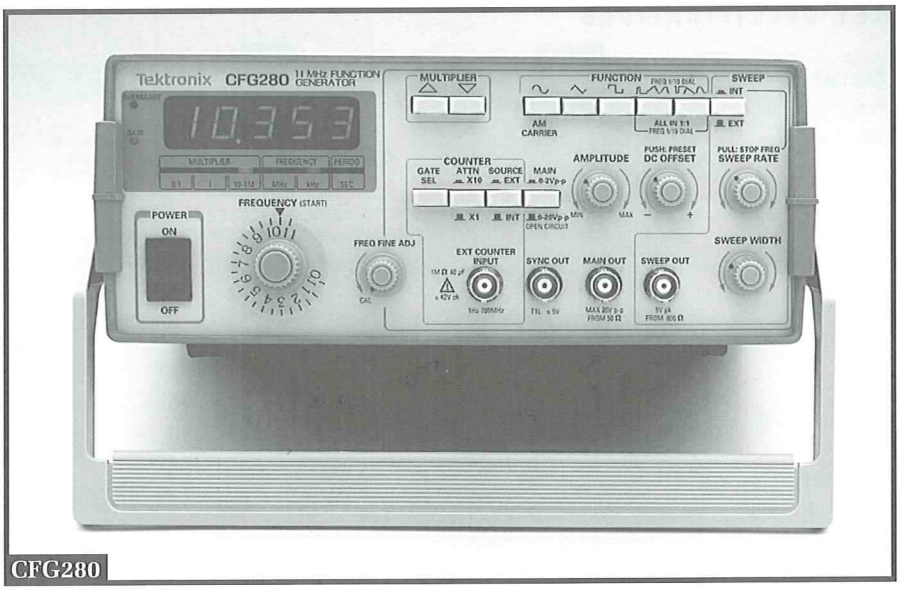
- 0.03 Hz to 3 MHz
- Square, Triangle, and Sine Waves; TTL Output
- 20 dB Attenuator
- Internal or External Frequency Sweep
- Variable Duty Cycle
- Variable Symmetry (20 to 80%)

CFG280

- 0.1 Hz to 11 MHz (Calibrated)
- 0.01 Hz to 11 MHz (Uncalibrated)
- 1 Hz to 100 MHz Counter
- Square, Triangle, and Sine Waves; TTL Output
- 20 dB Attenuator
- External Gate Input
- VCF (FM) Input
- AM 0 to 100% Input for External Sine Wave
- Internal or External Frequency Sweep

Applications

- Training
- Manufacturing Production Test
- Field Repair
- Bench Calibration and Repair
- Product Design



CFG280

CFG250 and CFG253

Function Generators produce sine, square, and triangle waves, and TTL signals for testing amplifiers, filters, and digital circuits. Sweep function can be controlled internally or with an external signal. Duty cycle, DC offset, sweep rate, sweep width, and amplitude are all operator controlled. The CFG253, at 0.03 Hz to 3 MHz, has a wider output bandwidth than the CFG250, at 0.2 Hz to 2 MHz.

CFG280 11 MHz Function Generator with Counter

The CFG280 combines an 11 MHz Function Generator with a 1 Hz to 100 MHz Frequency Counter. The onboard counter allows the operator to set the frequency output of the function generator precisely. This versatile instrument conserves both bench space and budget.

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

See Tektronix on the World Wide Web: http://www.tek.com

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Tektronix Measurement products are manufactured in ISO registered facilities.

Function Generators

CFG253 • CFG280 • CFG250

KEY SPECIFICATIONS

	CFG253	CFG250	CFG280
Waveform Outputs	Square wave, sine wave, triangle wave, TTL pulse, sweep functions for all outputs	Square wave, sine wave, triangle wave, TTL pulse, sweep functions for all outputs	Square wave, sine wave, triangle wave, TTL pulse, sweep functions for all outputs
Ranges	1.0 Hz to 1.0 MHz in 7 ranges	1.0 Hz to 1.0 MHz in 7 ranges	0.1 Hz (calibrated) to 11 MHz in 8 ranges
Frequency Multiplier	Variable from 0.3 to 3.0 times the selected frequency range	Variable from 0.2 to 2.0 times the selected frequency range	Variable from 0.1 to 1 (uncalibrated) 1 to 11 (calibrated)
Dial Accuracy	±5% of full scale	±5% of full scale	±5% of full scale from 0.1 Hz to 10 MHz
Sine Wave Distortion	<1% (10 Hz to 100 kHz)	<1% (10 Hz to 100 kHz)	<1% (10 Hz to 100 kHz) –30 dB at all other frequencies
Triangle Wave Linearity	20 Hz to 200 kHz: ≥99%; 200 kHz to 3 MHz: ≥97%	20 Hz to 200 kHz: ≥99%; 200 kHz to 2 MHz: ≥97%	0.1 Hz to 110 kHz: ≥99%; 110 kHz to 1 MHz: ≥97%; 1 MHz to 11 MHz: ≥95%
Square Wave Response	≤100 ns rise/fall time, maximum output into 50 Ω load	≤100 ns rise/fall time, maximum output into 50 Ω load	≤25 ns rise/fall time, maximum output into 50 Ω load
Main Output Amplitude	0 to 20 V p-p	0 to 20 V p-p	0 to 20 V p-p
Attenuator	20 dB	20 dB	20 dB
SYNC/TTL Output	TTL output level, rise <25 ns (20 TTL load) ≥3 V pk	TTL output level, rise <25 ns (20 TTL load) ≥3 V pk	<25 ns rise/fall time, maximum output into 50 Ω load
Main Output Impedance	50 Ω ±10%	50 Ω ±10%	50 Ω ±10%
DC Offset (continuously variable)	±10 V minimum open circuit; ±5 V minimum into 50 Ω load	±10 V minimum open circuit; ±5 V minimum into 50 Ω load	±10 V minimum open circuit; ±5 V minimum into 50 Ω load
Symmetry/Duty Cycle	5 to 1 minimum symmetry change	5 to 1 minimum symmetry change	95/5 fixed (pulse and ramp)
Internal Variable Sweep Rate	0.5 Hz to 50 Hz	0.5 Hz to 50 Hz	0.5 Hz to 50 Hz
External Voltage-controlled Variable Sweep Range (10 kΩ Input)	100:1 minimum for 0 to +10 V DC input with frequency control set at maximum	100:1 minimum for 0 to +10 V DC input with frequency control set at maximum	100:1 minimum for 0 to ±10 V DC input with frequency control set at 0.1 or 11
VCF (FM) Input	–	–	±10 V input shifts frequency ≥100:1 up or down with dial set at 0.1 or 11 respectively
AM	–	–	0 to 100%, DBSC, external sine wave only
Warranty	One year	One year	One year
Safety	UL, CSA	UL, CSA	ETL, CSA
CFG280 Counter Specifications			
Frequency Range (AC coupled)	–	–	1 Hz to 100 MHz
Sensitivity	–	–	30 mV RMS from 1 Hz to 50 MHz; 50 mV RMS from 50 MHz to 100 MHz:
Period Range/Resolution	–	–	1 ms to 60 s/1 ms
Crystal Frequency	–	–	10 MHz
Time Base Stability	–	–	±0.001% (±10 ppm) from 0° to 40°C
Frequency Accuracy	–	–	±(time base error + 1 count)
Period Accuracy	–	–	±(time base error + 1 count + trigger error)

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CFG250
2 MHz Function Generator.
Includes: Operator's Manual, US Power Cord, One Year Warranty.

CFG253
3 MHz Function Generator.
Includes: Operator's Manual, US Power Cord, One Year Warranty.

CFG280
11 MHz Function Generator with 100 MHz Counter.
Includes: Operator's Manual, US Power Cord, One Year Warranty.

SERVICE ASSURANCE OPTIONS
These products covered by the following service assurance options:

REP4100 – Provides one year of post-warranty Repair Protection.

CAL4100 – Provides one year of Calibration Services.

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

Power Supplies

CPS250 • PS280 • PS281 • PS282 • PS283

Features

CPS250

- Triple Output Power Supply
- Two Variable 0 to 20 V, 0.5 A Supplies
- Fixed 5 V, 2 A Supply
- Variable Current Limiting
- Overload Indicators

PS 280/283

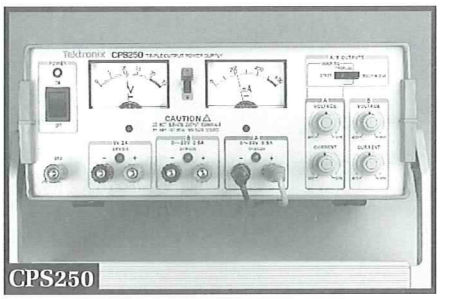
- One Fixed 5 V, 3 A Supply
- Two Variable Outputs, 0 to 30 V, 2 A (PS280), 1 A (PS283)
- Variable Current Limiting
- Selectable Independent Tracking Mode
- Dual Tracking, Variable 0 to 30 V, 2.0 A (PS280); 0 to 30 V, 1.0 A (PS283)

PS281/282

- 90 W, Single Output, 3-1/2 digit Display
- 0 to 30 V, 0 to 3 A (PS281)
- 0 to 18 V, 0 to 5 A (PS282)
- Variable Current Limiting
- Overload and Over-voltage Protection

Applications

- Training
- Manufacturing Production Test
- Field Repair
- Bench Calibration and Repair
- Product Design



CPS250

The CPS250 Triple Output Power Supply is a versatile instrument with two variable and one fixed output. Its attractive, compact design with tilt-bail handle takes up less bench space than most other power supplies. It meets most basic test and lab bench requirements.

PS280/PS283 Power Supplies

The Tektronix PS280 and PS283 Laboratory DC Power Supplies are multifunction benchtop or portable instruments. These regulated power supplies provide fixed 5 V output for powering logic circuits and two variable outputs for a wide variety of test and experimental uses.

The PS280 and PS283 contain two identical, independently adjustable DC power supplies that can vary from 0 to 30 V, and 0 to 2 A in the PS280 or 0 to 1 A in the PS283. Front-panel switches select one of three modes of operation: independent, series, or parallel.



PS281/282 DC Power Supplies

The Tektronix PS281/282 DC Power Supplies meet the requirements of laboratory, classroom and production environments. Output is continuously variable up to the rated voltage/current by means of coarse and fine potentiometers. The PS281 is rated at 30 V/3 A; the PS282 at 18 V/5 A max.

The PS281 and PS282 are designed to be connected in series to increase voltage output or in parallel for a higher current output. Serial and parallel tracking can be achieved by connecting a rear panel jumper between two or more units.

The compact case and multiple operating modes of the PS281 and PS282 offer convenience and flexibility for a space-limited engineering bench.

KEY SPECIFICATIONS

	PS281	PS282
Output Voltage	0 to 30 V DC	0 to 18 V DC
Output Current	0 to 3.0 A	0 to 5.0 A
Line Regulation	≤0.01% + 3 mV	≤0.01% + 3 mV
Load Regulation	≤0.01% + 3 mV	≤0.01% + 3 mV (≤3 A) ≤0.01% + 5 mV (>3 A)
Ripple/Noise	≤0.5 mV RMS, 5 Hz to 1 MHz	≤0.5 mV RMS, 5 Hz to 1 MHz (≤3 A) ≤1.0 mV RMS, 5 Hz to 1 MHz (>3 A)
Tracking Error	<±500 mV	<±500 mV
Displays		
Readout	One 3-1/2 digit LED	One 3-1/2 digit LED
Accuracy	±(0.5% of reading + 2 digits)	±(0.5% of reading + 2 digits)
Overload Indicator	Yes	Yes
Insulation		
Chassis to Terminal	≥20 MΩ at 500 V DC	≥20 MΩ at 500 V DC
Chassis to Power Cord	≥30 MΩ at 500 V DC	≥30 MΩ at 500 V DC
Safety Certification	ETL, T-MARK, CSA	ETL, T-MARK, CSA

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

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Tektronix Measurement products are manufactured in ISO registered facilities.

Power Supplies

CPS250 • PS280 • PS281 • PS282 • PS283

KEY SPECIFICATIONS

	CPS250	PS280	PS283
Output Voltage			
Two Variable	0 to 20 V DC	0 to 30 V DC	0 to 30 V DC
One Fixed	5.0 V	5.0 V	5.0 V
Output Current			
Two Variable	0 to 0.5 A (CC)*1	0 to 2.0 A (CC)*1	0 to 1.0 A (CC)*1
One Fixed (foldback limited)	2.0 A max	3.0 A max	3.0 A max
Line Regulation			
Two Variable	0.01% + 3 mV (CV); 0.2% + 3 mA (CC)	0.01% + 3 mV (CV); 0.2% + 3 mA (CC)	0.01% + 5 mV (CV); 0.2% + 3 mA (CC)
One Fixed	≤10 mV)(CV)	≤5 mV (CV)	≤5 mV (CV)
Load Regulation			
Two Variable	0.01% + 3 mV (CV); 0.2% + 6 mA (CC)	≤0.01% + 5 mV, current > 3 A (CV); ≤300 mV, 0 to 60 V single series tracking supply (CV); 0.2% + 3 mA (CC)	≤0.01% + 3 mV (CV) ≤300 mV, 0 to 60 V single series tracking supply (CV); 0.2% + 3 mA (CC)
One Fixed	0.1% + 5 mV (CV)	≤10 mV (CV)	≤10 mV (CV)
Ripple/Noise			
Two Variable	2 mV RMS, 5 Hz to 1 MHz (CV); 3 mA RMS, 5 Hz to 1 MHz (CC)	≤1 mV RMS, 5 Hz to 1 MHz (CV); ≤3 mA (CC)	≤1 mV RMS, 5 Hz to 1 MHz (CV); ≤3 mA (CC)
One Fixed	2 mV RMS	≤2 mV RMS	≤2 mV RMS
Output in Independent Mode			
	Two variable 0 to 20 V (CV); 0.5 A (CC)	Two variable 0 to 30 V (CV); 2.0 A (CC)	Two variable 0 to 30 V (CV); 1.0 A (CC)
Output in Parallel Mode	One 0 to 20 V, 1.0 A max	One 0 to 30 V, 4.0 A max	One 0 to 30 V, 2.0 A max
Tracking Error	±0.2% ± 20 mV	≤0.5% + 10 mV	≤0.5% + 10 mV
Series Mode	One 0–40 V, 0.5 A max or one ±20 V, 0.5 A	One 0 ±30 V, 2.0 A max or one 60 V, 2 A	One 0 ±30 V, 1.0 A max or one 60 V, 1 A
Tracking Error	±0.2% ±20 mV	±0.5% + 10 mV	±0.5% + 10 mV
Displays	Two analog meters (switchable)	Two 3-1/2 digit LED (switchable)	Two 3-1/2 digit LED (switchable)
Voltage Indicator	0 to 25 V DC ± 2.5% of full scale	0 to 30 V DC ± (0.5% of rdg + 2 digits)	0 to 30 V DC ± (0.5% of rdg + 2 digits)
Current Indicator	0 to 800 mA ± 2.5% of full scale	0 to 2 A DC ± (0.5% of rdg + 2 digits)	0 to 2 A DC ± (0.5% of rdg + 2 digits)
Overload Indicator	Yes	Yes	Yes
Insulation			
Chassis to Terminal	>50 MΩ at 500 V DC	≥20 MΩ at 500 V DC	≥20 MΩ at 500 V DC
Chassis to Power Cord	>50 MΩ at 500 V DC	≥30 MΩ at 500 V DC	≥30 MΩ at 500 V DC
Safety Certification	UL, CSA, T-MARK	ETL, CSA, T-MARK	ETL, CSA, T-MARK

**1 (CC): When operated in Constant Current mode. (CV): When operated in Constant Voltage mode.*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CPS250
Triple Output Power Supply.
Includes: Operator's Manual, 3 pairs of Test Leads, US Power Cord, One Year Warranty.

PS280
Triple Output 0 to 30 V/2 A Power Supply.
Includes: Operator's Manual, 3 pairs of Test Leads, US Power Cord, One Year Warranty.

PS281
Single Output 30 V/3 A Power Supply.
Includes: Instruction Manual, One pair of Test Leads, US Power Cord, One Year Warranty.

PS282
Single Output 18 V/5 A Power Supply.
Includes: Operator's Manual, 3 Pairs of Test Leads, US Power Cord, One Year Warranty.

PS283
Triple Output 0 to 30 V/1 A Power Supply.
Includes: Operator's Manual, 3 Pairs of Test Leads, US Power Cord, One Year Warranty.

SERVICE ASSURANCE OPTIONS
These products covered by the following service assurance options:

REP4100 – Provides one year of post-warranty Repair Protection.

CAL4100 – Provides one year of Calibration Services.

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

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ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

Programmable Benchtop Power Supplies

PS2510 • PS2510G • PS2511 • PS2511G • PS2520 • PS2520G • PS2521 • PS2521G

Features

PS2510/PS2510G
- Single Output
- 0 to 36 V, 0 to 3.5 A
- Digital LED Output Indicator
- SCPI Compatible (PS2510G)

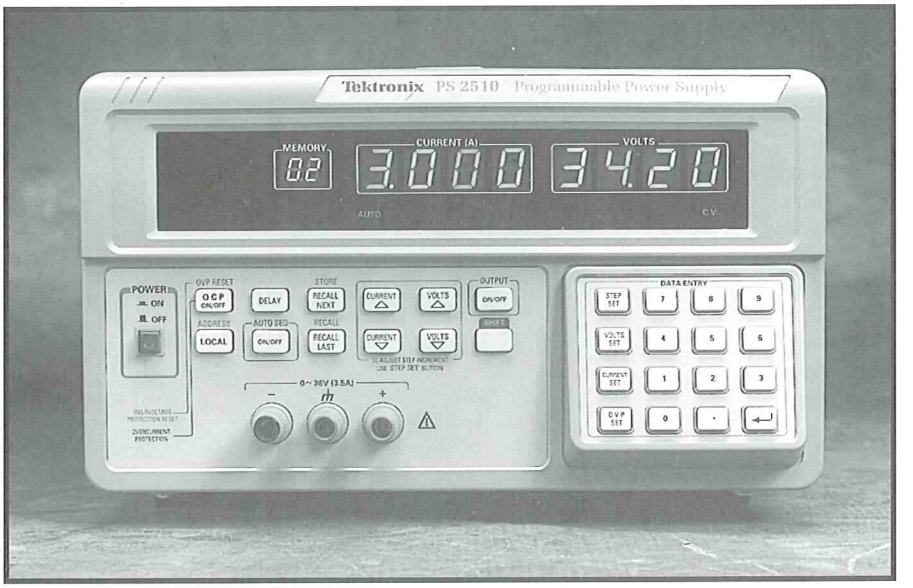
PS2511/PS2511G
- Single Output
- 0 to 20 V, 0 to 7 A
- Digital LED Output Indicator
- SCPI Compatible (PS2511G)

PS2520/PS2520G
- Triple Output
- One 0 to 6 V, 0 to 3 A
- Two 0 to 36 V, 0 to 1.5 A
- Digital LED Output Indicator
- SCPI Compatible (PS2520G)

PS2521/PS2521G
- Triple Output
- One 0 to 6 V, 0 to 5 A
- Two 0 to 20 V, 0 to 2.5 A
- Digital LED Output Indicator
- SCPI Compatible (PS2521G)

Applications

- Training
- Manufacturing Production Test
- Field Repair
- Bench Calibration and Repair
- Product Design



PS2510/PS2510G/ PS2511/PS2511G

The single output PS2510/PS2510G and PS2511/PS2511G Power Supplies are especially suited to low-cost computer controlled systems. The PS2510/PS2510G provide a maximum of 36 V and 3.5 A. The PS2511/PS2511G are rated up to 20 V and 7.0 A.

The PS2510G and PS2511G are GPIB programmable. The GPIB command sets are SCPI compatible.

Each power supply features 100 memories to store voltage and current limits for instant recall via the front panel or GPIB.

PS2520/PS2520G/ PS2521/PS2521G

The triple output PS2520/PS2520G and PS2521/PS2521G Power Supplies are versatile supplies suitable for many applications. The PS2520/PS2520G has a single supply providing a maximum of 6 V and 3 A and two supplies providing a maximum of 36 V and 1.5 A. The PS2521/PS2521G has a single supply providing a maximum of 6 V and 5.0 A and two supplies providing a maximum of 20 V and 2.5 A.

The supplies can be operated in one of three modes: independent, series, or parallel. In the independent mode, the output voltage and current of each supply are controlled independently. In the two tracking modes, the variable outputs are connected either in series or in parallel; the controls of the master power supply adjust the voltage or current of both power supplies.

The PS2520G and PS2521G are GPIB programmable. The GPIB command sets are SCPI compatible.

Each power supply features 100 memories to store voltage and current limits for instant recall via the front panel or GPIB.

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Programmable Benchtop Power Supplies

PS2510 • PS2510G • PS2511 • PS2511G • PS2520 • PS2520G • PS2521 • PS2521G

KEY SPECIFICATIONS

	PS2510/PS2510G	PS2511/PS2511G	PS2520/PS2520G	PS2521/PS2521G
Number of Outputs	1	1	3	3
Output Voltage	0 to 36 V	0 to 20 V	0 to 6 V, 0 to 36 V (two)	0 to 6 V, 0 to 20 V (two)
Output Current	0 to 3.5 A	0 to 7 A	0 to 3 A (6 V), 0 to 1.5 A (36 V)	0 to 5 A (6 V) 0 to 2.5 A (20 V)
Voltage Accuracy	0.025% + 25 mV	0.025% + 25 mV	0.05% 5 mV + 25 mV	0.05% 5 mV + 25 mV
Current Accuracy	0.2% + 10 mA	0.2% + 10 mA	0.2% + 10 mA	0.2% + 10 mA
Programmable Voltage Resolution	10 mV	10 mV	10 mV	10 mV
Programmable Current Resolution	1 mA	1 mA (2 mA >3.5 A)	1 mA	1 mA
Display	Digital, LED	Digital, LED	Digital LED	Digital, LED
Auto-series/Parallel Operation	N/A	N/A	Yes	Yes
Auto-master/Slave Tracking	N/A	N/A	Yes	Yes
Internal Memory	Yes, 100	Yes, 100	Yes, 100	Yes, 100
GPIB (SCPI)	Yes, PS2510G	Yes, PS2511G	Yes, PS2520G	Yes, PS2521G
Constant Voltage Mode	Yes	Yes	Yes	Yes
Constant Current Mode	Yes	Yes	Yes	Yes
Variable Current Limit	Yes	Yes	Yes	Yes
Over-voltage Protection	Yes	Yes	Yes	Yes
Over-current Protection	Yes	Yes	Yes	Yes
Dual 4-Digit Panel Meter	Yes	Yes	Yes	Yes
Safety Certifications	ETL, CSA	ETL, CSA	ETL, CSA	ETL, CSA

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

PS2510
Single Output Programmable Power Supply.

PS2510G
Single Output Programmable Power Supply.

PS2511
Single Output Programmable Power Supply.

PS2511G
Single Output Programmable Power Supply.

PS2520
Triple Output Power Supply.

PS2520G
Triple Output Programmable Power Supply.

PS2521
Triple Output Programmable Power Supply.

PS2521G
Triple Output Programmable Power Supply.
All Include: User Manual, US Power Cord, 1 Pair Black/Red Test Leads.

AVAILABLE ACCESSORIES

Programmer's Manual – Included with |PS2510G, PS2511G, PS2520G, PS2521G. Order 070-8069-00.

SERVICE ASSURANCE OPTIONS

These products covered by the following service assurance options:

REP4100 – Provides one year of post-warranty Repair Protection.

CAL4100 – Provides one year of Calibration Services.

Product(s) available through your local Tektronix Distributor listed in the back of this catalog.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

TekLumaColor™ Photometers

J17 • J18

Features

J18

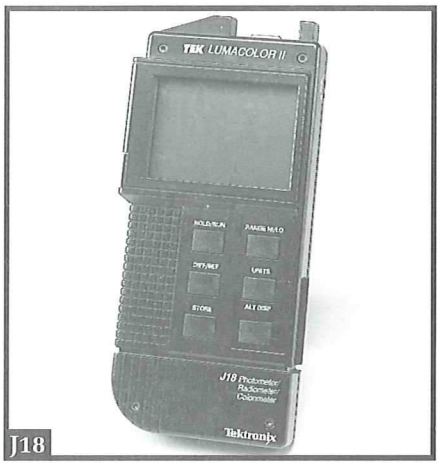
- Real-time Color Measurements
- Ten Memories for storing Reference Colors (with J1810)
- RGB Bar Graph
- D6500 Kelvin Calibration
- Color Temperature Measurement
- Full Control of Measurements Plus Output of Results (RS-232)
- Analog Output

J17

- Auto-ranging
- Auto Zero
- RS-232 Interface (Output Only)
- Wide Dynamic Range

COMMON FEATURES

- Interchangeable Pre-calibrated Heads
- Accurate Spectral and Cosine Corrections
- Metric/English Conversions
- Large LCD with Backlight
- Rugged
- Handheld
- Adaptable to Many Light Measurement Needs



J17/J18 Photometers

The Tektronix J17 and J18 are handheld digital Photometers/Radiometers/Colorimeters for the laboratory, field, or production area. A J17/J18 System consists of a J17/J18 handheld meter and one of nine interchangeable heads. At the heart of the J17/J18 is a microprocessor capable of performing several functions: Metric-to-US conversion, auto-range, auto-zero, hold, and conversion between color coordinate systems. The J17/J18 can be used with a PC for automated testing and data recording. The J17/J18 are powered by a 9-volt battery.

PLUG-IN HEADS PROVIDE MEASUREMENT FLEXIBILITY

Pre-calibrated plug-in heads measure illuminance, irradiance, luminance, radiance, light emitting diode (LED) output, and color using CIE coordinates (u' v' or xy). All heads use silicon photodiodes and spectrally-corrected, multi-element, glass filters for long-term stability and accuracy. Connection of a head to the J17/J18 automatically selects the correct measurement units. The backlit liquid crystal display can be read easily in dark locations.

J1803 8° LUMINANCE HEAD

- Video and Projection Screens
- Surface Reflectance

The J1803 measures luminance, in candelas/m^2 (nits) or footlamberts, where light scattered or emitted by a surface must be measured. Spectral response is closely matched to the CIE photopic curve, ensuring accurate results even when measuring spectrally different light sources.

The 8° acceptance angle is determined by internal field-stop apertures.

J1805 HEAD FOR LEDS

- Output of Red, Yellow, Green, and Blue LEDs

The J1805 measures luminous intensity in candelas or millicandelas.

Inserts are supplied to fit common sizes of LEDs. These inserts can be modified by the user for other LED sizes or similar light sources.

J1806 8° RADIANCE/RADIANT INTENSITY HEAD

- Display Color Balance

The J1806 is useful for quickly verifying or resetting color balance once initial color characterization has been done using the J1820 or J1810.

J1811 ILLUMINANCE HEAD

- Highway Illumination
- Luminaires and Lamps
- Workstation Illumination

The J1811 is an illuminance head with readout in footcandles or lumens/m^2 (lux). A multi-element glass filter and silicon photo-diode ensure a close match to the CIE photopic curve for accurate measurement of spectrally differing light sources.

J1812 IRRADIANCE HEAD

- Laser Experiments
- Infrared LED Testing

The J1812 measures irradiance in milliwatts/m^2 or output power in milliwatts. The spectral response is flat ±8% from 450 to 950 nanometers. The response is typically down 50% at 400 and 1030 nm.

J1810/J1820 CHROMATICITY HEAD

- Color Monitor Chromaticity and White Balance
- Color Temperature

The J1810/J1820 measure color coordinates in the 1931 CIE and 1976 CIE-UCS chromaticity systems. Color coordinates are automatically computed and displayed in either x and y or u' and v' units. Luminance in candela/m^2 or foot-lamberts may also be measured. The J1820 works with the J17; the J1810 provides similar performance plus real-time color measurements, correlated color temperature measurement and programmable control of the J18.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

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TekLumaColor™ Photometers

J17 • J18

CHARACTERISTICS

	J1803	J1805	J1806
Measurement	Luminance	Luminance Intensity	Radiant Intensity
Applications	Displays, Television, Medical	LEDs	Displays, Television
Ranges with J17	0.03 to 1,500,000 candelas/m^2 (Nit) 0.01 to 500,000 footlamberts	0.01 mcandelas to 100 candelas	0.001 to 1,000 W/m^2/sr
Ranges with J18	0.3 to 300,000 candelas/m^2 (Nit) 0.1 to 100,000 footlamberts	0.01 mcandelas to 10 candelas	0.001 to 200 W/m^2/sr
Spectral Response	CIE Photopic	CIE Photopic	Flat
Spectral Accuracy	f_1' =< 3% (DIN Class A)	f_1' = <3% (DIN Class A)	±8% 450 to 750 nm
Accuracy	5% ± 2 digits	5% ± 2 digits	5% ± 2 digits
Acceptance Angle	8°	8°	8°
Other Features	Suction cup	LED adaptors	Suction cup
Cable Length	3.5 ft	3.5 ft	3.5 ft

	J1810	J1811	J1812	J1820
Measurement	Chromaticity, Luminance	Illuminance	Irradiance	Chromaticity, Luminance
Applications	Displays, Television	Highway lighting, Office lighting, Transportation	Lasers, IR LEDs, Research	Displays, Television
Ranges with J17	Usable with J18 only	0.01 to 50,000 lux (lm/m^2) 0.001 to 5,000 footcandles	0.01 to 20,000 mW/m^2 1 nW to 2 mW	0.001 to 0.999 x,y and u',v' 0.3 to 300,000 candelas/m^2 (Nit) 0.1 to 100,000 footlamberts
Ranges with J18	0.001 to 0.999 x,y and u',v' 0.3 to 1,000 candelas/m^2 (Nit) 0.1 to 300 footlamberts	0.01 to 5,000 lux (lm/m^2) 0.001 to 500 footcandles	0.001 to 2,000 mW/m^2 0.1 nW to 0.2 mW	Usable with J17 only
Spectral Response	CIE Tristimulus	CIE Photopic	Flat	CIE Tristimulus
Spectral Accuracy	f_1' = <3% (DIN Class A)	f_1' = <3% (DIN Class A)	±8% 450 to 950 nm	f_1' = <3% (DIN Class A)
Accuracy	0.009 at D6500	5% ± 2 digits	5% ± 2 digits	0.018 at Illum A
Acceptance Angle	16°	180° (Cosine)	96° (Approx.)	16°
Other Features	Suction cup	Level and cover	Cover	Suction cup
Cable Length	3.5 ft	6 ft	6 ft	3.5 ft

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

J17
TekLumaColor™ Photometer.

J18
TekLumaColor™ Photometer.

Both Include: Battery, Operator's Manual. J17 and J18 require one or more of the following heads:

J1803
Luminance Head.
Includes: Operator's Manual, Spectral Curve, Suction Cup, Retainer/Filter Holder, Light Occluder.

J1805
LED Head.
Includes: Operator's Manual, Spectral Curve, Two LED inserts, Rubber Retainer.

J1806
Radiance/Radiant Intensity Head.
Includes: Operator's Manual, Spectral Curve, Suction Cup.

J1811
Illuminance Head (cosine corrected).
Includes: Operator's Manual, Spectral Curve.

J1812
Irradiance Head
Includes: Operator's Manual, Spectral Curve.

J1810
Color Head (J18 only)
Includes: Operator's Manual, Spectral Curve, Suction Cup.

J1820
Color Head (J17 only).
Includes: Operator's Manual, Spectral Curve.

AVAILABLE ACCESSORIES

RS-232 Cable – Order 012-1411-00.

120 V AC Supply – Order 119-5032-00.

220 V AC Supply – Order 119-3297-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

Measurement
Education

Features

LEARNING MATERIALS

Tektronix Learning Materials Are:

- Written by Educators and Instructional Designers
- Professionally Produced
- Comprehensive, Covering Both Operations and Concepts
- Designed for Beginning Through Advanced Students
- Available in Videotapes, Workbooks, Instructors Guides, QuickStart, and Self-study Packages

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

A Partnership Dedicated to Educational Excellence

As an educator, you play a key role in shaping the future of business and technology; you're committed to helping emerging technicians, scientists, and engineers learn skills they'll apply for years to come.

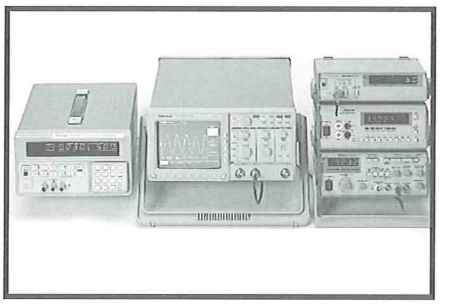
Tektronix products have long been the products of choice for educational institutions around the world because they:

- Are easy to learn and use
- Meet stringent testing standards
- Are rugged, student-proof and safe
- Are the same high quality instruments used in industry
- Provide a smooth transition from school to career

THE LONG TERM CHOICE

Tektronix' commitment to education does not end with the purchase of equipment. Our long term commitment to education is demonstrated by the availability of:

- Courseware and instructional materials
- Rugged and safe equipment
- Operator and technician training
- Extended warranties



Our basic instruments can be easily stacked and conserve bench space. They complement our analog and digital oscilloscopes as a popular setup for basic lab stations.

BUDGET SOLUTIONS

At Tektronix we understand the dilemma that many educators face – you have a need for industry-proven, up-to-date equipment, but your budgets don't always allow for funding. Therefore, we offer a line of low-cost basic electronics equipment through our distributors that meets the needs of both education and industry. You'll also be pleased to know that Tektronix offers special pricing for educational institutions.

We are working to meet your educational objectives – providing technologically advanced products, budget alternatives, and superior quality and service.

RUGGED AND SAFE

In both design and test, we ensure that our products meet stringent standards for EMI, humidity, temperature, electrostatic shock, and vibration. Tektronix products are also third-party certified by UL and CSA. Not only do these certifications protect you and your students, they help you comply with many state and local regulations.

A BROAD RANGE OF PRODUCTS

Tektronix offers the best selection of test and measurement equipment in the industry. Whether you're buying for a vocational center, community college or major university, you'll find we have everything you need.

The Tektronix measurement products include:

- Analog and Digital Oscilloscopes
- Logic Analyzers, Spectrum Analyzers
- Function Generators, Power Supplies, Counters
- Automatic stimulus and measurements tools
- Modular instruments for custom systems
- A full line of accessories

From basic to advanced laboratory and bench instrumentation, our products will meet your needs in:

- Electronics
- Mechanical Engineering
- Physics
- Semi- and fully-automated test

And in every Tektronix product you'll find the familiar, easy operation that's become a de facto standard the world over, which is perhaps the main reason why people in so many different environments prefer Tektronix equipment.

Because whether your students are preparing to seek their fortunes, or preparing to apply what they've learned to make it, there's no substitute for the confidence that comes from using the best: Tektronix.

Measurement
Education

Courseware and Training

For many instructors, the time spent preparing to teach far outweighs the time spent teaching. That's why we offer comprehensive and self-contained courseware. This courseware is designed to complement and supplement the broad range of Tektronix' test and measurement products and your classroom curriculum.

SELF-STUDY PACKAGES

Realizing the need for individuals to learn at their own pace, Tektronix has developed an extensive line of self-study packages. Engineers as well as students can sharpen their skills in instrument usage and application in less time than learning by trial and error.

In less than an hour, the student can learn the unique time-saving features of the equipment and put these to use immediately. The result is increased productivity.

To conserve valuable lab time, Tektronix has created these aids so that students can come prepared to apply their understanding of the equipment to the challenges of the curriculum.

Each self-study course includes a detailed video instruction tape and a workbook. Materials cover instrument operations as well as concepts and applications, from basic through advanced test and measurement techniques. Discussions include:

- Basic Instrument Concepts
- Major Product Features and Operation
- Applications
- Probe Compensation and Usage
- Measurement Techniques
- Controller Integration
- Communication Interfaces
- Display and Output Concepts

QUICKSTART PACKAGES

These specially designed packages provide detailed hands-on instruction and application examples. Each package provides step-by-step workbooks and specially designed signal generation boards to help the user get up and running in no time at all. These packages are designed for self-paced use or for integration into the classroom curriculum.



Tektronix' extensive selection of learning materials can save you countless hours in the preparation and presentation processes so that you can concentrate on what you do best – educating our next generation of engineers and technicians.

VIDEOTAPE AND LITERATURE

Tektronix offers educators one of the most extensive libraries of videotaped presentations on theory and application in the industry. And for classroom and lab work, Tektronix' primers and workbooks take students from the most basic level of skills through the highest levels of sophistication they'll need for a successful career.

SERVICE AND SUPPORT ALSO KEY

Tektronix' highly trained account managers, application engineers and distributors stand ready to offer you both curriculum and technical support. Our curriculum support materials and workshops will help you keep up to date. Also, we offer standard warranties as well as a variety of service programs to keep your Tektronix equipment calibrated and in the best working condition.

To complement the warranty programs, Tektronix has service centers conveniently located around the U.S. and throughout the world. You will want to take advantage of our service network because we can provide the expertise needed to calibrate and maintain your instruments at their highest level of performance.



"We are pleased to say that in our Industrial Electronics training program we are still successfully using Tektronix test equipment that was purchased 16 years ago. The wearability and quality of the equipment is noteworthy because we utilize the equipment on a daily basis in the instruction and training of our students. We spend little time on repairs and are very satisfied with the technical support and service offered through Tektronix."

Gene Prigmore
Industrial Electronics Instructor
Moore-Norman Vo-Tech Center
Norman, Oklahoma

Measurement
Education

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

VIDEOTAPE SELECTION GUIDE
Note: "XX" is to be replaced by one of the following:
NTSC format (used in USA)
00 = 3/4 in., **01** = BETA I, **02** = BETA II, **03** = BETA III, **04** = VHS/NTSC.

PAL format
06 = VHS/PAL, **08** = Workbooks.

SECAM format
07 = VHS/SECAM.

SELF-STUDY PACKAGES
Each self-study course includes a detailed video instruction tape and a workbook. Additional workbooks are available.

Fundamentals of Analog Scopes 068-0270-XX.

Fundamentals of Probes 068-0269-XX.

Fundamentals of Digital Scopes 068-0268-XX.

Fundamentals of GPIB 068-0260-XX.

Fundamentals of RS232 068-0259-XX.

Using the PC as a Controller 068-0301-XX.

Fundamentals of Logic Analyzers 068-0291-XX.

Operating the 2201 068-0290-XX.

Operating the 2205 068-0289-XX.

Operating the 2210 068-0274-XX.

Operating the 2211 068-0311-XX.

Operating the 2213A/2215A 068-0278-XX.

Operating the 2220 068-0273-XX.

Operating the 2221 068-0272-XX.

Operating the 2224 068-0310-XX.

Operating the 2225 068-0279-XX.

Operating the 2230 068-0271-XX.

Operating the 2232 068-0312-XX.

Operating the 2235 068-0277-XX.

Operating the 2236 068-0276-XX.

Operating the 2245A 068-0325-XX.

Operating the 2246A 068-0326-XX.

Operating the 2247A 068-0327-XX.

Operating the 2430A 068-0267-XX.

Operating the 2432 068-0266-XX.

Operating the 2432A 068-0305-XX.

Operating the 2440 068-0265-XX.

Operating the 2445A/2465A 068-0262-XX.

Operating the 2445B/2465B/2467B 068-0261-XX.

Operating the 11301A/11302A 068-0264-XX.

11301/11302 Waveform Measurement 068-0304-XX.

11401/11402 Waveform Measurement 068-0302-XX.

11401/11402 Adv. Waveform Measurement 068-0303-XX.

Operating the 1230 068-0288-XX.

QUICKSTART™ PACKAGES
Each package is designed to give step-by-step instruction using workbooks and specially designed signal generation boards.

TDS500/600 QuickStart Package 020-2024-00 (U.S.), 020-2025-00 (European).

2240 Series QuickStart Package*1 020-1864-04 (VHS/NTSC), 020-1864-06 (VHS/PAL).

GPX QuickStart Package 020-2093-00.

2211 DSO QuickStart Package*1 020-1811-04 (VHS/NTSC), 020-1811-06 (VHS/PAL).

2400 Series Digital Oscilloscopes QuickStart Package*1 020-1679-00 U.S. power (VHS/NTSC), 020-1681-00 European power (VHS/PAL).

11402/11403 QuickStart Package 020-1767-01 (U.S.), 020-1768-01 (European).

DSA 600 QuickStart Package 020-1769-00 (U.S.), 020-1770-00 (European).

2252/2247A/2245A QuickStart Package*1 020-1864-04 (VHS/NTSC), 020-1864-06 (VHS/PAL).

2232/2224/2221A QuickStart Package*1 020-1812-04 (VHS/NTSC), 020-1812-06 (VHS/PAL).

VIDEOTAPES

Oscillo-what? What Is an Oscilloscope? Discusses the display, vertical, horizontal and trigger sections and introduces digitizing oscilloscopes. 068-0218-XX.

Oscilloscope Primer Practical Scope How to use a scope, acquire a trace, select suitable vertical and horizontal scale factors, and how to use the special features on the Tektronix 2225 Oscilloscope. 068-0227-XX.

The Vital Link – Probe and Signal Concepts 068-0229-XX. See page 436 for full description.

Fundamentals of Oscilloscopes: A Functional Overview For people with prior electronics knowledge and some exposure to oscilloscopes. Explains functional characteristics of a typical analog oscilloscope. 068-0217-XX.

Fundamentals of Oscilloscopes: Digital Storage Concepts Describes and illustrates functional concepts of typical digital storage oscilloscope. 068-0240-XX.

222 Family Operation Overview of oscilloscope operation and a detailed front panel tour of the 222 Family. 068-0344-XX.

Understanding Spectrum Analyzers Highlights differences between time and frequency domain displays. Examines real time and swept super heterodyne spectrum analyzers. Demonstrates basic controls and functions. 068-0350-XX.

Soldering FlexLead™ Adapters 068-0320-04 (VHS/NTSC), 068-0320-06 (VHS/PAL), 068-0320-07 (VHS/SECAM).

Networking 101 – Ethernet Networking Made Simple Describes Ethernet from its hardware perspective. Demonstrates how Ethernet works. Illustrates common Ethernet building blocks. 068-0345-XX.

Networking 102 – TCP/IP Explains basics of TCP/IP addressing the three classes of networks, use of netmasks to create subnets, how TCP/IP/Ethernet addressing work together to move data across networks, use of a default gateway to move data between networks. 068-0347-XX.

Networking 103 – Token-ring Discusses Token-ring Computer networks. Explores the similarities and differences with Ethernet. Explains source routing, MAUs, Cabling and LAN speed. Third in a series of Networking videotapes. 068-0348-XX.

LITERATURE

Lab Bench Equipment Orientation Instructor guide and workbooks for CFC250, CFG250, CDM250 and CPS250 (50 workbooks, 1 guide). 062-9511-01.

Oscilloscope XYZs Primer Covers horizontal, vertical and trigger functions, controls, use of probes, terminology, and theory of waveforms and measurement techniques (50 primers). 062-9323-01.

ABCs of Probes (50 primers). 062-9471-00.

**1 Videotape included where noted.*

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.



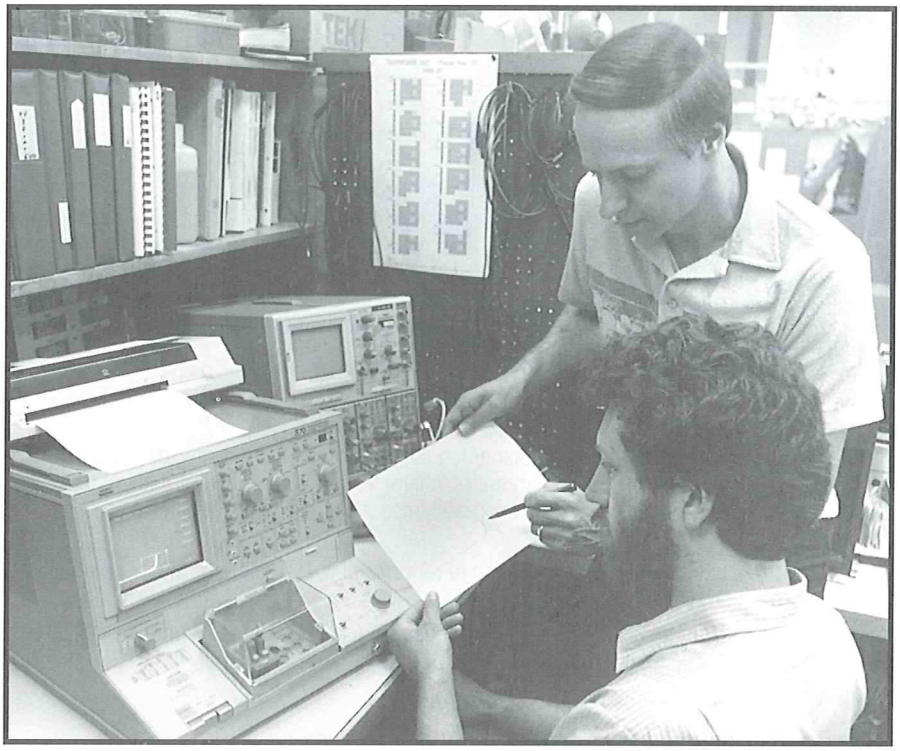
See Tektronix on the World Wide Web: http://www.tek.com

Semiconductor DC Characterization

Characterization and Test Solutions for Semiconductor Design, Manufacture and Quality Assurance

- The 370A provides a broad measurement range with up to 20 A capability.
- The 3000 W 371A has all the power you will need for high power semiconductors.
- Metrics*1 software for interactive computer control of the 370A and 371A curve tracers.

*1 *Metrics is a trademark of Metrics Technologies.*



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Instrumentation Carts....520

Curve Tracer
370A

Features

- High Precision Measurements of Semiconductor Devices
  - Up to 2000 Volts or 10 Amp Sourcing
  - Up to 220 Watts
  - Down to 1 Nanoamp Measurement Resolution
- Down to 2 Millivolt Measurement Resolution
- Waveform Comparison
- Envelope Display
- Waveform Averaging
- Dot Cursor
- 3.5 Inch MS-DOS Compatible Disk Storage

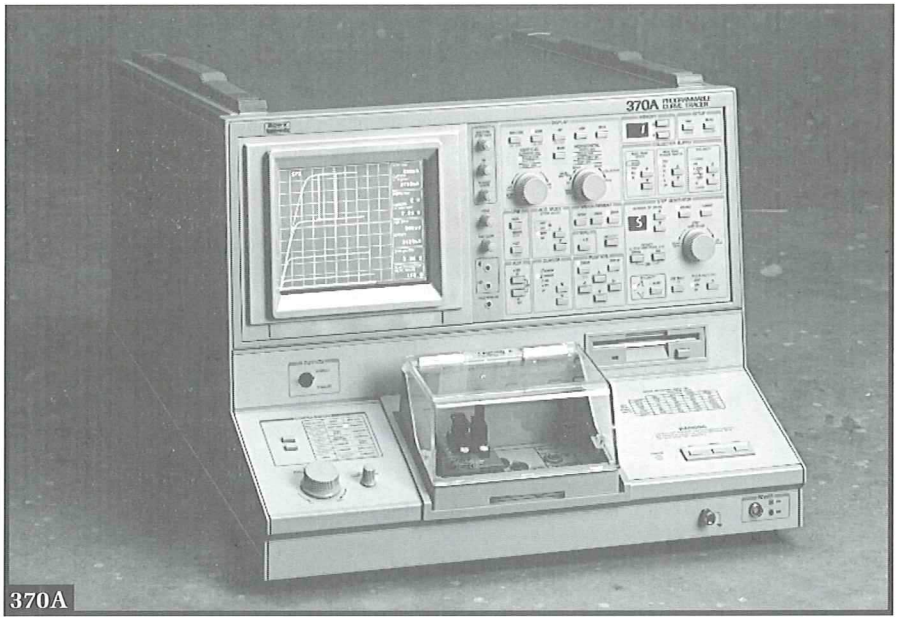
BENEFITS

- Kelvin Sense Measurements
- High Resolution Measurements
- Versatile Power Range
- Fully Programmable
- Save and Recall Setups Using Floppy Disk for Later Use

Applications

Manual or Automated High Resolution DC Parametric Characterization of Semiconductors

- Incoming Inspection
- Manufacturing Test
- Process Monitoring and Quality Control
- Data Sheet Generation
- Component Matching
- Failure Analysis
- Engineering



370A

370A Programmable Curve Tracer

The 370A, the world standard for high resolution curve tracers is used in a wide variety of applications. The 370A performs DC parametric characterization of transistors, thyristors, diodes, SCRs, MOSFETs, opto-electronic components, solar cells, solid state displays and other semiconductor devices.

In the R&D lab, it is used for characterization of new designs, extraction of SPICE parameters, failure analysis, and data sheet generation.

In manufacturing test, the 370A is used to verify device quality and process monitoring.

The 370A is used for incoming inspection to verify device performance, perform failure analysis and to match components.

INTERACTIVE, PROGRAMMABLE CONTROL
Interactive control of all measurements is accomplished from the full featured front panel or over the GPIB. Operating parameters can be adjusted and stored and recalled using several storage methods including the 370A non-volatile memory, the built-in DOS compatible floppy disk or to an external controller.

TEST AND MEASUREMENT SOFTWARE
Metrics software offers computer-controlled DC parameter characterization of numerous semiconductor devices. Through Metrics control of the 370A, measurements can be performed without the need to interact with the instruments front panel. Every aspect of instrument control and data analysis is available through a set of interactive dialog boxes that are configured in a graphics-oriented Microsoft Windows environment.

Turn to page 432 for more information about Metrics software.

TEST FIXTURING
A test fixture is a standard accessory that provides safe device enclosure to ensure operator protection during measurements. The test fixture accommodates standard A1001 through A1005 adapters with Kelvin sensing, 3-pin adapters without Kelvin sensing and the A1023 and A1024 surface mount adapters.

DIRECT HARDCOPY
Plotter output data can be sent directly from the 370A without the need for an external controller. Plotting can continue while the 370A performs the next tasks.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

Curve Tracer
370A

Source Characteristics

COLLECTOR SUPPLY

Modes – AC, ±DC, ±Leakage, ±Rectified Sine.

Range	Max Peak Current (±)	Peak Current Pulsed (±)*1
16 V	10 A	20 A
80 V	2 A	4 A
400 V	.4 A	.8 A
2000 V	.05 A	.1 A

*1 *Collector supply is not pulsed; assumes a pulsed step generator supply.*

STEP GENERATOR

Modes – Stair step: DC, 80 µsec pulse, 300 µsec pulse.

Step Range – Current: 50 nA to 200 mA in 1-2-5 sequence. Voltage: 50 mV to 2 V in 1-2-5 sequence.

Offset – Up to ±10X step amplitude.

No. of steps – 0 to 10.

Measurement Characteristics

Collector Current – Measurement range: 100 nA/div (1 nA resolution) to 2 A/div. Accuracy: 1.5% of cursor readout +0.05 div of setting (with dot cursor).

Emitter Current – Measurement range: 1 nA/div (10 pA resolution) to 2 mA/div. Accuracy: 1.5% of cursor readout + 0.05 div of setting + 1 nA.



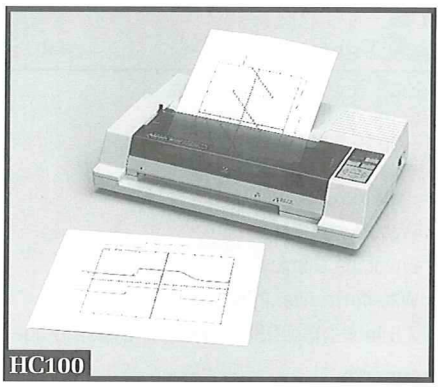
Accessory

K475

Instrument Cart

- Ergonomic design
- Simple height, angle, and shelf adjustments
- Durable steel and aluminum construction
- Large diameter smooth rolling casters
- Nylon safety straps included

For complete selection information on all Accessory products, see page 434.



Accessory

HC100

Low-cost, Four-color Plotting

- Compatible with GPIB, RS-232, Centronics interfaces
- Plots both U.S. and A4 formats on paper, mylar and overhead material
- Graphics and text capability
- Compact package

For complete selection information on all Accessory products, see page 434.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

370A
Curve Tracer.
Includes: Blank Adapter A1001; In-line Transistor A1002, Axial Diode Lead Adapter A1005; 4 and 6 Lead Transistor/FET Adapter A1007; Floppy Diskette (119-3446-00); Protective Cover (337-3344-00); Spare Fuses 125 V/4 A (159-0259-00); Slow Blow 250 V/2 A Fuse (159-0160-00); Power Cord (161-0066-00); Operator's Manual (070-7779-00).

Opt. 1R – Rack Mounting.

ADDITIONAL ACCESSORIES – Also see page 434.
Service Manual – Order 070-7780-00.
Calibration Fixture – Order 067-0187-00.
Rackmount Kit – Order 016-0930-00.
Socket Adapters – See adapters on page 433.
SOFTWARE
METRICS Software – Core Program (requires 063-1650-00 drivers). Order 063-1649-00.
METRICS Software – Tektronix 37x Curve Tracer Drivers. Order 063-1650-00.
CART – Order K475.

CAMERA – Order C-9 Opt. 1A and Opt. 07.
PLOTTER – HC100 with Opt. 01.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1, and with Tektronix Standard Codes and Formats.*

See Tektronix on the World Wide Web: http://www.tek.com

Curve Tracer
371A

Features

- High Power Measurements of Semiconductor Devices
  - Up to 3,000 Volts
  - Up to 400 Amps
  - Up to 3,000 Watts
- Waveform Comparison
- Envelope Display
- Waveform Averaging
- 3.5 Inch MS-DOS Compatible Disk Storage

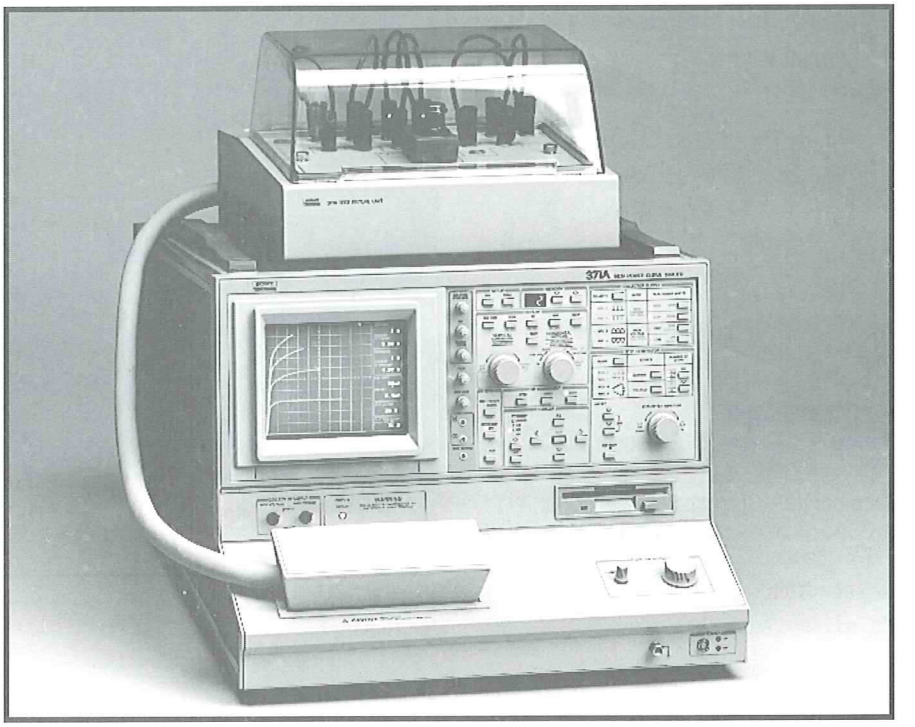
BENEFITS

- High Power to Test Power Semiconductors Like IGBTs
- Kelvin Sense Measurements
- Versatile Power Range
- Fully Programmable
- Save and Recall Setups Using Floppy Disk for Later Use

Applications

Manual or Automated DC Parametric Characterization of High Power Semiconductors

- Incoming Inspection
- Manufacturing Test
- Process Monitoring and Quality Control
- Data Sheet Generation
- Component Matching
- Failure Analysis
- Engineering



371A High Power Programmable Curve Tracer

The 371A, the industry leader in high power curve tracers is used for testing a wide variety of power semiconductors. It performs DC parametric characterization of thyristors, SCRs, IGBTs and power MOSFETs.

The high voltage collector mode permits testing the Off-Characteristics of a device up to 3,000 volts. The pulsed high current collector mode provides output current pulses greater than 400 amps peak for testing On-Characteristics. It also permits high power testing up to 3,000 watts.

In the R&D lab, the 371A is used for characterization of new designs of power devices, extraction of SPICE parameters, failure analysis, and data sheet generation.

In manufacturing test, the 371A is used to verify device quality and process monitoring.

The 371A is used for incoming inspection to verify power device performance and perform failure analysis.

INTERACTIVE, PROGRAMMABLE CONTROL
Interactive control of all measurements can be done from the full featured front panel or over the GPIB. Operating parameters can be adjusted and stored and recalled using several storage methods including the 371A non-volatile memory, the built-in DOS compatible floppy disk or to an external controller.

AUTOMATED CURSOR MEASUREMENTS
The 371A provides three cursor measurement modes. The Dot cursor provides direct screen readout of voltage, current, gm or DC beta at any point. The Window cursor can be positioned between two curves to measure small signal beta or gm, and can also be used for visual go/no-go tests. The Function Line cursor provides screen readout of a slope or intercept value.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1, and with Tektronix Standard Codes and Formats.*

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Curve Tracer
371A

SWEEP MEASUREMENT MODE
In the sweep measurement mode, the 371A will automatically construct a family of curves while stimulating the device with low duty-cycle pulses. With this capability, power curves can be displayed without excessive heating of the device.

TEST FIXTURING
A test fixture is a standard accessory that provides safe device enclosure to ensure operator protection during measurements. The test fixture accommodates standard A1001 through A1005 adapters with Kelvin sensing, 3-pin adapters without Kelvin sensing and the A1023 and A1024 surface mount adapters.

DIRECT HARDCOPY
Plotter output data can be sent directly from the 371A without the need for an external controller. Plotting can continue while the 371A performs the next tasks.

TEST AND MEASUREMENT SOFTWARE
Metrics software offers computer-controlled DC parameter characterization of numerous semiconductor devices. Through Metrics control of the 371A, measurements can be performed without the need to interact with the instrument's front panel. Every aspect of instrument control and data analysis is available through a set of interactive dialog boxes that are configured in a graphics-oriented Microsoft Windows environment.

Turn to page 432 for more information about Metrics software.

Characteristics

COLLECTOR SUPPLY
Modes – High Current: 250 µsec pulses with max. peak of 30 volts. High Voltage: Full rectified sine with max. peak of 300 volts (positive and negative polarities for both modes).

Range	Peak Current	Peak Power
30 V	400 A	3 kW
30 V	40 A	300 W
300 V	40 mA ±20%	30 W
300 V	4 mA ±20%	3 W
3 kV	4 mA 0 ±20%	300 mW
3 kV	4 mA ±20%	30 mW

Measurement Characteristics

COLLECTOR CURRENT

Maximum Power Setting	Vertical Range (in 1-2-5 increments)
3 kW	1 A/div to 50 A/div
300 W	500 mA/div to 5 A/div
30 W	100 µA/div to 5 mA/div
3 W, 300 mW	10 µA/div to 500 µA/div
30 mW	1 µA/div to 50 µA/div

Accuracy: within 0.1 vertical division.

Test Fixture – Designed to allow easy connection to a variety of devices. It has a safety enclosure to assure operator protection. Special patch cords are provided for connecting large devices.

STEP GENERATOR
Modes – Current (stair step): DC, 500 µsec ±10% of pulse. Voltage (stair step): DC.

Step Range – Current: 1 mA/step to 2 A/step pulsed (hi current mode). 1 µA/step to 2 mA/step DC (hi voltage mode). Voltage: 200 mV/step to 5 V/step. Offset: ±10X step amplitude (5X in 5 V/step and 2 V/step settings).

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

371A
High Power Curve Tracer.
Includes: In-line Transistor A1002; TO3/TO66 Adapter A1003; Power Cord (070-6839-00); Operator's Manual (070-8043-00); and Pocket Reference Guide (070-6841-00).

ADDITIONAL ACCESSORIES – Also see page 434.

Field Wiring Cable – Order 198-5628-00.

Service Manual – Order 070-8044-02.

Calibration Fixture – Order 067-1345-00.

Rackmount Kit – Order 016-0930-00.

Socket Adapters – See adapters section on page 433.

SOFTWARE
METRICS Software – Core Program (requires 063-1650-00 drivers). Order 063-1649-00.

METRICS Software – Tektronix 37x Curve Tracer Drivers. Order 063-1650-00.

CART – Order K475.

PLOTTER – HC100 with Opt. 01.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

GPIB IEEE-488 *Product(s) complies with IEEE Standard 488.1, and with Tektronix Standard Codes and Formats.*

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Metrics Software

Features

- Control Test, Measurement and Analysis from the PC
- Drivers Support Both the 370A and 371A Curve Tracers
- Easy to Use, Microsoft Windows Environment

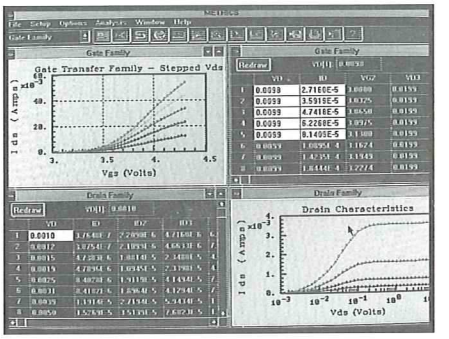
BENEFITS

- No Programming Needed
- Extend Measurement Capability Beyond Manually Operated Instrument
- Allows performing automated procedures
- Transfer Data Easily to Other Graphic or Analysis Programs With DDE Support

Applications

AUTOMATED DC PARAMETRIC CHARACTERIZATION OF

- Research and Development
- Incoming Inspection
- Process Monitoring and Quality Control
- Data Sheet Generation
- Component Matching
- Failure Analysis



Metrics Allows Comprehensive Instrument Control

Metrics control of the industry standard 370 and 371 Series curve tracers provide DC parameter characterization of numerous small signal and high-power semiconductor devices including diodes, bipolar transistors, MOSFETs, thyristors, ICs and IGBTs.

In addition to comprehensive instrument control, Metrics provides the capability to collect, analyze and display test data in the Microsoft Windows environment. Metrics robust drivers access all the accuracy and resolution of the 370 and 371 Series curve tracers while enhancing the instruments' versatility and ease of use.

POINT, CLICK AND MEASURE

The setup editor is a graphic workspace where test setups can be completely configured and saved without any programming. Test setups and instrument forcing conditions are constructed through point-and-click editing. Using the mouse, the test instrument, device type, interconnections and measurement conditions can be specified.

DATA COLLECTION AND ANALYSIS

From the data window, one or more plot windows with user-defined specifications can be created. To focus on any section of a plot, the zoom feature allows magnifying the area of interest.

Data analysis is supported with a full range of data reduction tools including five variable tracking and nontracking cursors, curve fitting, axes scaling and plot formatting. A vector/scaler engineering calculator provides advanced post processing and manipulation of the test data.

TEST MANAGEMENT UNDER GRAPHIC CONTROL

Metrics uses an advanced file management system to store and retrieve project files. When a device is tested, all information relating to that device is stored in a project file. The project file includes all test setups, forced test conditions, data and plot windows that were defined for a particular device.

AUTOMATED TESTING

Metrics supports automated testing with several convenient capabilities. The automatic test sequence function runs a series of tests on a device by simply pushing one button. When testing a large group of devices, the Autostore function will store data for each device in a separate, sequentially number file.

MAKE MEASUREMENTS NOT POSSIBLE FROM MANUAL CONTROL

In Metrics, any instrument supply can be configured for sweep, step or constant mode, something not possible from the front panel. For example, the software can be configured to sweep the base supply while stepping the collector supply.

An additional capability is the ability to set step quantity or step size beyond those available from the front panel. Metric allows specifying any step size and step quantity within the power capabilities of the instrument.

Metric's Autoscaling mode eliminates the need to manually search through various scaling ranges to optimize measurement results.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ORDERING INFORMATION

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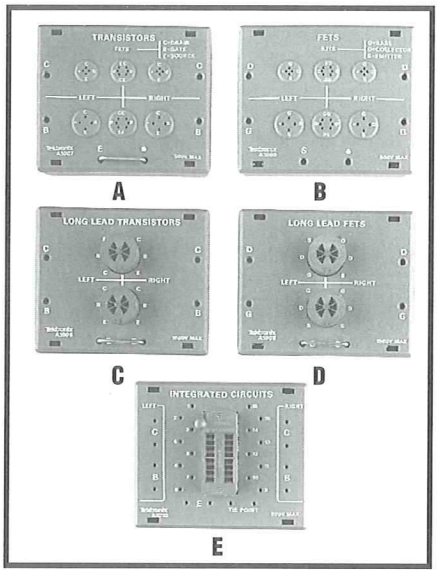
METRICS SOFTWARE
Core Program – Requires 063-1650-00 drivers to operate 37x curve tracers. Order 063-1649-00.

METRICS SOFTWARE
370 and 371 Series Curve Tracer Drivers – Order 063-1650-00.

Semiconductor Testers
Device Adapters

Features

ADAPTERS
- Dual Width Adapters
- Kelvin Sensing Adapters
- SMT Device Adapters



DUAL WIDTH ADAPTERS
Adapters A1006 through A1010 fit the side-by-side terminals on test fixtures of the 370A Curve Tracer. These adapters allow either 1 or 2 devices mounted in the adapter which is useful for alternating comparisons of two devices.

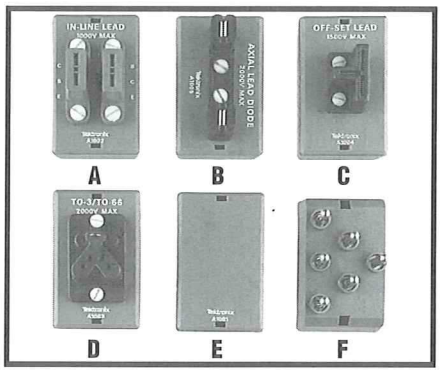
A. Transistor Adapters for Bipolar Transistors and some MOSFETs – Order A1007.

B. FET Adapter for most FETs – Order A1009.

C. Long Lead Transistor Adapter for Transistors with Untrimmed Leads – Order A1006.

D. Long Lead FET Adapter for FETs with Untrimmed Leads – Order A1008.

E. Integrated Circuit Adapter for Multi-Pin Dual-in-Line Device Packages – The pins are connected to the collector, base or emitter terminals with patch cords. A tie point is also provided for an external power supply or signal source connection to the IC pins. Includes one each lead for connecting auxiliary supply to the tie points (196-3067-00); six each 4-inch test leads (012-0310-00). Order A1010.



KELVIN SENSING ADAPTERS
These adapters fit the test fixtures of the 370A and 371A Curve Tracer.

A. In-Line Adapter – Accepts large and small TO-220 transistors with in-line leads. Spacing between leads is 0.06 inch to 0.18 inch. The adapter is wired for both B-C-E and C-B-E lead configurations. Order A1002.

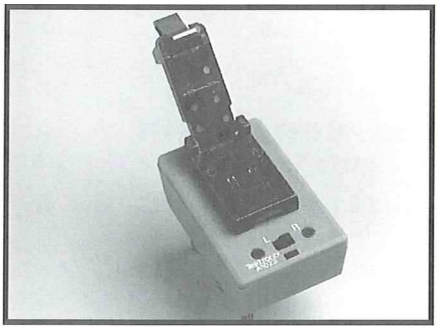
B. Axial Lead Diode Adapter – Order A1005.

C. Offset Lead Adapter for Power Transistor – Order A1004.

D. TO-3/TO-66 Adapter for Power Transistors – Order A1003.

E. Blank Adapter for Mounting Custom Sockets – Order A1001.

F. Example Showing Adapter Bottom 6th Pin for Base/Gate Kelvin Sensing



A1023 SOT-23 Adapter.

SMT DEVICE ADAPTERS
SOT-23 Adapter for Surface Mount Devices – Order A1023.

TO 252/SMT DPack Adapter for Surface Mount Devices – Order A1024.

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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With Tektronix, the Difference Is Measurable

Whether you're using a scope from our revolutionary TDS 300/400A/500A/600(A/B)/700A, TAS or 11000 Series, our portable 2400 or 2200 Series, or our TLS Series, you've invested in the finest line of measurement instruments available. That's why it doesn't pay to compromise performance with unreliable accessories.

A dependable probe is essential to completing your test system because even the most advanced scope can only be as precise as the data that goes into it. Off-the-shelf general-purpose probes are frequently unreliable and are not expressly designed for your scope. They can cost you in ways you never bargained for: greatly impaired measurement results, embarrassing errors, and expensive delays.

PLUG IN PEACE OF MIND

Only genuine Tektronix probes measure up to your Tektronix scope, with designed-in compatibility and identical standards for quality, for performance you can always depend on.

Of course, choosing the *right kind* of probe is equally important, which is why we offer the world's largest and most respected line: passive and active voltage probes, current probes, high voltage probes, opto-electrical converters, specialty probes, and SMD probes designed for dense circuitry. All are built with the kind of ruggedness, reliability and long life that add up to the best probe value on the market. And they're complimented by an amazingly wide array of probe accessories for virtually every need.

DOCUMENTATION

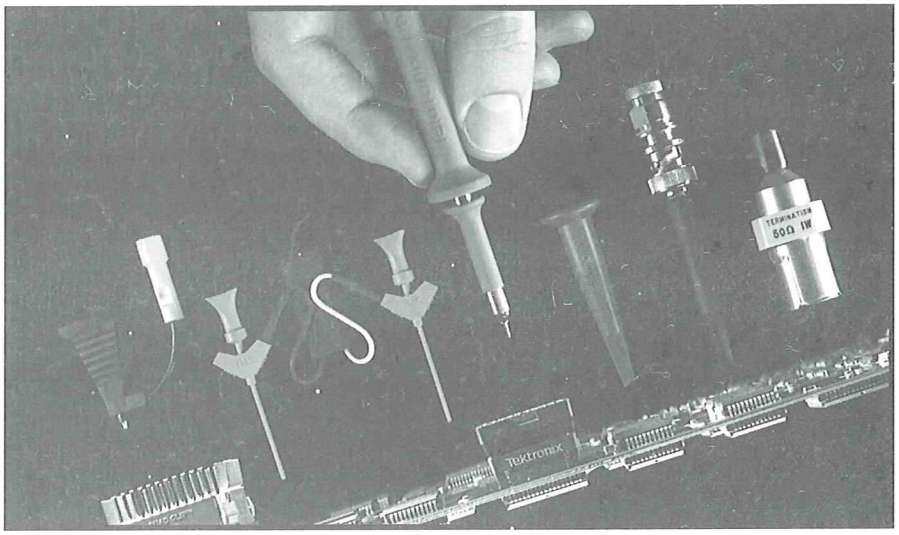
We also provide a complete family of products for documenting your measurement results, a step that's become almost as essential as testing itself. As with our probes, only Tektronix software, film-based cameras, printers, and plotters are precision-matched to your instrument and applications. They're exceptional values, too, as are TEK SCOPE-MOBILE® carts and workstations which free up bench space and make equipment easy to share and move around.

SUPPORT IN EVERY SENSE OF THE WORD

Tektronix products come with all the back-up you could ever need: generous warranties, optional extended service plans, and parts and service that are always readily available. Plus we offer the convenience of Tektronix' worldwide field office network for in-person product demos, service, and other assistance.

Even more than that, expert personal guidance is as close as your phone any time you need help in choosing and using Tektronix products. And we're always ready to assist you with the widest choice of training materials in the industry.

An extra measure of performance, compatibility, quality, and support – added value that increases your productivity without raising your costs. That's the competitive advantage you get with every Tektronix product.



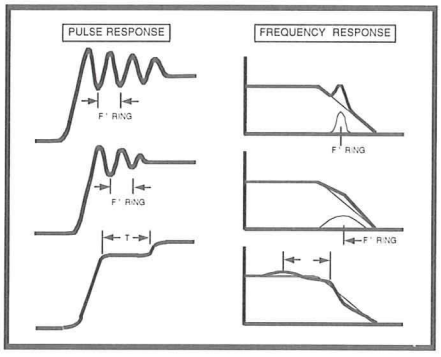
Probe Tutorial

Tektronix Instrument Probes

A probe can be any conductor used to establish a connection between the circuit under test and the measuring instrument. This conductor could be a piece of bare wire, a multimeter lead, or a piece of unterminated coaxial cable.

These "simple probes", however, do not fulfill the essential purpose of a probe; that is, "to extract minimal energy from the circuit under test and transfer it to a measuring instrument with maximum fidelity." The bare wire can load the input amplifier with its high capacitance and inductance or even cause a short circuit; multimeter leads are unshielded and are often susceptible to stray pickup, and the unterminated coax will severely capacitively load the circuit under test (100 pF per meter typically). Also, the unterminated coax is usually resonant at certain frequencies and does not allow faithful transfer of the signal to the test instrument due to reflections.

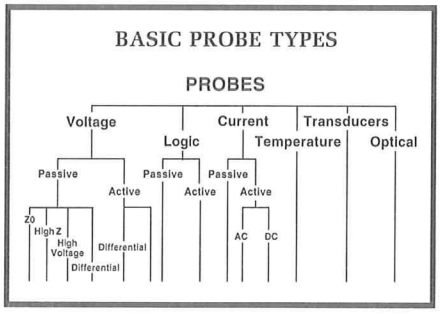
Tektronix has been designing and manufacturing instrument probes for more than 40 years, placing a constant effort on minimizing the reflections and other effects associated with unterminated coaxial probe cables and to reduce the effect of coaxial probe cables' capacitance in today's high-speed probing products.



This brief tutorial will quickly review the basic probe types and look at some of the more common issues around probe selection.

Types of Probes

Tektronix probe products include General Purpose Passive Voltage Probes, Active (FET) Voltage Probes, SMD Passive Voltage Probes, Active and Passive Current Probes, High Voltage Passive Probes, 50 Ω Divider Passive Voltage Probes (Zo, low impedance/high frequency), and Differential Voltage Probes, to name a few.



GENERAL PURPOSE PASSIVE (Page 456)
Attenuating Passive Voltage Probes are the most commonly used probes today. They provide a convenient and extremely rugged, yet inexpensive, way to acquire signals from your device under test. They maintain the accuracy of the oscilloscope to which they are connected over a wide dynamic range (±400 V). The 10X passive voltage probe presents a high impedance to the circuit under test at low frequencies (approximately 5 MHz and lower). Their main disadvantage is a decreasing impedance level with increasing frequency (i.e., high input capacitance).

ACTIVE FET PROBES (Page 446)
FET probes include active components (field effect transistors or other active devices) rather than passive components. The FET input results in a higher input impedance without loss of signal, i.e., low input capacitance (typically <0.4 pF to <2 pF), and high input resistance values (typically >100 kΩ). Some FET probes include an offset control that allows a substantial increase in the active probe's linear dynamic range. Since FET probes have a 50 Ω output impedance, they can drive a 50 Ω cable. This capability allows the distance from the probe tip to the instrument to be increased within the practical limits of the probe amplifier system and the limitations of the coaxial cable.

HIGH VOLTAGE PASSIVE (Page 488)
Several high voltage probes are available from Tektronix that provide 100X or 1000X compensated dividers. Because of the larger attenuation factors required for high voltage applications, the input capitance is reduced to approximately 3 pF.

CURRENT PROBES (Page 502)
Current probes provide a method to measure the current flowing in a circuit. Two types of current probes are available, the traditional AC only probes and the "Hall Effect" semiconductor type. AC only current probes use a transformer to convert current flux into AC signals and have a frequency response from a few hundred Hz to GHz. Combining a "Hall Effect" device with an AC transformer provides a frequency response from DC to 50 MHz. Because of its "non-invasive" nature, a current probe typically imposes less loading than other probes.

50 Ω DIVIDER PROBES (Z0) (Page 455)
50 Ω Divider Probes provide the lowest input capacitance (typically <1 pF for high frequency signals) and are used with high frequency, 50 Ω input scopes. 50 Ω Divider Probes provide the most consistent probe loading because they exhibit a frequency response that is essentially flat throughout their designed frequency range.

DIFFERENTIAL PROBES (Page 490)
Tektronix differential probes are available with high common mode rejection ratio (P5200/ADA 400A). The normal 10X probe has a typical accuracy of ±1% and gives a differential measurement accuracy of two parts per 100. Using this 10X probe, the common mode rejection ratio of a scope and probe combination would be no better than 50:1. A matched pair (P6135A) of differential probes allows the user to adjust the probe's attenuation for compatibility with a variety of Tektronix amplifiers to provide common mode rejection ratios of 10,000:1 and higher. This attenuation adjustment includes probe compensation so the probes match at high frequency as well as low frequencies.

Probe Tutorial

PROBE SELECTION CRITERIA

Proper probe selection will extend and enhance an instrument's performance, while imprudent probe selection often reduces your system's performance. Thoughtful consideration of probe characteristics will help ensure that the performance of your instrument meets your application's requirements. While the major considerations for an appropriate probe are its loading and signal fidelity transfer, physical parameters such as probe size, cable length and device under test interconnect adapters are potentially more important to the success of your measurement.

For a complete understanding and description of signal acquisition probing techniques, issues and applications, the following information is available by contacting your local Tektronix representative.

"ABC's of Probes" –
- Literature # 60W-6053-5 (Free)

"Probing High Frequency Digital Circuitry" –
- Literature # 60W-8412-0 (Free)

"Active Probes: Their Unique Characteristics and Applications" –
- Literature # 60W-6883 (Free)

"The Effect of Probe Input Capacitance on Measurement Accuracy" –
- Literature # 60W-8910-0 (Free)

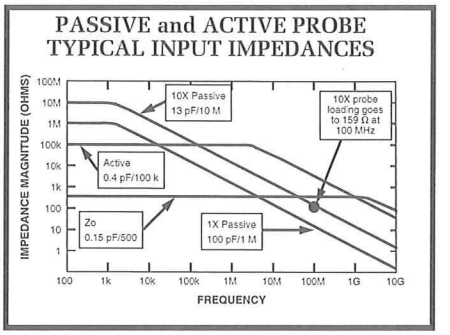
"Probe and Signal Concepts" –
- Videotape and Workbook.
  Order 068-0229-XX specify tape format:
  - 01 Beta
  - 02 Beta II
  - 03 Beta III
  - 04 VHS NTSC
  - 06 VHS PAL
  - 07 VHS SECAM

"Differential Oscilloscope Measurements" –
- Literature # 51W-10540-0

CRITERIA

Bandwidth/Rise Time

The bandwidth of a probe can be defined as the maximum –3 dB frequency a user can expect with a scope/probe system. In most probes, the bandwidth/rise time product is close to 0.35. In many cases the bandwidth is verified by pulse rise time to ensure minimum aberrations. To define these parameters accurately, the source impedance is specified as a terminated 50 Ω system (i.e., 25 Ω).



Probe Loading

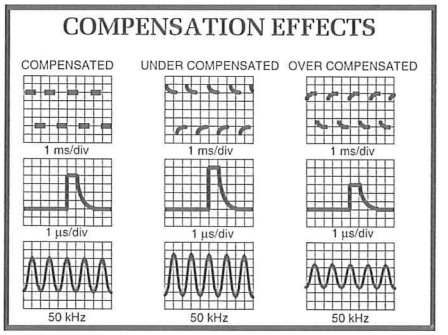
Input resistance and capacitance is used to describe the loading effect of a probe. At low frequencies (<1 MHz) the probe input resistance is the key factor for probe loading of the circuit under test. At higher frequencies the probe input capacitance is now the significant factor. The chart above shows various probes and changes in their impedance as frequency changes.

Aberrations

A high frequency probe that is specified without limiting aberrations can provide very misleading measurements. Existing aberrations can indicate a severely distorted bandwidth/roll-off characteristic.

Compensation Range

The range of a scope's input capacitance over which a specific probe will compensate to provide a flat frequency/attenuation ratio.



Tip: Always remember to check/adjust the compensation of your probe when you move it between channels or to another scope.

Attenuator Ratio

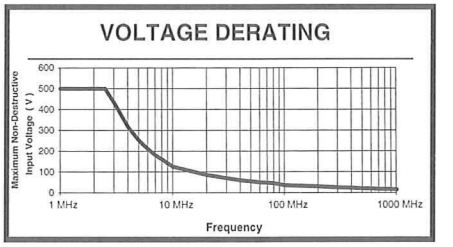
When correctly terminated, a probe should have a constant attenuation ratio. The attenuation ratio is the ratio of the output signal to the input signal. The attenuation should remain constant throughout a wide band of frequencies, decreasing by 3 dB as the frequency increases to the rated bandwidth.

Maximum Voltage

The maximum voltage (DC + peak AC) should be specified to ensure a usable, upper voltage range. At Tektronix, probes are tested in accordance with standard safety procedures.

Voltage Derating with Frequency

This specification is applicable for all high frequency probes. Either the termination elements or the resistive center conductor in the probe cable limits the maximum voltage that may be applied to a probe at a specific frequency. This derating applies at frequencies above 100 kHz.



Probe Length

Keep probe cable lengths as short as possible because extra length decreases the bandwidth and increases the loading capacitance of the probe. Longer probe cables also have greater propagation delays (typically 4 ns/meter in passive probes).

Probe Tip Accessories

A wide variety of adapters is available to mechanically connect the probe to the circuit under test (see page 476 for complete selection information). Since the probe tip conducts very little current, many materials that are normally considered to be good conductors have high resistance at lower current levels. Tektronix probe tips use an alloy coating to minimize current conduction problems.

Probe Coding

Probe coding provides the user with an indication of the actual probe tip sensitivity. This coding eliminates the need to divide by the attenuation ratio or remember which probe is being used. Most passive probes today provide readout capability that allows you to read your measurements directly from the oscilloscope screen.

Maximum Current (CW)

The maximum sine wave current that can be measured with a specified current probe without distortion.

Maximum Current (Pulse)

The maximum current pulse that can be measured with a specified current probe without distortion limited by Amp-Second (A-S) product.

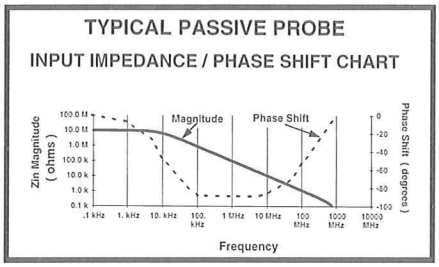
Probe Tutorial

Amp-Second Product
The maximum integral of the Pulse Current Waveform that may be measured without distortion. (See page 503 for more detail.)

Maximum DC Current
At levels lower than the RMS current specification, a DC level will saturate AC-only current probes causing distortion and insertion impedance changes. The impedance reflected into the circuit being measured is normally in the form of resistance and inductance.

PROBING CONSIDERATIONS AND RULES OF THUMB

A prime consideration in selecting the proper probe is the circuit loading effect of the oscilloscope/probe combination. The probe with the highest input impedance (lowest input capacitance and highest input resistance) will provide the least circuit loading. As circuit frequency increases and/or rise time decreases, the capacitive loading becomes most important. At DC and low frequencies the resistive loading is the most important.



Capacitive loading of voltage probes is the most important consideration when measuring fast rise time pulses. The time required to charge the input capacitance of the probe from the 10 to 90% level is

$$t_r = 2.2 \times R_{source} \times C_{probe}$$

Probe only rise time is the rise time of the probe driven from a terminated 50 Ω source. From this formula the rise time of the probe/oscilloscope system may be calculated for non passive probes that terminate in 50 Ω.

$$t_{r2\ system} = t_{r2\ probe} + t_{r2\ scope}$$

Bandwidth (3 dB down) of the probe/oscilloscope system may be calculated, knowing the system rise time and using the formula

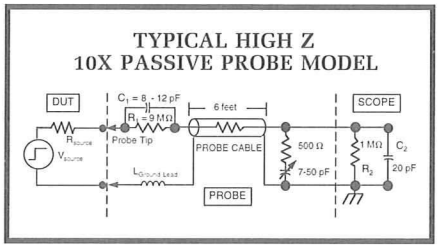
$$BW \approx 0.35 / t_{rise}$$

As you can see, these formulas are all dependent upon the input capacitance of the probe/oscilloscope system. **Since input capacitance plays such an important role, carefully consider the value of the probe's input capacitance when selecting your probe.**

Probe attenuation ratio is also an important consideration. The oscilloscope must have enough gain to allow viewing of the attenuated signal when using probes with larger attenuation ratios.

When an attenuating probe is used with an oscilloscope, the input resistance and input capacitance of the oscilloscope are represented by R_2C_2, and the probe resistance and capacitance are represented by R_1C_1 (see the figure below).

$$R_2C_2 = R_1C_1 = \text{Optimum Signal Transfer}$$



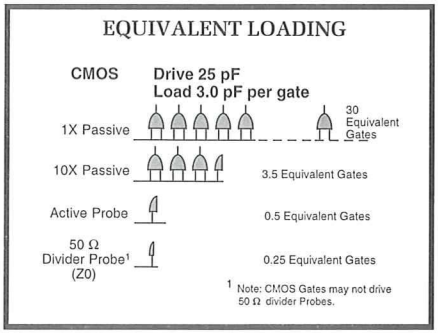
When the probe is first connected to the oscilloscope, compensate it by applying a low frequency square wave (1 to 10 kHz normally) to achieve the equalization of time constants. Improper compensation will result in either overshoot, roll-off or incorrect signal amplitudes (see Compensation Effects figure page 436).

The charts on pages 438 to 445 give you information on specifications, oscilloscope compatibility and obsolete probe replacements to help you select the right probe for your application.

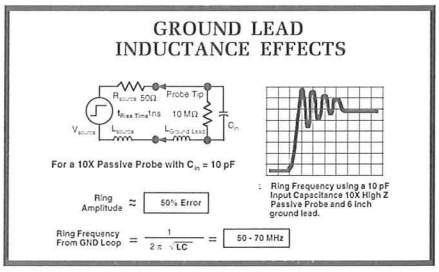
CONSIDER THE FOLLOWING FACTORS IN MAKING YOUR PROBE SELECTION:

- **Match Probe to Scope Input Resistance and Input Capacitance** – Be sure the desired probe will match the input resistance and capacitance of the oscilloscope being used. Fifty ohm (50 Ω) scope inputs will require 50 Ω probes. One Megaohm (1 MΩ) scope inputs will require 1 MΩ probes. Also check for connector interface compatibility or choose the appropriate adapter required. 1 MΩ inputs may also be used with appropriate 50 Ω adapters.
- **Match to Scope Bandwidth and Rise Times** – Select a probe with adequate rise time and bandwidth for the oscilloscope and application.
- **Probe Loading Effects** – Minimize probe loading effects by selecting low-impedance test points. Although the input impedance of a probe is made as high as possible, it still will always have some finite effect on the circuit under test. Usually cathodes, emitters and sources are preferred over plates, collectors or drains. Inputs to high-impedance dividers should be used rather than the midpoints.

  Be aware of the fact that the input impedance of a probe varies inversely with frequency. Example: A probe having a bandwidth of 50 MHz and an input resistance of 10 MΩ at DC would have an input resistance of approximately 1.5 kΩ at 50 MHz. Choose the probe with the lowest possible input capacitance and highest input resistance for best overall signal fidelity.



- **Time Delay Effects** – Time delay differences must be considered, particularly in phase and time coincidence measurements and in differential measurement applications. Always use two probes of the same model and cable length when making skew or time difference measurements.
- **Grounding Effects** – Grounding practices should always be kept in mind, particularly in high-impedance probe applications. Using as short a ground path as possible (preferably a coaxial adapter or short ground connector) will minimize the effect of series inductance to the probe input.



Oscilloscopes to Probes

Cross Reference

RECOMMENDED PROBES

	Passive 1X*6	Passive 10X*6	Passive 1X/10X*6	SMD 10X*6	50 Ω Divider	High Volt. 100X*6	High Volt. 1000X*6	Active
TDS 300/400/500(A)/600(A/B)/700A/800 and TLS 200 Series								
TDS 310/320	P6101B	**P6109B**	P6129B	P6561AS		P5100	P6015A	P6243S
TDS 350	P6101B	**P6111B**	P6129B	P6561AS		P5100	P6105A	P6243S
TDS 410/A	P6101B	**P6138**	P6129B	P6562AS		P5100	P6015A	P6243
TDS 420/A	P6101B	**P6138**	P6129B	P6562AS	P6156*2	P5100	P6015A	P6243
TDS 460/A	P6101B	**P6138**	P6129B	P6562AS	P6156*2	P5100	P6015A	P6243
TDS 520/A	P6101B	**P6139A**		P6563AS	P6156*2	P5100	P6015A	P6243
TDS 524/A	P6101B	**P6139A**		P6563AS	P6156*2	P5100	P6015A	P6243
TDS 540/A	P6101B	**P6139A**		P6563AS	P6156*2	P5100	P6015A	P6243
TDS 544/A	P6101B	**P6139A**		P6563AS	P6156*2	P5100	P6015A	P6243
TDS 620(A/B)	P6101B	P6139A		P6563AS	P6156*2	P5100	P6015A	**P6243**
TDS 640/A	P6101B	P6139A		P6563AS	P6156*2	P5100	P6015A	**P6205**/P6243
TDS 644(A/B)	P6101B	P6139A		P6563AS	P6156*2	P5100	P6015A	**P6243**
TDS 684(A/B)/680B	P6101B	P6139A		P6563AS	P6156*2	P5100	P6015A	P6245
TDS 744A	P6101B	**P6139A**		P6563AS	P6156*2	P5100	P6015A	P6243
TDS 784A	P6101B	P6139A		P6563AS	P6156*2	P5100	P6015A	P6245
TDS 820					P6150			**P6207**
TLS 216								**P6240**
TAS 400/200 Series								
TAS 465	P6101B	**P6109B**	P6129B	P6561AS		P5100	P6015A	
TAS 475	P6101B	**P6109B**	P6129B	P6561AS		P5100	P6015A	
TAS 485	P6101B	**P6111B**	P6129B	P6561AS		P5100	P6015A	
TAS 220	P6101B	P6103B	P6119B			P5100	P6015A	
TAS 250	P6101B	P6103B	P6119B			P5100	P6015A	
11000 Series								
11A32	P6101B	P6134C	P6063B	P6562AS		P5100	P6015A	P6243
11A33	P6101B	P6135A*4		P6562AS				
11A34/V	P6101B	P6134C	P6063B	P6562AS		P5100		P6243*7
11A52					P6156*2			P6243
11A72					P6156*2			P6204/P6217
11A81					P6156*2			P6204/P6217
SD20/22/24/ 26/30/32					P6150			P6217*5
2400 Series								
2430/A/M	P6101B	**P6133 Opt. 25**	P6063B	P6562AS	P6156*2	P5100	P6015A	P6202A*1
2431L	P6101B	**P6136 Opt. 25**	P6063B	P6562AS	P6156*2	P5100	P6015A	P6201*1
2432/A/M	P6101B	**P6137**	P6063B	P6562AS	P6156*2	P5100	P6015A	P6201*1
2439	P6101B	**P6136 Opt. 25**	P6063B	P6562AS	P6156*2	P5100	P6015A	P6202A*1
2440/M	P6101B	**P6137**	P6063B	P6562AS	P6156*2	P5100	P6015A	P6201*1
2445	P6101B	**P6131**	P6063B	P6562AS	P6156*2	P5100	P6015A	P6202A*1
2445A	P6101B	**P6133 Opt. 25**	P6063B	P6562AS	P6156*2	P5100	P6015A	P6202A*1
2445B	P6101B	**P6137, P6133 Opt. 25***3	P6063B	P6562AS	P6156*2	P5100	P6015A	P6202A*1
2455A/B	P6101B	**P6136 Opt. 25**	P6063B	P6562AS	P6156*2	P5100	P6015A	P6202A*1

Continued on next page.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

- Tektronix Scopes to Tektronix Probes.
- Bolded probes are those normally shipped with the scope.
- For non-bolded probes, the scope bandwidth may be limited by the probe shown.
- Use scope's bandwidth and probe specification chart to determine overall probe/scope bandwidth.

Oscilloscopes to Probes

Cross Reference

RECOMMENDED PROBES

	Passive 1X*6	Passive 10X*6	Passive 1X/10X*6	SMD 10X*6	50 Ω Divider	High Volt. 100X*6	High Volt. 1000X*6	Active
2400 Series (continued)								
2465	P6101B	**P6131**	P6063B	P6562AS	P6156*2	P5100	P6015A	P6201*1
2465A	P6101B	**P6136 Opt. 25**	P6063B	P6562AS	P6156*2	P5100	P6015A	P6201*1
2465B	P6101B	**P6137**	P6063B	P6562AS	P6156*2	P5100	P6015A	P6201*1
2467	P6101B	**P6136 Opt. 25**	P6063B	P6562AS	P6156*2	P5100	P6015A	P6201*1
2467B/HD	P6101B	**P6137**	P6063B	P6562AS	P6156*2	P5100	P6015A	P6201*1
Digitizers								
RTD 710A/TD1301	P6101B	P6109B	P6129B			P5100	P6015A	P6205/P6245*5
RTD 720A					P6156*2			P6204/P6245*5
SCD1000/SCD5000					P6156*2			P6217/P6245*5
TVS Series								
TVS 600	P6101B	P6139A		P6563AS	P6156	P5100	P6015A	P6245
THS 700 Series								
THS 710/THS 720		P6113B				P5102*8		
2200 Series								
2201/2205/2210	P6101B	**P6103B**	P6119B			P5100	P6015A	
2211/2212	P6101B	**P6109B**	P6129B			P5100	P6015A	
2213/A	P6101B	**P6122**	P6119B			P5100	P6015A	
2214	P6101B	**P6103B**	P6119B			P5100	P6015A	
2215/A	P6101B	**P6122**	P6119B			P5100	P6015A	
2216	P6101B	**P6109B**	P6129B			P5100	P6015A	
2220	P6101B	**P6122**	P6129B			P5100	P6015A	
2221/A/2224	P6101B	**P6109B**	P6129B			P5100	P6015A	
2225	P6101B	**P6103B**	P6119B			P5100	P6015A	
2230/2232/ 2235(A)	P6101B	**P6109B**	P6129B			P5100	P6015A	
2235L	P6101B	**P6122**	P6119B			P5100	P6015A	
2236/A	P6101B	**P6109B**	P6129B			P5100	P6015A	
2245(A)/2246(A)	P6101B	**P6109B**	P6129B			P5100	P6015A	P6205*5
2247/A/2252	P6101B	**P6109B**	P6129B			P5100	P6015A	P6205*5
200 Series								
224	**P400**	P850						

*1 *The P6201 and P6202A active probes require probe power, which is normally supplied by the scope (either standard or optional to the scope). If probe power is unavailable, an 1101A power supply can be used to supply probe power.*

*2 *The P6156 is standard with 10X attenuation. Other attenuations are available. Order Option 25 for 10X plus 100X and see ordering information on page 475 for separate 1X and 20X attenuator tips.*

*3 *2445B shipped with P6133 Option 25 probe until BW changed to 200 MHz, then shipped with P6137.*

*4 *Differential Pair.*

*5 *Requires 1103 TEKPROBE™ Power Supply. For SCD1000 order SCD1000 Option 1E.*

*6 *1 MΩ input required.*

*7 *11A34 only.*

*8 *P5102 is a 10X High Voltage Probe.*

VOLTAGE PROBE/PAGE INDEX

Probe	Page	Probe	Page	Probe	Page	Probe	Page	Probe	Page	Probe	Page	Probe	Page	Probe	Page
ADA 400A	493	P6015	444	P6062B	462	P6108A	444	P6125	444	P6136	464	P6202A	452	P6243	448
P400	488	P6015A	488	P6063B	462	P6109	444	P6129	444	P6137	464	P6203	445	P6245	448
P5100	488	P6046	492	P6101A	444	P6109B	458	P6129B	458	P6138	464	P6204	450	P6561A/AS	466
P5102	460	P6048	444	P6101B	458	P6111B	458	P6131	464	P6139A	464	P6205	450	P6562	444
P5200	494	P6053	444	P6102A	444	P6113B	458	P6133	464	P6148A	444	P6206	445	P6562A/AS	466
P5205	494	P6053B	444	P6103	444	P6115	444	P6134	444	P6149A	444	P6207	454	P6563A/AS	466
P6006	444	P6053C	444	P6103B	458	P6119	444	P6134C	464	P6150	455	P6217	450	P850	488
P6007	444	P6055	444	P6105A	462	P6119B	458	P6135	444	P6156	455	P6230	445	YT5060	461
P6008	444	P6056	444	P6106A	462	P6121	444	P6135A	496	P6201	452	P6231	445	YT5100	461
P6009	444	P6057	444	P6107A	444	P6122	462								

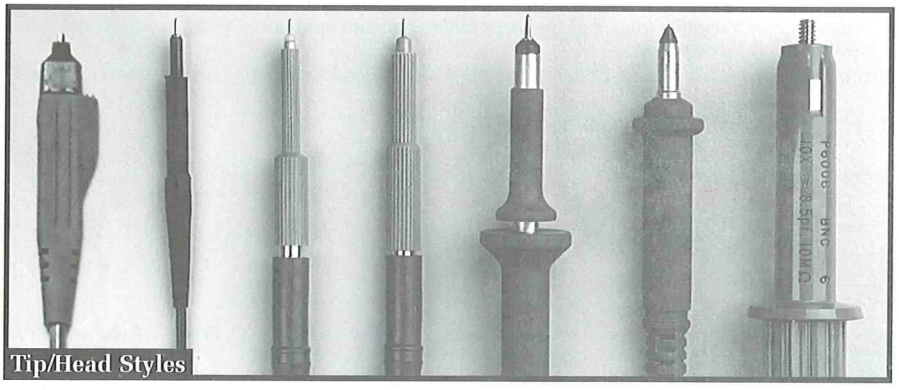
Probes
Specifications Chart

PASSIVE PROBES

Type	Cable Length	Attenuation	Bandwidth at –3dB	System Input Resistance	Typical Input C	Max Voltage DC + pk AC	Compensation Range	Read Out	ID/Gnd Ref.	Tip/Head Style	Page
1X Passive Probe											
P6101B	2 m	1	15 MHz	1 MΩ	100 pF	420 V	NA			5 mm (Min)	458
10X Passive Probes											
P5102	3.1 m	10	100 MHz	5 MΩ	11.2 pF	1000 V RMS	24 to 28 pF			mono.	460
P6103B	2 m	10	60 MHz	10 MΩ	13 pF	420 V	15 to 35 pF			5 mm (Min)	458
P6105A	2 m	10	100 MHz	10 MΩ	11 pF	500 V	15 to 35 pF	√	√	5 mm (Min)	462
Opt. 01	1 m	10	100 MHz	10 MΩ	9 pF	500 V	15 to 35 pF			5 mm (Min)	
Opt. 03	3 m	10	90 MHz	10 MΩ	13 pF	500 V	15 to 30 pF			5 mm (Min)	
P6106A	2 m	10	250 MHz	10 MΩ	11 pF	500 V	15 to 35 pF	√	√	5 mm (Min)	462
Opt. 01	1 m	10	250 MHz	10 MΩ	9 pF	500 V	15 to 35 pF			5 mm (Min)	
Opt. 03	3 m	10	150 MHz	10 MΩ	13 pF	500 V	15 to 30 pF			5 mm (Min)	
P6109B	2 m	10	100 MHz	10 MΩ	13 pF	420 V	15 to 35 pF	√		5 mm (Min)	458
P6111B	2 m	10	200 MHz	10 MΩ	14 pF	420 V	15 to 35 pF	√		5 mm (Min)	458
P6113B	2 m	10	100 MHz	10 MΩ	11.8 pF	300 V RMS	15 to 35 pF			5 mm (Min)	458
P6122	1.5 m	10	100 MHz	10 MΩ	11 pF	500 V	15 to 35 pF			5 mm (Min)	462
P6131	1.3 m	10	300 MHz	10 MΩ	10.8 pF	500 V	14 to 18 pF	√		2.5 mm (Sub)	464
Opt. 02	2 m	10	250 MHz	10 MΩ	13.5 pF	500 V	14 to 18 pF			2.5 mm (Sub)	
Opt. 03	3 m	10	150 MHz	10 MΩ	14.5 pF	500 V	14 to 18 pF			2.5 mm (Sub)	
P6133	2 m	10	150 MHz	10 MΩ	12.7 pF	500 V	10 to 25 pF	√		2.5 mm (Sub)	464
Opt. 01	1.3 m	10	150 MHz	10 MΩ	11.4 pF	500 V	10 to 25 pF			2.5 mm (Sub)	
Opt. 03	3 m	10	120 MHz	10 MΩ	14.5 pF	500 V	10 to 25 pF			2.5 mm (Sub)	
Opt. 25	1.3 m	10	150 MHz	10 MΩ	10.8 pF	500 V	10 to 25 pF			3.5 mm (Comp.)	
P6134C	1.5 m	10	400 MHz	10 MΩ	11.3 pF	500 V	12 to 18 pF	√	√	2.5 mm (Sub)	464
P6136	1.3 m	10	350 MHz	10 MΩ	10.8 pF	500 V	12 to 18 pF	√		2.5 mm (Sub)	464
Opt. 25	1.3 m	10	350 MHz	10 MΩ	10.8 pF	500 V	12 to 18 pF			3.5 mm (Comp.)	
P6137	1.5 m	10	400 MHz	10 MΩ	10.8 pF	500 V	12 to 18 pF	√	√	3.5 mm (Comp.)	464
P6138	1.3 m	10	350 MHz	10 MΩ	10 pF	500 V	12 to 18 pF	√		3.5 mm (Comp.)	464
P6139A	1.3 m	10	500 MHz	10 MΩ	8 pF	500 V	8 to 12 pF	√		3.5 mm (Comp.)	464
P6561AS	1.3 m	10	200 MHz	10 MΩ	<11 pF	42 V	15 to 35 pF	√		SMD	466
P6562AS	1.3 m	10	350 MHz	10 MΩ	<11 pF	42 V	12 to 35 pF	√		SMD	466
P6563AS	1.3 m	20	500 MHz	9.5 MΩ	<5 pF	42 V	7 to 30 pF	√		SMD	466

m = meters V = volts MHz = Megahertz mono. = monolithic HVP = high voltage probe MΩ = Megaohms pF = picofarads mm = millimeters

TIP/HEAD STYLES



SMD Active *SMD* *2.5 mm Subminiature* *3.5 mm Compact* *5 mm Miniature* *4 mm* *6/32 Thread Monolithic*

Probes
Specifications Chart

PASSIVE PROBES

Type	Cable Length	Attenuation	Bandwidth at –3dB	System Input Resistance	Typical Input C	Max Voltage DC + pk AC	Compensation Range	Read Out	ID/Gnd Ref.	Tip/Head Style	Page
1X/10X Switchable											
P6062B	2 m	1/10	6.5/100 MHz	1/10 MΩ	105/14 pF	500 V	15 to 47 pF	√	√	5 mm (min.)	462
Opt. 01	1.5 m	1/10	8/100 MHz	1/10 MΩ	100/13 pF	500 V	15 to 47 pF			5 mm (min.)	
Opt. 03	3 m	1/10	4.5/100 MHz	1/10 MΩ	135/17 pF	500 V	15 to 47 pF			5 mm (min.)	
P6063B	2 m	1/10	6/200 MHz	1/10 MΩ	105/14 pF	500 V	15 to 24 pF	√	√	5 mm (min.)	462
Opt. 01	1.5 m	1/10	12/200 MHz	1/10 MΩ	80/11 pF	500 V	15 to 24 pF			5 mm (min.)	
P6119B	2 m	1/10	10/100 MHz	1/10 MΩ	100/18 pF	420 V	15 to 35 pF			5 mm (min.)	458
P6129B	2 m	1/10	10/100 MHz	1/10 MΩ	100/18 pF	420 V	15 to 35 pF	√		5 mm (min.)	458
100X/1000X High Voltage											
P5100	3.1 m	100	250 MHz	10 MΩ	2.75 pF	2,500 V	7 to 30 pF	√		mono.	488
P6015A	3.0 m	1000	75 MHz	100 MΩ	3.0 pF	40,000 V	7 to 49 pF			HVP	488
Opt. 1R	3.0 m	1000	75 MHz	100 MΩ	3.0 pF	40,000 V	7 to 49 pF	√		HVP	
Opt. 25	7.6 m	1000	25 MHz	100 MΩ	3.0 pF	40,000 V	7 to 49 pF			HVP	
Opt. 2R	7.6 m	1000	25 MHz	100 MΩ	3.0 pF	40,000 V	7 to 49 pF	√		HVP	

ACTIVE PROBES

Type	Length	Attenuation	Bandwidth at –3dB	System Input Resistance	Typical Input C	Max Voltage DC + pk AC	Linear Range	DC Offset Range	ID/Gnd Ref.	Tip/Head Style	Page
P6201	1.8 m	1	900 MHz	100 kΩ	3.0 pF	±100 V	±0.6 V	±5.6 V		mono.	452
		10	900 MHz	1 MΩ	1.5 pF	±200 V	±6.0 V	±56 V		mono.	
		100	900 MHz	1 MΩ	1.5 pF	±200 V	±60 V	±200 V		mono.	
P6202A	2.0 m	10	500 MHz	10 MΩ	2.0 pF	±200 V	+6.0 V	±55 V		mono.	452
		100	500 MHz	10 MΩ	2.0 pF	±200 V	±60 V	±200 V		mono.	
P6204	1.5 m	10	1000 MHz	10 MΩ	1.9 pF	±40 V	±10 V	±15 V	√	5 mm (min.)	450
P6205	1.5 m	10	750 MHz	1 MΩ	2.0 pF	±40 V	±10 V	N/A		5 mm (min.)	450
P6207	1.6 m	10	4000 MHz	100 kΩ	0.4 pF	±40 V	±4.0 V	±5 V		4 mm	454
P6217	1.5 m	10	4000 MHz	100 kΩ	0.4 pF	±40 V	±4.0 V	±5 V		4 mm	450
P6243	1.3 m	10	1000 MHz	1 MΩ	1.0 pF	±40 V	±8.0 V	N/A		SMD Active	448
P6245	1.3 m	10	1500 MHz	1 MΩ	1.0 pF	±40 V	±8.0 V	±10 V		SMD Active	448

50Ω DIVIDER PROBES

Type	Length	Attenuation	Bandwidth at –3dB	System Input Resistance	Typical Input C	Max Voltage DC + pk AC	Instrument Input	Read Out	ID/Gnd Ref.	Tip/Head Style	Page
P6150	1 m	10	9 GHz	500 Ω	<0.15 pF	12.5 V RMS	50 Ω			Comp.	455
		1	≥3 GHz	50 Ω	N/A	*1	50 Ω				
P6156	1.5 m	10	≥3.5 GHz	500 Ω	≤1 pF	15 V RMS	50/1 MΩ	√	√	3.5 mm (Comp.)	455
Opt. 25		100	≥3.0 GHz	5000 Ω	≤1.1 pF	50 V RMS	50/1 MΩ				
		20	≥3.5 GHz	1000 Ω	≤1 pF	22 V RMS	50/1 MΩ				
		1	≥1.5 GHz	50 Ω	N/A	*2	50/1 MΩ				

DIFFERENTIAL PROBES/SIGNAL CONDITIONERS

Type		Type	
ADA 400A	For Specifications see page 493.	P6046	For Specifications see page 492.
P5200/P5205	For Specifications see page 494.	P6135A	For Specifications see page 496.
Kit for P5100	Order 040-1487-00. For Specifications see page 489.		

m = meters V = volts MHz = Megahertz mono. = monolithic HVP = high voltage probe MΩ = Megaohms pF = picofarads mm = millimeters

*1 *Limited by scope input or 42 V RMS.*
*2 *Limited by scope input or 50 V RMS.*

Discontinued Instruments

Probe Replacement Guide

SUGGESTED REPLACEMENTS

Discontinued Scope	Passive 10X	Passive 1X/10X	SMD 10X	Low-Z	High Volt. 100X	High Volt. 1000X	Active
11000 Series							
11201/A	P6134C	P6063B	P6562AS		P5100	P6015A	P6204/P6205
11A71				P6156 Opt. 25			P6204/P6217
7000 Series							
7A13	P6135A*3				P5100	P6015A	
7A15A/7A18/A	P6105A	P6129B	P6561AS		P5100	P6015A	P6202A*1/P6205*2
7A16A	P6106A	P6063B	P6561AS		P5100	P6015A	P6202A*1/P6205*2
7A19/7A24				P6156 Opt. 25			P6201*1/P6217*2
7A22	P6135A*3						
7A26	P6106A	P6063B	P6561AS		P5100	P6015A	P6202A*1/P6205*2
7A29/P				P6156 Opt. 25			P6201*1/P6217*2
7A42	P6131	P6063B	P6561AS	P6156 Opt. 25	P5100		P6202A*1/P6205*2
7D15	P6106A	P6063B	P6561AS				
7D20	P6106A	P6129B	P6561AS			P6015A	
5000 Series							
5A14N	P6006/P6102A	P6062B	P6561AS		P6007	P6015A	
5A15N/5A18N	P6006/P6102A	P6062B	P6561AS		P6007		
5A21N/5A22N	P6135A*3						
5A26	P6135A*3						
5A38N	P6105A	P6129B	P6561AS		P6009		
5A45/5A48/5D10	P6105A	P6129B	P6561AS		P6009	P6015A	
2400 Series							
2430/A/M	P6133 Opt. 25	P6063B	P6562AS	P6156 Opt. 25	P5100	P6015A	P6202A*1
2300 Series							
2335/2336	P6109B	P6119B			P5100	P6015A	
2336YA	P6109B	P6119B			P5100	P6015A	
2337	P6109B	P6119B			P5100	P6015A	
400 Series							
434/455	P6105A	P6129B	P6561AS		P5100	P6015A	P6202A*1
464	P6105A	P6062B	P6561AS		P5100	P6015A	P6202A*1
464/M 464(M)	P6105A	P6129B	P6561AS		P5100	P6015A	P6202A*1
465/B/M	P6105A	P6129B	P6561AS		P5100	P6015A	P6202A*1/P6201*1
466	P6105A	P6062B	P6561AS		P5100	P6015A	P6202A*1
468	P6105A	P6129B	P6561AS		P5100	P6015A	P6202A*1
475/A (485)	P6106A	P6063B	P6561AS	P6156 Opt. 25	P5100	P6015A	P6201*1
300 Series							
305/314/335		P6062B					
336/A		P6062B					
390AD	P6105A	P6129B			P5100	P6015A	
200 Series	**Passive 1X**	**Passive 10X**					
222 A	P400	P850					
222 PS	P400	P850					

**1 Requires Scope Power or 1101A Power Supply.*

**2 Requires Scope Power or 1103 Power Supply.*

**3 Differential Pair.*

Discontinued Instruments

Probe Replacement Guide

SUGGESTED REPLACEMENTS

Discontinued Scope	Passive 10X	Passive 1X/10X	SMD 10X	Low-Z	High Volt. 100X	High Volt. 1000X	Active
TAS 400 Series							
TAS 455	P6109B	P6129B	P6561AS		P5100	P6015A	
TDS 500 Series							
TDS 544A	P6139A		P6563AS	P6156 Opt. 25	P5100	P6015A	P6205/P6243
TM 500/5000 Mainframe Plug-ins							
AM 502	P6135A*3						
DC 503A/504A/ 5004	P6106A						
DC 509/5009/ 510/5010	P6106A						
DC 505/A	P6122						
DC 508/A	P6106A						
SC 501/2/3		P6062B			P6007	P6015A	
SC 504	P6105A	P6129B			P6009	P6015A	
SI5010				P6156*2			P6202A*1

*1 *Requires Scope Power or 1101A Power Supply.*

*2 *Requires Scope Power or 1103 Power Supply.*

*3 *Differential Pair.*

VOLTAGE PROBE/PAGE INDEX

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ADA 400A	493	*P6015*	444	*P6062B*	462	*P6108A*	444	*P6125*	444	*P6136*	464	*P6202A*	452	*P6243*	448
P400	488	*P6015A*	488	*P6063B*	462	*P6109*	444	*P6129*	444	*P6137*	464	*P6203*	445	*P6245*	448
P5100	488	*P6046*	492	*P6101A*	444	*P6109B*	458	*P6129B*	458	*P6138*	464	*P6204*	450	*P6561A/AS*	466
P5102	460	*P6048*	444	*P6101B*	458	*P6111B*	458	*P6131*	464	*P6139A*	464	*P6205*	450	*P6562*	444
P5200	494	*P6053*	444	*P6102A*	444	*P6113B*	458	*P6133*	464	*P6148A*	444	*P6206*	445	*P6562A/AS*	466
P5205	494	*P6053B*	444	*P6103*	444	*P6115*	444	*P6134*	444	*P6149A*	444	*P6207*	454	*P6563A/AS*	466
P6006	444	*P6053C*	444	*P6103B*	458	*P6119*	444	*P6134C*	464	*P6150*	455	*P6217*	450	*P850*	488
P6007	444	*P6055*	444	*P6105A*	462	*P6119B*	458	*P6135*	444	*P6156*	455	*P6230*	445	*YT5060*	461
P6008	444	*P6056*	444	*P6106A*	462	*P6121*	444	*P6135A*	496	*P6201*	452	*P6231*	445	*YT5100*	461
P6009	444	*P6057*	444	*P6107A*	444	*P6122*	462								

Discontinued Probes

Replacement Guide

PASSIVE PROBES

Discontinued Probe	Characteristics: Attn	B/W MHz	Comp. Range	R/O	ID	Direct Replacement	Suggested Replacement	Changes in Characteristics: Attn	B/W MHz	Comp. Range	R/O	ID	Other
P6006	10	35	15 to 55	N	N	*1	**P6062B**	1/10	7/100	15 to 47	Y		Body Size
P6007	100	20	8 to 55	N	N	*1							
P6008	10	100	12 to 47	N	N	No Replacement							
P6009	100	120	8 to 55	Y	N	*1							
P6015	1000	75	12 to 47	N	N	**P6015A**				7 to 49			
P6048	10	100	15 to 20	N	N		**P6202A/1101A**	10	500	50 Ω	Y	N	Active
P6053/B/C	10	200	15 to 35	Y	Y		**P6106A**	10	250	15 to 35	Y	N	Accessories
P6055	10	150	17 to 23	Y	Y		**P6135A**	10	150	10 to 47	Y	Y	Accessories
P6056	10	3500	50 Ω	Y	Y		**P6156**	10	3500	50 Ω	Y	Y	Accessories
P6057	100	1400	50 Ω	Y	N		**P6156 Opt 25**	100	3000	50 Ω	Y	Y	Accessories
P6101A	1	15	Any	N	N	**P6101B**							
P6102A	10	60	36 to 55	Y	N		**P6062B**	1/10	7/100	15 to 47	Y	N	Accessories
P6103	10	50	15 to 35	N	N	**P6103B**			60				
P6104A	10	100	18 to 22	Y	N		**P6105A**	10	100	15 to 35	Y	N	ID Button
P6107A	10	100	20 to 51	Y	N		**P6062B**	1/10	7/100	15 to 47	Y	N	Not Rt Angle
P6108A	10	100	15 to 35	N	N		**P6109B**				Y		Body Size
P6109	10	150	15 to 35	Y	N	**P6109B**			100				
P6115	1	5	Any	N	N		**P6101B**	1	15	Any	N	N	
P6119	1/10	8/100	15 to 35	N	N	**P6119B**			10/100				
P6121	10	100	20 to 26	N	N		**P6109B**	10	100	15 to 35	Y	N	
P6125	5	200	15 to 33	N	N		**P6063B**	1/10	6/200	15 to 24	Y	N	
P6127	1/10	8/300	12 to 18	Y	N		**P6063B**	1/10	6/200	15 to 24	Y	N	
P6129	1/10	8/100	15 to 35	Y	N	**P6129B**			10/100				
P6130	10	250	15 to 35	Y	N		**P6106A**	10	250	15 to 35	Y	N	Body Size
P6134	10	300	12 to 18	Y	Y		**P6134C**						Body Size
P6135	10	150	13 to 16	Y	Y		**P6135A**						Body Size
P6148A	10	50	20 to 51	Y	N		**P6062B**	1/10	7/100	15 to 47	Y	N	Not Rt Angle
P6149A	10	50	20 to 51	N	N		**P6062B**	1/10	7/100	15 to 47	Y	N	Not Rt Angle
P6562	10	350	15 to 30	Y	N	**P6562AS**				12 to 35			Accessories

**1 Contact your local Tektronix representative for availability.*

Discontinued Probes

Replacement Guide

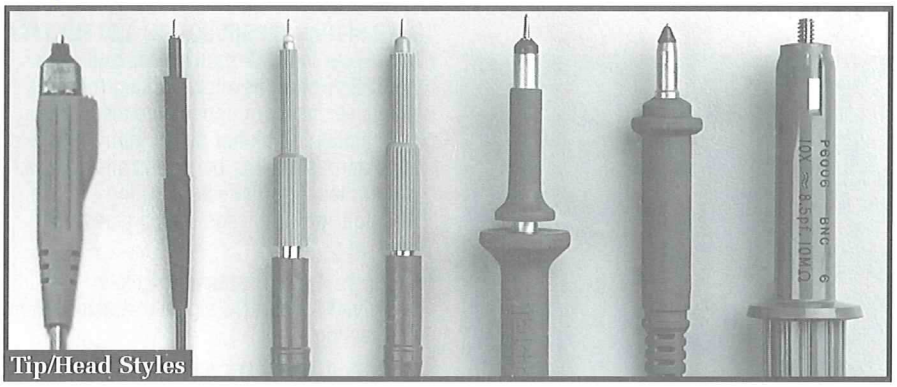
ACTIVE PROBES

Discontinued Probe	Characteristics Attn	B/W MHz	Linear Range	DC Offset	Max Vin	Cin pF	Rin	Suggested Replacement	Changes in Characteristics Attn	B/W MHz	Linear Range	DC Offset	Max Vin	Cin pF	Rin
P6203	10	1000	±10 V	±10 V	40	2	10 k	P6204 w/1103 or	10	1000	±10 V	±10 V	40	1.9	10 M
								P6205 w/1103	10	750	±10 V	N/A	40	2	1 M
P6206	10	1000	±10 V	N/A	40	2	1 M	P6204 w/1103 or	10	1000	±10 V	±10 V	40	1.9	10 M
								P6205 w/1103	10	750	±10 V	N/A	40	2	1 M
P6230	10	1500	±5 V	±5 V	30	1.3	450	P6231 w/1103	10	1500	±5 V	±5 V	30	1.6	450
P6231	10	1500	±5 V	±5 V	30	1.6	450	P6245	10	1500	±8 V	±10 V	40	1.0	1 M

VOLTAGE PROBE/PAGE INDEX

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P400	*488*	*P6015A*	*488*	*P6063B*	*462*	*P6109*	*444*	*P6129*	*444*	*P6137*	*464*	*P6203*	*445*	*P6245*	*448*
P5100	*488*	*P6046*	*492*	*P6101A*	*444*	*P6109B*	*458*	*P6129B*	*458*	*P6138*	*464*	*P6204*	*450*	*P6561A/AS*	*466*
P5102	*460*	*P6048*	*444*	*P6101B*	*458*	*P6111B*	*458*	*P6131*	*464*	*P6139A*	*464*	*P6205*	*450*	*P6562*	*444*
P5200	*494*	*P6053*	*444*	*P6102A*	*444*	*P6113B*	*458*	*P6133*	*464*	*P6148A*	*444*	*P6206*	*445*	*P6562A/AS*	*466*
P5205	*494*	*P6053B*	*444*	*P6103*	*444*	*P6115*	*444*	*P6134*	*444*	*P6149A*	*444*	*P6207*	*454*	*P6563A/AS*	*466*
P6006	*444*	*P6053C*	*444*	*P6103B*	*458*	*P6119*	*444*	*P6134C*	*464*	*P6150*	*455*	*P6217*	*450*	*P850*	*488*
P6007	*444*	*P6055*	*444*	*P6105A*	*462*	*P6119B*	*458*	*P6135*	*444*	*P6156*	*455*	*P6230*	*445*	*YT5060*	*461*
P6008	*444*	*P6056*	*444*	*P6106A*	*462*	*P6121*	*444*	*P6135A*	*496*	*P6201*	*452*	*P6231*	*445*	*YT5100*	*461*
P6009	*444*	*P6057*	*444*	*P6107A*	*444*	*P6122*	*462*								

TIP/HEAD STYLES



Tip/Head Styles

SMD Active | *SMD* | *2.5 mm Subminiature* | *3.5 mm Compact* | *5 mm Miniature* | *4 mm* | *6/32 Thread Monolithic*

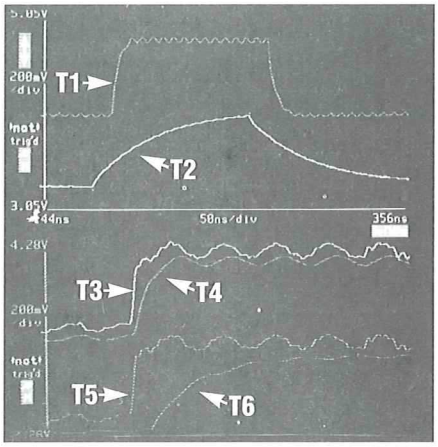
Active Probes

FET Voltage Probe Tutorial

Features

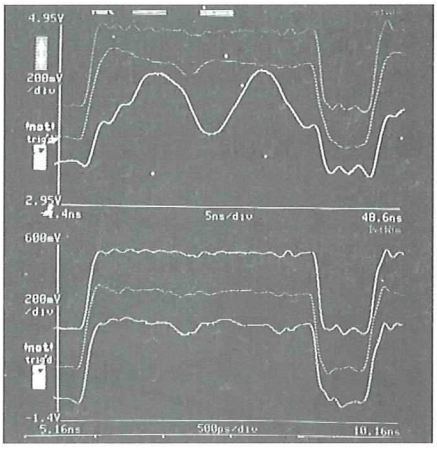
DESIGNED FOR:

- Digital Design and Debug of Logic Families Such As:
  - ECL
  - GaAs
  - MOS: CMOS; FastCMOS; BiCMOS
  - TTL
- Component Characterization/Measurement of High-speed Analog Circuitry Relative to:
  - Amplitude Levels
  - Aberrations
  - Propagation Delay and Timing
  - Bandwidths and Rise Times



The waveforms above show impedance test points of 50 Ω and 1 kΩ as probed with:

- *A 1X Passive probe [trace T1 (50 Ω), trace T2 (1 kΩ)]*
- *A 10X Active FET probe [trace T3 (50 Ω), trace T4 (1 kΩ)]*
- *A 10X Passive probe [trace T5 (50 Ω), trace T6 (1 kΩ)]*



The waveforms above show the effects of ground lead inductance. The top three traces show how the displayed waveform changes as the passive probe's ground lead length is increased from 1/2 in. (top trace) to 6 in. to 12 in. (bottom trace). The bottom three traces show how an active probe's waveform remains relatively unchanged, regardless of ground lead length, using the same ground lead sequence as the passive probe in the top three traces.

Choosing an Active Probe

Today active probes achieve higher performance than their predecessors and their high impedance passive counterparts. They provide:

EASY USE

- **Integral Probe Power** from compatible instrumentation.
- **Scope AutoCal*1** which compensates for probe offsets and drift.
- **Readout Encoding** accounts for probe attenuation factor and reduces measurement reading errors.
- **Auto Termination** eliminates the need to manually terminate the system (TEKPROBE™ models).
- **Wide Linear Dynamic Range** allows access to today's logic voltage levels.
- **Variable DC Offset** allows correction for DC levels, to bring the signal into the probe's linear dynamic range. Probe Offset is controlled by a compatible instrument, or externally by the probe itself.

TRUER SIGNAL REPRODUCTION AND FIDELITY

- **Ultra-Low Input Capacitances and High Input Resistances** allow making measurements at unknown impedance test points by maintaining higher probe input impedance across a wider bandpass and reduce ground lead loop effects allowing the use of longer ground leads than a standard passive probe.
- **DC up to 4 GHz Bandwidths** allow improved AC and DC signal characterization and testing.

SERVICE, DURABILITY AND RELIABILITY

- **1 Year Warranty**
- **Gold-Plated Replaceable Probe Tips** (Replaceable except P6207/P6217) improve electrical connections and reliability and they lower maintenance costs.

**1 11000TDS (400A) (500A) (600A/B) (700A) Series.*

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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Tektronix Measurement products are manufactured in ISO registered facilities.

Active Probes

FET Voltage Probe Tutorial

GUIDE TO CHOOSING AN ACTIVE PROBE

WHEN YOU HAVE	WHAT YOU NEED	WHY
Source impedance; >100 Ω and/or low power circuits	Any active probe with greater than 100 kΩ and <2 pF depends on the instrumentation interface, the frequency range and the sensitivity required.	Active probes maintain a higher input impedance throughout their frequency range. The low input C and high input R combination allows the acquisition of the fastest rise times and accurate amplitude measurements and provides less signal drain than a conventional passive probe.
Small signal circuit analysis	P6201 with its 1X sensitivity or P6217, P6245, P6243, P6204 and P6205 with 11 K high resolution mode.	Unity gain (1X) allows full sensitivity without bandwidth loss and maintains signal amplitude of small signals.
Characterization of circuits >350 MHz	The use of active probes or 50 Ω divider probes is recommended. The specific model depends upon the frequency and measurement response required.	Low input C, 50 Ω divider probes provide excellent rise time and propagation delay measurements; however, active probes provide better overall circuit analysis capabilities (amplitudes, rise times, propagation delay, aberrations, etc.).
Tuned circuits: Oscillators, tank circuits, etc.	P6217, P6207, P6245, P6243, P6201, P6204 dependent upon the frequency and measurement response required.	Low input C and high input R minimize circuit disturbance by reducing any additional impedance to the circuit.
General purpose circuit characterization and trouble-shooting where the circuit under test impedance is unknown or not easily calculated, and/or access to circuit ground is several inches away.	The P6243 and P6245 active probes provide low input C, high input R, durability and a budget price.	Low input C and the high input R provide truer signal fidelity for unknown or uncalculated impedance points. Lower input Cs also provide a higher ring frequency than passive probes, allowing the use of longer grounds.

Probe Type	Cable Length in meters	Atten-uation	Band-width at –3dB in MHz	Input C in ≤pF	Input R in Ω	Linear Dynamic Range in Volts	DC Offset Range in Volts	Maximum Voltage in Volts (DC + pk AC)	Interface/ Readout/ Identify*2	Recommended Instrument
P6201	1.8	1X 10X 100X	900 900 900	3 1.5 1.5	100 k 1 M 1 M	±0.6 ±6.0 ±60	±5.6 ±56 ±200	±100 ±200 ±200	BNC/Y/N BNC/Y/N BNC/Y/N	400/2400/ 7000 Series*3
P6202A	2	10X 100X*1	500 500	2 2	10 M 10 M	±6.0 ±60	±55 ±200	±200 ±200	BNC/Y/N BNC/N/N	400/2400/ 7000 Series *3
P6204	1.5	10X	1000	1.9	10 M	±10	±15	±40	TPB/Y/Y	11000*4 TDS 400(A)*5/ 500(A)/600(A/B)/700(A)
P6205	1.5	10X	750	2	1 M	±10	NA	±40	TPB/Y/N	11000*4 TDS 400(A)*5/ 500(A)/600(A/B)/700(A)
P6207	1.6	10X	4000	0.4 (typical)	100 k	±4.0	±5.0	±40	TPS/Y/N	TDS 820
P6217	1.5	10X	4000	0.4 (typical)	100 k	±4.0	±5.0	±40	TPB/Y/N	11000*4 TDS 400(A)*5/ 500(A)/600(A/B)/700(A)
P6243	1.3	10X	1000	≤1	1M	±8.0	N/A	±40	TPB/Y/N	11000*4 TDS 400(A)*5/ 500(A)/600(A/B)/700(A)
P6245	1.3	10X	1500	≤1	1M	±8.0	±10.0	±40	TPB/Y/N	11000*4 TDS 400(A)*5/ 500(A)/600(A/B)/700(A)

**1 Optional Accessory. Order 010-0384-00.*
**2 Interface/Readout/Identify-AutoProbe Code: (TPB=TEKPROBE™ BNC)/(TPS=TEKPROBE™ SMA)/(BNC=Conventional BNC)/(Y=Yes)/(N=No).*
**3 Requires Probe Power connector on the scope or recommended power supply.*
**4 11000 Series = 11A32/11A34/11A52/11A71/11A81 in a compatible mainframe, i.e., DSA 600/CSA 400/11400, etc.*
**5 DC Offset Functions are not incorporated into the TDS 400.*

1 GHz Active Probe for SMDs

New P6243 • New P6243S • P6245

Features

P6243

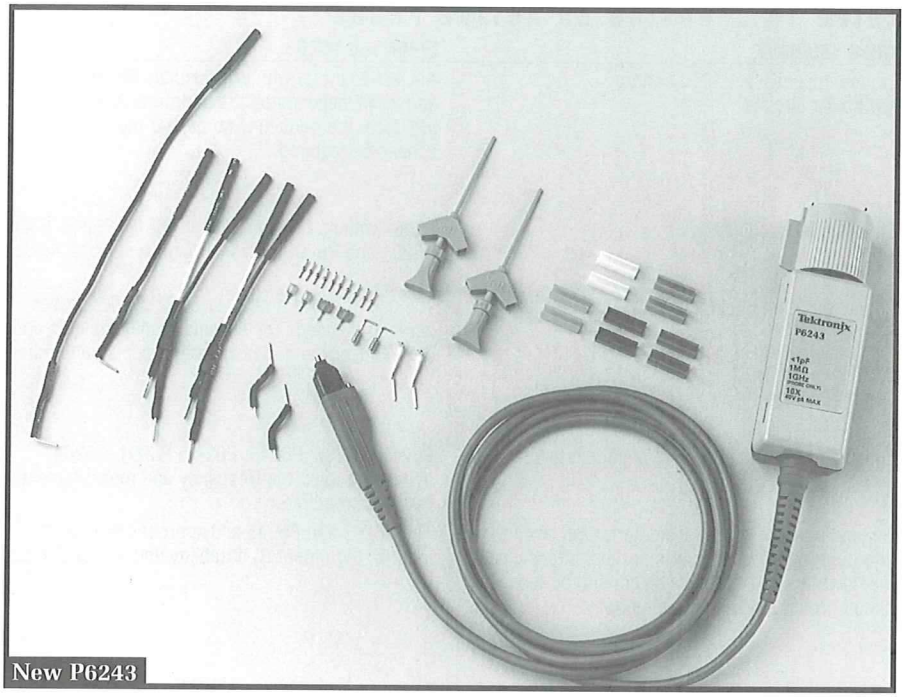
- ≤1 pF Input Capacitance
- 1 GHz Bandwidth (probe only)
- 1 MΩ Input Resistance
- Direct Access to SMDs as Small as 0.5 mm Pitch
- Measures CMOS, BiCMOS, ECL, GaAs and TTL logic
- Low Mass Probe Head/Cable
- No Additional Power Supplies or Cables Are Required with TEKPROBE™ BNC Interface

P6245

- ≤1 pF Input Capacitance
- ≥1.5 GHz Bandwidth (Probe Only)
- 1 MΩ Input Resistance
- Direct Access to SMDs as Small as 0.5 mm Pitch
- Measures CMOS, BiCMOS, ECL, GaAs and TTL logic
- Low Mass Probe Head/Cable
- No Additional Power Supplies or Cables Are Required with TEKPROBE™ BNC Interface

Applications

- High-speed Digital Systems Design
- Component Design/Characterization
- Educational Research
- Manufacturing Engineering and Test



New P6243

1 GHz Active Probe for SMDs for TEKPROBE™ BNC Interfaces

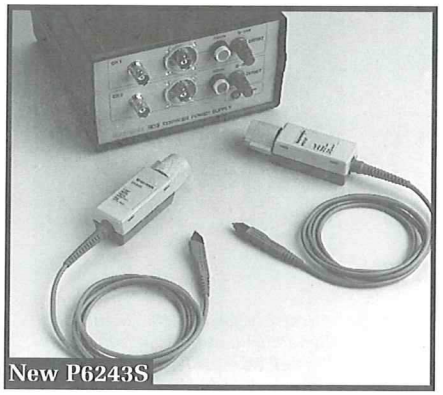
P6243

The P6243 Active FET probe is the high performance probing solution for 500 MHz Digital Storage Oscilloscopes. The P6243 has a probe only bandwidth of 1 GHz and will provide a 500 MHz system bandwidth when used with Tektronix' full line of 500 MHz DSOs. In addition, the P6243 is powered by the TEKPROBE™ BNC interface, eliminating the need for additional power supplies and cables when used with TEKPROBE™ BNC oscilloscopes.

The P6243 offers superior signal acquisition on surface mount devices compared to the much higher capacitive loading of passive probes. The P6243 has ≤ 1 pF capacitive loading which allows it to measure high speed signals without affecting the signal or device under test. Furthermore, the included accessories and adapters allow for easy attachment to SMDs.

P6243S

The P6243S is the ideal package for using the P6243 on non-TEKPROBE™ BNC oscilloscopes. The P6243S consists of 2 P6243 probes and the 1103 TEKPROBE™ Power Supply. This provides the full performance of the P6243 (except automatic scale factor readout) on any oscilloscope, including Tektronix' TDS300 Series and 2400 Series oscilloscopes.


New P6243S

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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Tektronix Measurement products are manufactured in ISO registered facilities.

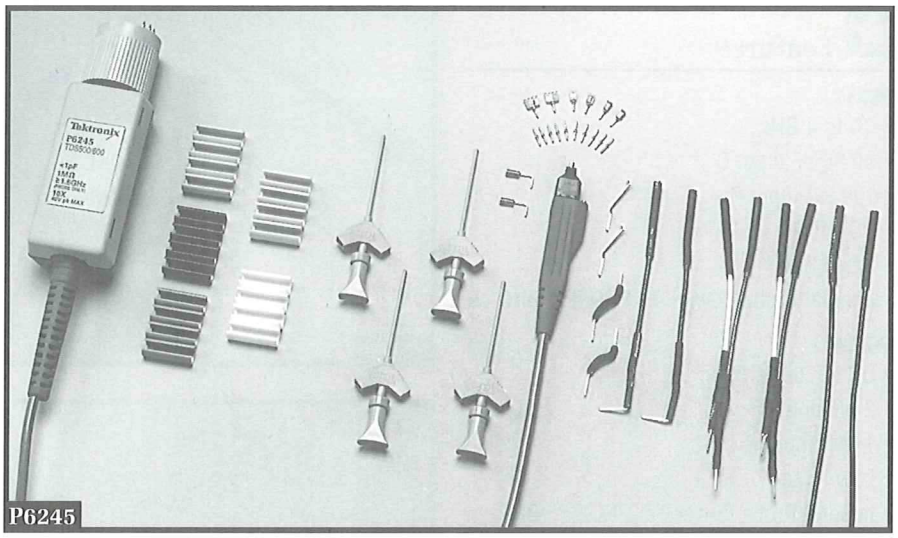
Active FET Probe for SMDs

New P6243 • New P6243S • P6245

P6245 Active FET Probe for TEKPROBE™ BNC Interfaces

The P6245 Active FET probe provides the electrical and mechanical performance required for today's digital systems designs. The P6245 achieves high-speed signal acquisition by solving three traditional problems:

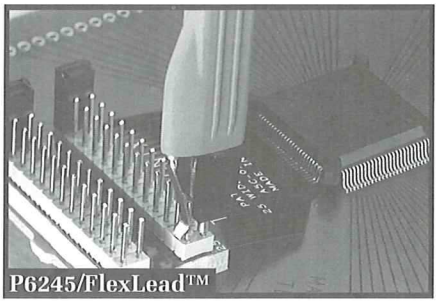
- Lower DUT loading (≤1 pF/1 MΩ probe loading)
- Direct and easy access to SMDs (Small compact probe head and versatile attachment accessories allow direct connection to the DUT.)
- Access DUT signals at scope bandwidth (P6245 Active FET Probe provides scope bandwidth at the probe tip for the TDS 684A and TDS 784A.)



P6245

CHARACTERISTICS

Probe Type	Cable Length	Attenuation	Bandwidth in GHz (Probe Only)	Rise Time	Input C in pF	Input R in Ω	Linear Dynamic Range	DC Offset Range	Max Voltage (Non-destruct)	Propagation Delay
P6243	1.3	10X	1.0	350 ps	<1 pF	1M	±8V	N/A	±40	5.3 ns ±200 ps
P6245	1.3	10X	1.5	267 ps	<1 pF	1M	±8V	±10 V	±40	5.3 ns ±200 ps


P6245/FlexLead™

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P6243S
Active Probe System.
Includes: Two each P6243 Active Probe, 1 each 1103 TEKPROBE™ Power Supply.

P6243
Active Probe.
Includes: Two each: 50 mil, 25 mil (0.65 mm), and 0.5 mm SureFoot™ Adapters; 10 each Solderable Probe Tips; 2 each 1 in., 1 each 3 in. and 6 in. Ground Leads; 1 each Y Lead Adapters; 4 each SMT KlipChip™; 2 each of 5 colors, Cable Markers; 2 each Spring Adapter: Right Angle; and Instruction Manual.

P6245
Active FET Probe.
Includes: Two each: 50 mil, 25 mil (0.65 mm), and 0.5 mm SureFoot™ Adapters; 10 each Solderable Probe Tips; 2 each 1 in., 3 in., and 6 in. Ground Leads; 2 each Y Lead Adapters; 4 each SMT KlipChip™; 2 each of 5 colors, Cable Markers; 2 each Spring Adapter: Right Angle; and Instruction Manual.

RECOMMENDED ACCESSORIES
See page 486.

POWER SUPPLY – TEKPROBE™ POWER SUPPLY
Order 1103.
See page 451 for complete selection information.

SMD PROBING ADAPTERS*1
SureFoot™ Adapters –
50 mil pitch. Order SF501.
25 mil and 0.65 mm pitch. Order SF502.
0.5 mm pitch. Order SF503.
FlexLead™ Adapters –
JEDEC Packages (25 mil pitch).
EIAJ Packages (0.65 mm pitch).
EIAJ Packages (0.5 mm pitch).
**1 See pages 468 to 473 for complete SMD Adapters information.*

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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Active FET Probes

P6217 • P6205 • P6204 • 1103

Features

P6217
- DC to 4 GHz
- ≤0.40 pF Input C
- 100 kΩ Input R
- DC Offset
- Small Size
- Integral Probe Power TEKPROBE™ BNC

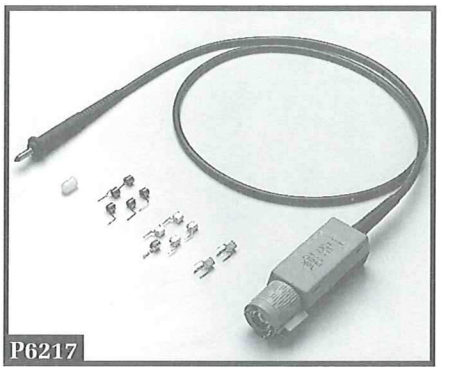
P6205
- DC to 750 MHz
- 2 pF Input C
- 1 MΩ Input R
- Low Price
- Integral Probe Power TEKPROBE™ BNC

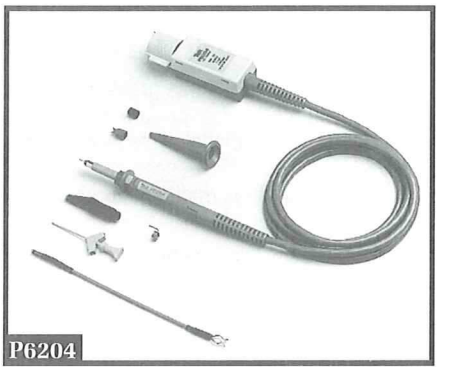
P6204
- DC to 1 GHz
- 1.9 pF Input C
- 10 MΩ Input R
- DC Offset
- Identify Button
- Integral Probe Power TEKPROBE™ BNC

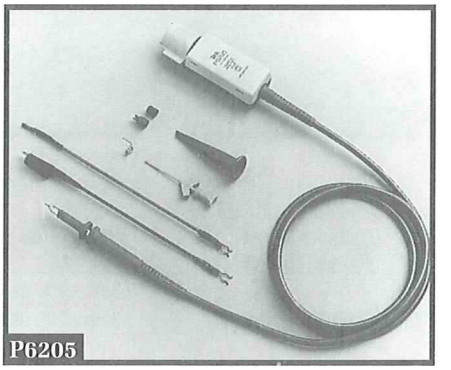
1103
- Powers up to Two Probes
- For Use with P6203, P6204, P6205, P6217, P6243, P6245 on Non-TEKPROBE™ Interfaced Scopes
- Overload Protected

Applications

- High-speed Digital Systems Design
- Component Design/Characterization
- Educational Research
- Manufacturing Engineering and Test









Active FET Probes for TEKPROBE™ BNC Interface

The P6204, P6205 and P6217 Probes are Tektronix' line of Low Circuit Loading Signal Acquisition probes for CSA (Communications Signal Analyzers), DSA (Digitizing Signal Analyzers), 11000 Series and the TDS Family of Oscilloscopes.

The P6204, P6205 and P6217 are designed with FET devices for their inputs, which allows very high input resistance values and low input capacitances.

The P6217 provides the widest bandwidth and lowest input capacitance for a handheld active voltage probe with 100 KΩ input resistance.

The P6204 provides wide bandwidth, with low input capacitance and the highest input resistance available. At the same time the P6204 is the only active FET probe available which provides remote control capabilities.

The P6205 provides low input capacitance and high input resistance performance at a budget price.

All three Active FET probes provide a wide linear dynamic input range for accessing most digital device families using today's logic voltage levels.

Power for the P6204, P6205 and P6217 is supplied by the CSA, DSA, TDS and 11000 Series mainframes through the TEKPROBE™ BNC Interface, eliminating the need for extra cabling and/or external power supplies.*[1]

A variable DC Offset function, which is controlled through the mainframe (CSA, DSA and 11000 Series) to bring signals (those within the offset control range) into the dynamic range of the probe, is available for the P6204 and P6217 probes.

Probe information such as type, serial number, attenuation factor, offset scale factor, input resistance, and termination resistance required is communicated through the TEKPROBE™ Interface between the Active Probe and the CSA, DSA and 11000 Series mainframes. This information is used by these oscilloscope mainframes during the scope initialization sequence and measurement analysis.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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Active FET Probes

P6217 • P6205 • P6204 • 1103

Remote Control of several 11000 Series Programmable Functions/Actions is possible using the "Identify Button" on the P6204 probe head. These functions include Autoset, recall the next in a series of stored setups, invoke Automatic-Measurement, issue an SRQ (service action request), or activate the trace identification function.

These Active Probes may also be used with 50 Ω or 1 MΩ oscilloscope systems, with conventional BNC interfaces, via the Tektronix 1103 TEKPROBE™ Power Supply. The 1103 has dual TEKPROBE™ inputs, dual BNC signal outputs, and dual voltage offset on/off switches and potentiometers.

BENEFIT HIGHLIGHTS

- **Low Input C, High Input R –** Minimizes circuit under test loading.
- **Probe Power Directly from CSA, DSA,TDS or 11000 Series TEKPROBE™ BNC Interfaces –** Means no additional cables or power supplies required.*1
- **Variable DC Offset (Except P6205) –** Allows correction for DC levels to bring the signal into the probe's dynamic measurement range.
- **Readout Coding for 10X Attenuation –** Reduces confusion and errors in measurement readings.
- **Gold-Plated Replaceable Probe Tips (Except P6217) –** Improved electrical connections and lower maintenance costs.
- **Miniature Size Accessories (Except P6217) –** Provides wide range of circuit attachments.
- **UL Listed –** Third party certification for safe operation.

DESIGNED FOR:

- Digital design and debug of logic families such as:
  - ECL
  - GaAs
  - MOS: CMOS; FastCMOS; BiCMOS; TTL
- Component characterization/measurement of high-speed analog circuitry relative to:
  - amplitude levels
  - aberrations
  - propagation delay and timing
  - bandwidths and rise times

**1 To use these TEKPROBE™ BNC Interface Probes on the 11800 or CSA 800 Series requires an 1103 TEKPROBE™ Power Supply, an SMA Male to BNC Female adapter, and a 50 Ω BNC cable.*

CHARACTERISTICS

Probe Type	Nominal Cable Length in meters	Attenuation	Bandwidth at –3 dB in MHz	Input C in pF	Input R in Ω	Linear Dynamic Range in Volts	DC Offset Range in Volts	Max. Voltage in Volts (DC + pk AC)	Interface/ Readout/ Identify*2	Recommended Instrument
P6204	1.5	10X	1000	1.9	10 M	±10	±15	±40	TPB/Y/Y	11000 *3
P6205	1.5	10X	750	2	1 M	±10	NA	±40	TPB/Y/N	11000 *3 TDS 400(A)*4 TDS 500(A) TDS 600(A/B)/TDS 700(A)
P6217	1.5	10X	4000	0.40 Typical	100 k	±4.0	±5.0	±40	TPB/Y/N	

**2 Interface/Readout/Identify Code: (TPB=TEKPROBE™ BNC)/(TPS=TEKPROBE™ SMA)/(BNC=CONVENTIONAL BNC)/(Y=Yes)/(N=No).*
**3 11000 SERIES = 11A32/11A34/11A52/11A71/11A72/11A81.*
**4 P6204, P6217, and P6245 DC Offset functions are not incorporated into the TDS 400 Family.*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P6204
10X, 1 GHz Active FET Probe.
Includes: Retractable Hook Tip (013-0107-07); 6 in. Ground Lead with Alligator (196-3120-00); 6 in. Ground Lead with Square-pin Receptacle (196-3198-00); Ground Contact, Spring (214-4125-00) SMT KlipChip™ (206-0364-00); Insulating Ground Cover (166-0404-01); IC Test Tip; Carrying Case; Instruction Manual (070-6949-00).

P6205
10X, 750 MHz Active FET Probe.
Includes: Same as P6204 except Instruction Manual (070-8202-00).

P6217
4 GHz Active FET Probe.
Includes: 4-post ECB Mount Ground Socket (131-5308-00); Edge Tab Ground Socket (131-5309-00); 2 each of 5 Lengths Wire-form Ground (131-5482-00); 1 Electrostatic Protection Cap (200-3961-00); 1 Adjustable Anti-static Wrist Strap (006-3415-04); Storage Cabinet; Instruction Manual (070-8553-00).

1103
TEKPROBE™ Power Supply.
For P6203, P6204, P6205, P6217, P6245 and P6231. Powers 2 Probes.

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Opt. A5 – Available.
See the General Customer Information Section for description.

ADDITIONAL ACCESSORIES (FOR 1103)
36 In. Precision 50 Ω BNC cable – Order 012-0482-00.
50 Ω Feedthrough Termination – Order 011-0049-01.

RECOMMENDED ACCESSORIES FOR P6204, P6205, P6217

See pages 477 and 482.

Probe Tip Adapter – For P6207, P6217 and SD-14 Active Probes. Instruction Sheet Plus SMA Male 50 Ω Termination provided.Order 013-0271-01.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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Active FET Probes

P6201 • P6202A • 1101A

Features

FOR 50 Ω AND 1 MΩ INTERFACES

P6201

- True Signal Fidelity, DC up to 900 MHz
- 1.5 pF Input C*1
- 1 MΩ Input R*1
- 1X/10X/100X
- AC-DC Coupling
- Variable DC Offset, up to ±200 V
- Selectable 50 Ω, Termination for Use with 50 Ω or 1 MΩ Inputs

P6202A

- DC to 500 MHz
- 2 pF Input C
- 10 MΩ Input R
- 10X/Optional 100X
- AC-DC Coupling
- Variable DC Offset, up to ±200 V
- Selectable 50 Ω, Termination for Use with 50 Ω or 1 MΩ Inputs

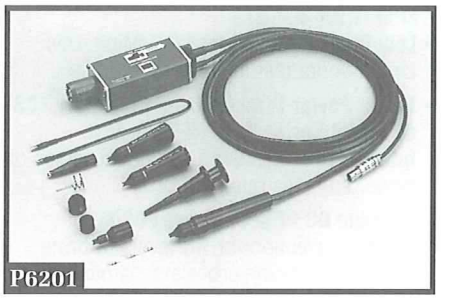
1101A

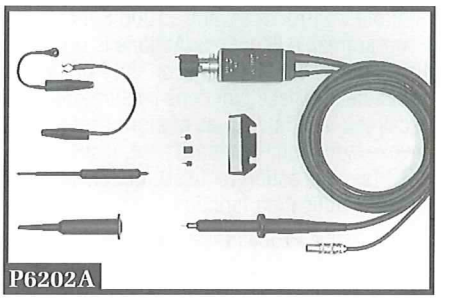
- Powers up to Two Probes
- For Probe Use with Oscilloscopes That Do Not Have Probe Power
- Compatible with the P6201, P6202A, and P6230
- Overload Protected
- Variable DC Offset, up to ±200 V
- Selectable 50 Ω, Termination for Use with 50 Ω or 1 MΩ Inputs

**1 See specifications.*

Applications

- Digital Design and Debug of Logic Families
- Component Characterization/Measurement of High-speed Analog Circuitry


P6201


P6202A

P6201/P6202A

The P6201 and P6202A are Tektronix' line of Low Circuit Loading Active Signal Acquisition probes for 400 Series, 2400 Series, and 7000 Series Families of Oscilloscopes.

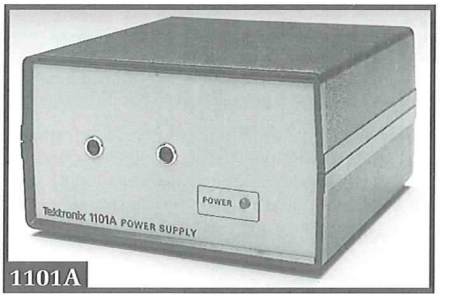
The P6201 and P6202A with Active FET devices in their inputs provide very high input impedances.

Both the P6201 and P6202A probes provide a wide linear dynamic input range for accessing most digital device families using today's logic voltage levels.

The P6201 provides unity gain (1X) and is the best general purpose FET probe within its voltage range. Plug-on attenuator heads provide wider dynamic ranges (10X and 100X), while maintaining the oscilloscope readout factor.

Wider dynamic input range for the P6202A is achieved by an optional 10X attenuator head which provides 100X attenuation.

Both the P6201 and P6202A probes provide a variable DC Offset function which is set via the offset controls on the probe's compensation box to bring signals (those within the offset control range) into the dynamic range of the probe.



1101A

AC or DC coupling selection is available on the P6201 and P6202A FET Probes. When AC coupled, the DC voltage component is blocked, allowing viewing of superimposed signals.

A self-contained selectable 50 Ω termination switch allows the P6201 or P6202A to be terminated into a 50 Ω or 1 MΩ oscilloscope inputs.

Power for the P6201 and P6202A is supplied by the 400 Series, 2400 Series, and 7000 Series mainframes through the optional Probe Power Jack, or the 1101A Power Supply.

The P6201 or P6202A may also be used with other 50 Ω and 1 MΩ input real-time oscilloscopes, sampling systems, spectrum analyzers and counters via the 1101A and appropriate interface adapters (SMA to BNC, GR to BNC, etc.).

The 1101A power supply provides external power to probes when the oscilloscope used does not have the capability to supply probe power.

The 1101A has two power receptacles that will power up to two independent probes, such as the P6201, P6202A, and P6230.

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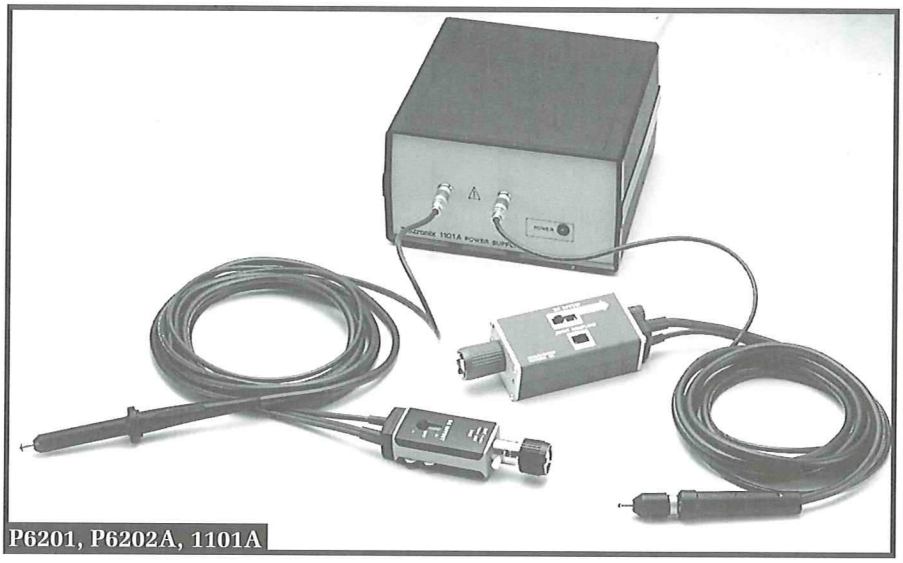
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Active FET Probes

P6201 • P6202A • 1101A

DESIGNED FOR:

- Digital design and debug of logic families such as:
  - ECL
  - GaAs
  - MOS: CMOS; FastCMOS; BiCMOS
  - TTL
- Component characterization/measurement of high-speed analog circuitry relative to:
  - amplitude levels
  - aberrations
  - propagation delay and timing
  - bandwidths and rise times



P6201, P6202A, 1101A

CHARACTERISTICS

Probe Type	Nominal Cable Length in meters	Attenuation	Bandwidth at –3 dB in MHz	Input C in pF	Input R in Ω	Linear Dynamic Range in Volts	DC Offset Range in Volts	Maximum Voltage in Volts (DC + pk AC)	Interface/ Readout/ Identify*1	Recommended Instrument
P6201	1.8	1X	900	3	100 k	±0.6	±5.6	±100	BNC/Y/N	400/2400/ 7000 Series*2
		10X	900	1.5	1 M	±6.0	±56	±200	BNC/Y/N	
		100X	900	1.5	1 M	±60.0	±200	±200	BNC/Y/N	
P6202A	2	10X	500	2	10 M	±6.0	±55	±200	BNC/Y/N	400/2400/ 7000 Series*2
		100X*3	500	2	10 M	±60.0	±200	±200	BNC/Y/N	

*1 *Interface/Readout/Identify-AutoProbe Code: (TPB=TEKPROBE™ BNC) / (TPS=TEKPROBE™ SMA) / (BNC=Conventional BNC) / (Y=Yes) / (N=No).*

*2 *Requires Probe Power connector on mainframe or 1101A Power Supply.*

*3 *Optional Accessory. Order 010-0384-00.*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P6201
1X, 900 MHz FET Probe.
Includes: Retractable Probe Tip (013-0135-00); 10X Attenuator Head (010-0376-00); 100X Attenuator Head (010-0377-00); 3 Probe Tips (206-0200-00); Miniature Probe Tip Adapter (103-0164-00); 12 in. Ground Lead (175-0848-02); Ground Contact (131-1302-00); Alligator Clip (344-0046-00); Electrical Insulating Sleeve (166-0557-00); Ground Contact Insulator (342-0180-00); Probe Holder (352-0351-00); Carrying Case; Instruction Manual (070-1306-02).

P6202A
10X, 500 MHz FET Probe.
Includes: Retractable Probe Tip (013-0097-01); 2 Alligator Clips (344-0046-00); Probe Holder (352-0351-00); 3 in. Ground Lead (175-0849-00); Probe Adjustment Tool (003-0675-01); 6 in. Ground Lead (175-1017-00); 2 Replaceable Probe Tips (206-0230-01); Electrical Insulating Sleeve (166-0404-01); Carrying Case; Instruction Manual (070-3642-00).

ADDITIONAL ACCESSORIES
Also see pages 482 and 485.

10X Attenuator – (P6202A only) For a total of 100X attenuation. Order 010-0384-00.

1101A Power Supply –
For P6201, P6202A. Powers 2 Probes.

INTERNATIONAL POWER PLUG OPTIONS (FOR 1101A)

Opt. A1 – Universal Euro, 220 V 50 Hz.
Opt. A2 – United Kingdom, 240 V 50 Hz.
Opt. A3 – Australian, 240 V 50 Hz.
Opt. A4 – North American, 240 V 60 Hz.
Opt. A5 – Switzerland, 220 V 50 Hz.

See General Customer Information Section for additional description.

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Active FET Probe

P6207

Features

P6207

- True Signal Fidelity
  - DC up to 4 GHz
- Ultra-low Input Capacitance
  - 0.4 pF Provides Lower Circuit Loading and the Use of Longer Ground Leads
- 100 kΩ Input Resistance
  - Maintains Circuit Biasing Levels
- Easy to Use
  - Active Performance with Passive Simplicity
- Variable DC Offset ±5 V
- Integral Probe Power TEKPROBE™ SMA
- Small Geometry Accessibility

Applications

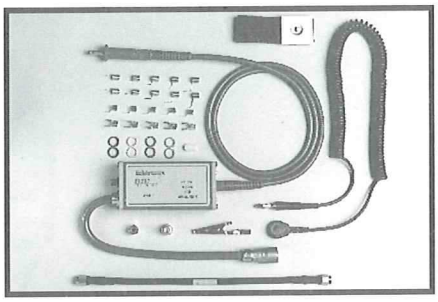
- Digital Design and Debug of Logic Families Such as ECL, GaAs, MOS (CMOS; FastCMOS; BiCMOS), TTL
- Component Characterization/Measurement of High-speed Analog Circuitry Relative to:
  - Amplitude Levels
  - Aberrations
  - Propagation Delay and Timing
  - Bandwidths and Rise Times

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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P6207 Active FET Probe For TEKPROBE™ SMA Interfaces

The P6207 Active (FET) Probe is a Low Circuit Loading Signal Acquisition probe for TDS820 Oscilloscopes.

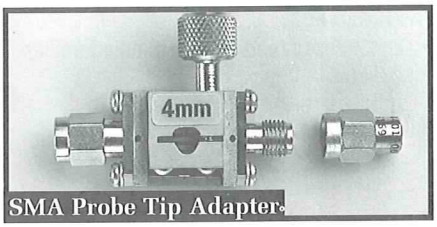
The P6207 provides the widest bandwidth and lowest input capacitance at 100 kΩ available for a handheld active voltage probe.

The P6207 provides a wide linear dynamic input range for accessing most digital device families using today's logic voltage levels.

The P6207's lower input capacitance reduces the AC current flow and the sensitivity to ground loops, thereby easing ground lead length requirements.

BENEFIT HIGHLIGHTS

- **Low Input C, High Input R** – Minimizes circuit under test loading.
- **Probe Power Directly from TDS800 Series TEKPROBE™ SMA Interfaces** – Means no additional cables or power supplies required.
- **Variable DC Offset** – Allows correction for DC levels to bring the signal into the probe's dynamic measurement range.
- **Readout Coding for 10X Attenuation** – Reduces confusion and errors in measurement readings.
- **Gold-Plated Probe Tips** – Improved electrical connections.
- **UL Listed** – Third party certification for safe operation.



PROBE TIP ADAPTER

The Probe Tip Adapter is a high-performance 50 Ω "T" type pickoff for use with high impedance Tektronix P6207 or P6217 Active FET probes, the Tektronix SD-14 Sampling Head and other probes compatible with the 4 mm probe tip system. The in-line portion of the "T" is fitted with SMA-compatible 2.92 mm connector, one end male and one end female. The signal pickoff point is a receptacle for the Probe Tip. An SMA male 50 Ω termination is included.

When used with the P6207 or P6217, the Probe Tip Adapter allows signal pickoff from a 50 Ω system with a minimum of disturbance of the system characteristics. This provides a convenient means of obtaining a signal for the P6207 or P6217 from a closed coaxial 50 Ω system.

P6207 Characteristics

Nominal Cable Length in meters – 1.6.

Attenuation – 10X.

Bandwidth at –3dB in MHz – 4000.

Input C in pF – 0.4 Typical.

Input R in Ω – 100 k.

Linear Dynamic Range in Volts – ±4.0.

DC Offset Range in Volts – ±5.0.

Maximum Voltage in Volts (DC + pk AC) – ±40.

Interface/Readout/Identify*1 – TPS/Y/N.

Recommended Instruments – TDS820.

**1 Interface/Readout/Identify-AutoProbe Code: (TPB=TEKPROBE™ BNC)/(TPS=TEKPROBE™ SMA)/(BNC=Conventional BNC)/(Y=Yes)/(N=No).*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P6207
4 GHz Active FET Probe, SMA.
Includes: 1 RF Cable Assembly, 8.5 in. (174-1120-00); 4-post ECB Mount Ground Socket (131-5308-00); Edge Tab Ground Socket (131-5309-00); 2 each of 5 Lengths Wire-form Ground (131-5482-00); 1 Electrostatic Protection Cap (200-3961-00); 1 SMA Shorting Connector (015-1021-00); 1 Adjustable Anti-static Wrist Strap (006-3415-04); Storage Cabinet; Instruction Manual (070-7909-00).

RECOMMENDED ACCESSORIES

See page 477.

Probe Tip Adapter – For P6207, P6217, SD-14. Active Probes. Instruction Sheet plus SMA Male 50 Ω Termination Provided (015-1022-00). Order 013-0271-01.

50Ω Divider (Zo)

P6150 • P6156

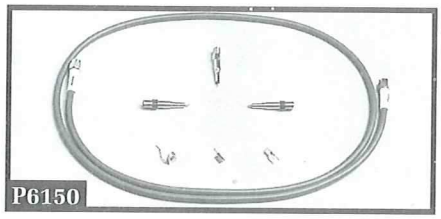
Features

LOW IMPEDANCE ZO TDR PASSIVE PROBES

- P6150 to 9 GHz
- P6156 to 3.5 GHz
- Low Capacitive Loading to Extremely High Frequencies
- Interchangeable Attenuator Tip Assemblies, 1X and 10X (also 20X and 100X on P6156)

Applications

- High-speed Device Characterization in Microwave Communication, Signal Processing, and Logic Applications
- Propagation Delays for ECL, GaAs and Other Logic Circuitry and Devices
- Circuit Board Impedance Testing (TDR)
- High-speed Sampling Systems

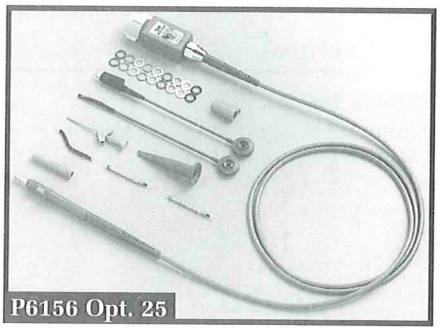


P6150 DC TO 9 GHz

The P6150 is a very high bandwidth, 10X attenuation, low impedance probe designed for use with the SD2X family of Sampling/TDR plug-ins. 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 is included to optimize attachment to the device under test while maintaining high signal integrity.

P6156 DC TO 3.5 GHz

The P6156 is a 3.5 GHz, low impedance Zo probe (50 Ω divider) which comes standard with a 10X (500 Ω) attenuator tip. The 100X attenuation value is available as an option, and the 1X and 20X attenuators may be purchased as replaceable sub-assemblies. Although designed for the 11A52, 11A72, and 11A81, the P6156 probe may be used with 11000 Series plug-ins, the 11800 Series SD2X Sampling/TDR plug-ins, 7000 Series plug-ins and Sampling/TDR units, 2400 Series,



or other 50 Ω/1 MΩ input channel amplifiers and oscilloscopes (with the proper adapters). The 50 Ω Termination required by the P6156 is automatically sensed by 11000 Series mainframes and plug-ins.The P6156 may be directly connected to a 50 Ω input, but requires a 50 Ω termination when used with 1 MΩ amplifiers. This probe gives you a handy identify button for accessing many of the functions of your 11000 or DSA600 Series scopes from the probe. The attenuator tips are color-coded to a switch on the compensation box of the P6156 to help in properly setting the readout scale factor.

Note: The P6156 attenuator tip must be changed and the compensation box readout switch changed to provide the various 1X, 10X, 20X, and 100X attenuation values. Tip colors match switch setting colors.

CHARACTERISTICS

Probe Type	Nominal Length	Attenuation	Bandwidth	Rise Time	Loading Input R/C	Max V In	Propagation Delay
P6150	1 m	10X ±2%	9 GHz	<38.8 ps	500 Ω/<0.15 pF	12.5 V RMS	4.40 ns ±0.1 ns
		1X ±2%	≥3 GHz	≤170 ps	50 Ω/N/A	*1	4.40 ns ±0.1 ns
P6156	1.5 m	10X ±3%	≥3.5 GHz	<100 ps	500 Ω/≤1 pF	15 V RMS	7.75 ns ±0.07 ns
		100X ±3%	≥3.0 GHz	≤120 ps	5000 Ω/≤1.1 pF	50 V RMS	7.75 ns ±0.07 ns
		20X ±3%	≥3.5 GHz	<100 ps	1000 Ω/≤1 pF	22 V RMS	7.75 ns ±0.07 ns
		1X ±5%	≥1.5 GHz	<300 ps	50 Ω/N/A	*2	7.75 ns ±0.07 ns

Interface/Readout/Identify: Interface: B=BNC; S=SMA Readout/Identify: Y=Yes; N=No

**1 Limited by scope input or 42 V RMS.*
**2 Limited by scope input or 50 V RMS.*

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P6150
10X, 9 GHz, 1.0 m, Low Impedance Probe.
Includes: One 1X Attenuator Head (206-0398-00); Two 10X Attenuator Heads (206-0399-03); 1.0 m Cable Assembly (174-1341-00); Instruction Sheet (070-7173-00); and 1 Accessory Kit consisting of: 20 each Ground Clip, 3 each Adjustable Ground Lead, 10 each Electrical Contact, and 2 each Probe to Circuit Board Ground Connectors (020-1708-00).

ADDITIONAL ACCESSORIES
See pages 477 and 480.

SMA Male to BNC Female – Order 015-0554-00.
SMA Female to BNC Male – Order 015-0572-00.
SMA to Probe Tip – (For P6156 only) Order 013-0237-00.

P6156
3.5 GHz (10X), 1.5 m Low Impedance Probe.
Includes: 10X Attenuator Head (206-0380-00); 6 in. Ground Lead with Alligator Clip (196-3305-00); Retractable Hook Tip (013-0107-07); 2 in. Ground Lead (195-4240-00); 6 in. Ground Lead (196-3113-02); Ground Collar (343-1003-01); SMT KlipChip™ (206-0364-00); 2 each Cable Markers, various colors: gray, white, green, red; Probe Tip Holder (352-0670-00); Instruction Sheet (070-6430-00).

Opt. 25 – Adds 100X Attenuator.

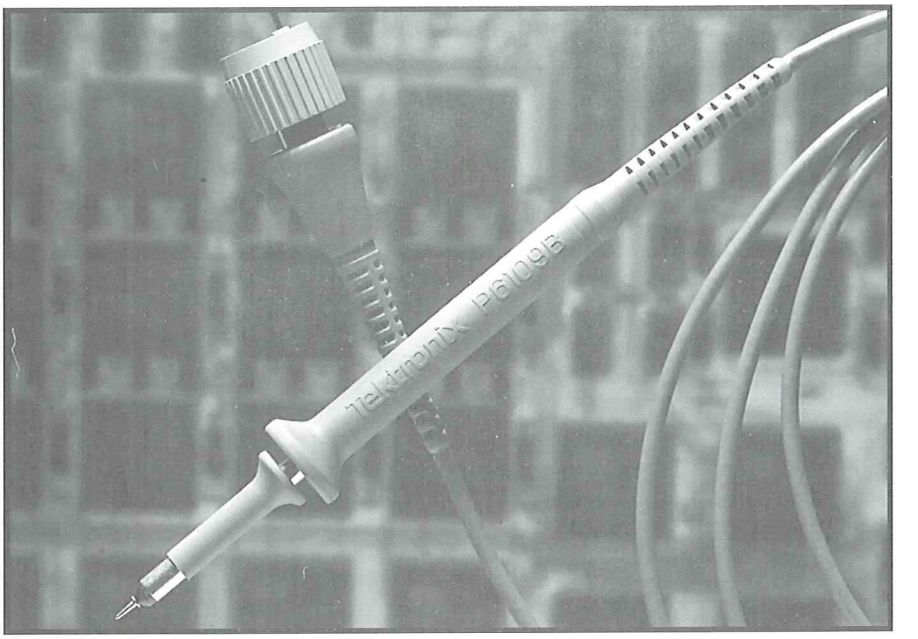
Probe Tips – For P6156 only
(1X) Order 206-0379-00.
(10X) Order 206-0380-00.
(20X) Order 206-0381-00.
(100X) Order 206-0382-00.

Passive Voltage Probes

Features

PASSIVE VOLTAGE PROBES

- Every Scope Needs at Least a Pair of General Purpose Probes



Tips on Selecting Probes

Nearly all general purpose and laboratory oscilloscopes use probes to make a direct, flexible and convenient connection to a device-under-test (DUT). Of all the different types of measurements, voltage measurements top the list by a wide margin. The ideal probe/oscilloscope combination should acquire the signal and truly represent it on the display without changing the signal source.

CONSIDER YOUR SCOPE'S...

- **Bandwidth?** Select a probe with equal or better bandwidth.
- **Input capacitance?** Select a probe with a compensation range covering the scope's nominal input capacitance.
- **Readout feature support?** Select a probe that provides automatic coding for scale factor.
- **Input loading?** Standard passive probes support 1 MΩ inputs. 50 Ω probes are also available in passive and active (FET) styles.

CONSIDER YOUR APPLICATION...

- **Engineering and design –** High frequency, specialty, absolute measurements.
- **Service –** Mixture of high and low frequency, specialty and general purpose, absolute and relative measurements.
- **Manufacturing –** Low frequency, general purpose, relative measurements.

CONSIDER YOUR MEASUREMENTS . . .

- **How will probe loading affect your measurements?** High resistance probes (10 MΩ) give minimum amplitude error; however, any significant tip capacitance will degrade the leading edge.
- **What is the waveform rise time?** Passive probes work in conjunction with the scope's input circuitry to provide a system bandwidth.
- **What is the peak voltage?** Passive probes typically have 420 V peaks. High voltage probes can handle 1.5 kV to 40 kV.
- **What is the waveform amplitude?** Maximum input voltage for a passive probe is stated as DC pulse peak AC. This is also the maximum safe input before electrical damage occurs.

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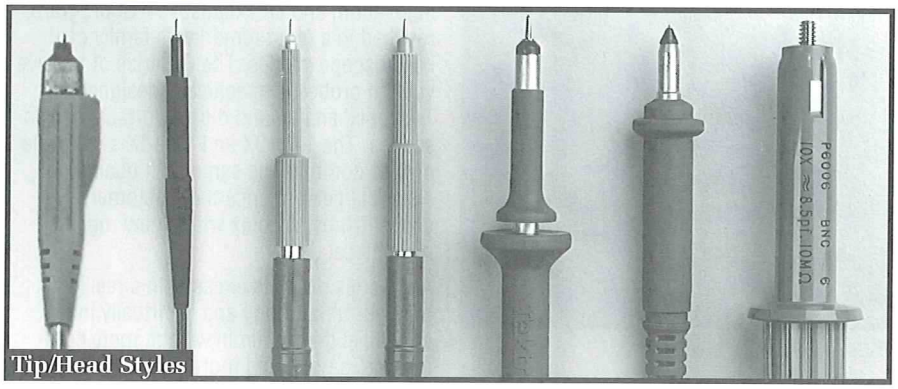
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Passive Voltage Probes

CONSIDER YOUR MECHANICAL REQUIREMENTS...

- **Probe size?** Small probes are easier to handle and attach to test points. Larger probes are more durable.
- **Tip type?** Probe tip durability is affected by materials and design. Tektronix' most durable configuration for passive voltage probes is the miniature type which is supported by a wide variety of tip accessories for test point connection. The compact probe configuration offers improved electrical performance. Subminiature probe types are useful for probing high density circuitry where several probes have to be attached in close proximity.
- **Environmental conditions?** Probes are expected to be exposed to harsh conditions in the field, but often overlooked are the rigors of daily use and abuse that general purpose probes are most likely to experience.

TIP/HEAD STYLES



SMD Active *SMD* *2.5 mm Subminiature* *3.5 mm Compact* *5 mm Miniature* *4 mm* *6/32 Thread Monolithic*

Passive Voltage Probes

P6101B • P6103B • P6109B • P6111B • P6113B • P6119B • P6129B

Features

B-SERIES 1 MΩ INPUTS

P6101B
- 1X, 15 MHz

P6103B
- 10X, 60 MHz

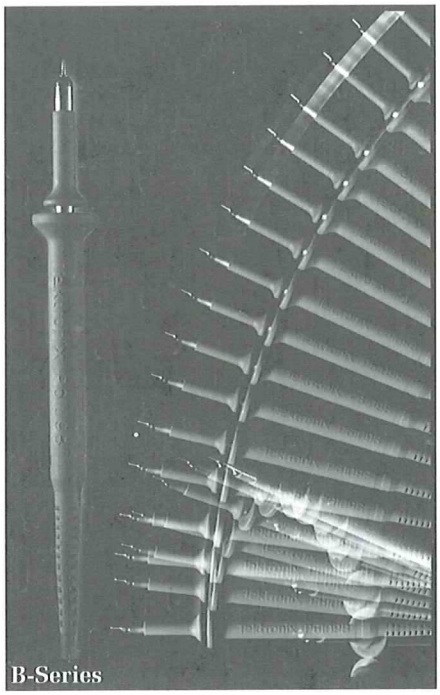
P6109B
- 10X, 100 MHz
- Readout

P6111B
- 10X, 200 MHz
- Readout

P6113B
- 10X, 100 MHz

P6119B
- 1X/10X
- 10 MHz/100 MHz

P6129B
- 1X/10X
- 10 MHz/100 MHz
- Readout



B-Series Family Photo.

B-Series Passive Voltage Probes

- Single piece, molded rubber body
- Lightweight ergonomic design
- 10 times improvement in durability
- HYBRID/SMT circuitry on multi-layer circuit board for improved performance and reliability
- New stronger replaceable probe tip
- UL safety certification
- 1 year unconditional guarantee
- Miniature probe tip compatible with a wide range of Tektronix accessories and adapters

Passive voltage probes are the most commonly used oscilloscope probe. Other specialty probes expand the range and functionality of an oscilloscope as a measurement system, but a general purpose, passive voltage probe is the working end of the oscilloscope, a tool used and abused every day without concern by engineers and technicians. The probe's utility is often taken for granted…that is, until it doesn't work. And then it's a scramble just to complete the simplest task.

Two years of customer research, design innovation, and an exhaustive test program resulted in a most remarkable family of oscilloscope probes. The B-Series of passive voltage probes is specifically designed for Tektronix' analog and digital portable oscilloscopes. The 1X, 10X and 1X/10X switchable probes combine the same high quality electrical performance that customers expect from Tektronix with a new rugged mechanical design.

A B-Series probe is encased in a resilient, molded rubber body and is virtually indestructible. It is lighter in weight, more comfortable to hold, and more reliable than modular probe styles. The probe's replaceable tip is designed to withstand up to 20 pounds of force. Patented integral strain relief allows complete freedom of movement while providing superior cable flex. Each probe has received UL safety certification and meets MIL-T-28800, Class 3, environment specifications – something portable scope users will appreciate.

PROBE/SCOPE COMPATIBILITY

Probe	Scope/Product
P6101B	All Scopes
P6103B	2201, 2205, 2212, 2214, 2225, TAS 220, TAS 250
P6109B	2211, 2221, 2224, 2230, 2232, 2235A, 2236A, 2245A, 2246A, 2247A, 2252, TAS 455, TAS 465, TAS 475, TDS 310, TDS 320
P6111B	TAS 485, TDS 350
P6113B	THS 710, THS 720
P6119B	2201, 2205, 2212, 2214, 2225, TAS 220, TAS 250
P6129B	2211, 2221, 2224, 2230, 2232, 2235, 2236A, 2245A, 2246A, 2247A, 2225, TAS 455, TAS 465, TAS 475, TDS 310, TDS 320, TDS 350

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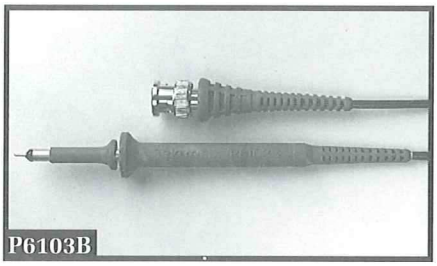
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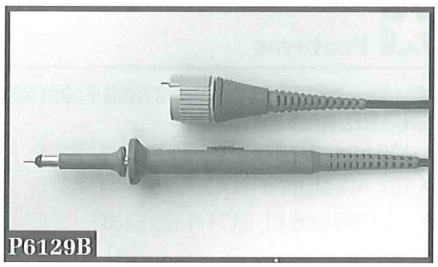
Passive Voltage Probes

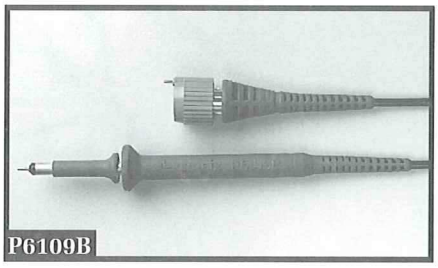
P6101B • P6103B • P6109B • P6111B • P6113B • P6119B • P6129B

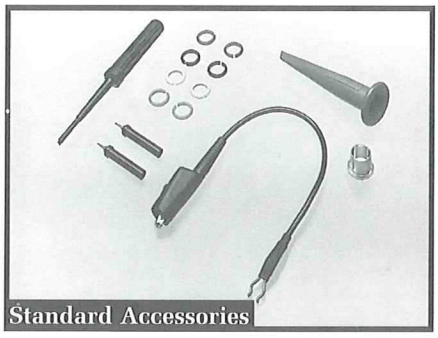
The P6101B, P6103B, P6109B, P6111B, P6113B, P6119B and P6129B probes are designed to complement Tektronix' family of portable DSO and ART instruments. The core of each probe's performance is supplied by a Tektronix HYBRID/SMT device. Tektronix' instrumentation experience provides an extra margin of quality and reliability to the B-Series that is not commonly available to probe manufacturers. B-Series probes have been designed and tested to support the overall system performance and measurement quality that Tektronix oscilloscopes guarantee.

Through the introduction of the B-Series, Tektronix has set a new standard for passive voltage probe styling, performance and durability.


P6103B


P6129B


P6109B


Standard Accessories

CHARACTERISTICS *(Note: All probe cables are 2 meters.)*

Type	Attenuation	Bandwidth Megahertz (MHz)	Comp. Range Picofarads (pF)	System Input Resistance Megaohms (MΩ)	Typical Input C Picofarads (pF)	Maximum Voltage DC + pk AC (Volts)	Readout
P6101B	1X	15	NA	1	100	420	
P6103B	10X	60	15 to 35	10	13	420	
P6109B	10X	100	15 to 35	10	13	420	√
P6111B	10X	200	15 to 35	10	14	420	√
P6113B	10X	100	15 to 35	10	11.8	300 V AC RMS	
P6119B	1X/10X	10/100	15 to 35	1/10	100/18	420	
P6129B	1X/10X	10/100	15 to 35	1/10	100/18	420	√

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P6101B
1X, 15 MHz Passive Voltage Probe.
Includes: 4 Pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 Replacement Probe Tips; BNC to Probe Tip Adapter; Adjustment Tool; Storage Pouch; Instruction Manual (070-7819-03).

P6103B
10X, 60 MHz Passive Voltage Probe.
Includes: 4 Pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Common Lead; 2 Replacement Probe Tips; BNC to Probe Tip Adapter; Adjustment Tool; Storage Pouch; Instruction Manual (070-7847-02).

P6109B
10X, 100 MHz Passive Voltage Probe with Readout.
Includes: 4 Pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 Replacement Probe Tips; BNC to Probe Tip Adapter; Adjustment Tool; Storage Pouch; Instruction Manual (070-7849-02).

P6111B
10X, 200 MHz Passive Voltage Probe.
Includes: 4 Pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 Replacement Probe Tips; BNC to Probe Tip Adapter; Adjustment Tool; Storage Pouch; Instruction Manual (070-8543-01).

P6113B
10X, 100 MHz Passive Voltage Probe.
Includes: 4 Pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Common Lead; 2 Replacement Probe Tips; BNC to Probe Tip Adapter; Adjustment Tool; Instruction Manual (070-9274-00).

P6119B
1X/10X, 10/100 MHz Passive Voltage Probe.
Includes: 4 Pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 Replacement Probe Tips; BNC to Probe Tip Adapter; Adjustment Tool; Storage Pouch; Instruction Manual (070-8000-02).

P6129B
1X/10X, 10/100 MHz Passive Voltage Probe with Readout.
Includes: 4 Pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 Replacement Probe Tips; BNC to Probe Tip Adapter; Adjustment Tool; Storage Pouch; Instruction Manual (070-8547-02).

RECOMMENDED ACCESSORIES
See pages 482 to 483.

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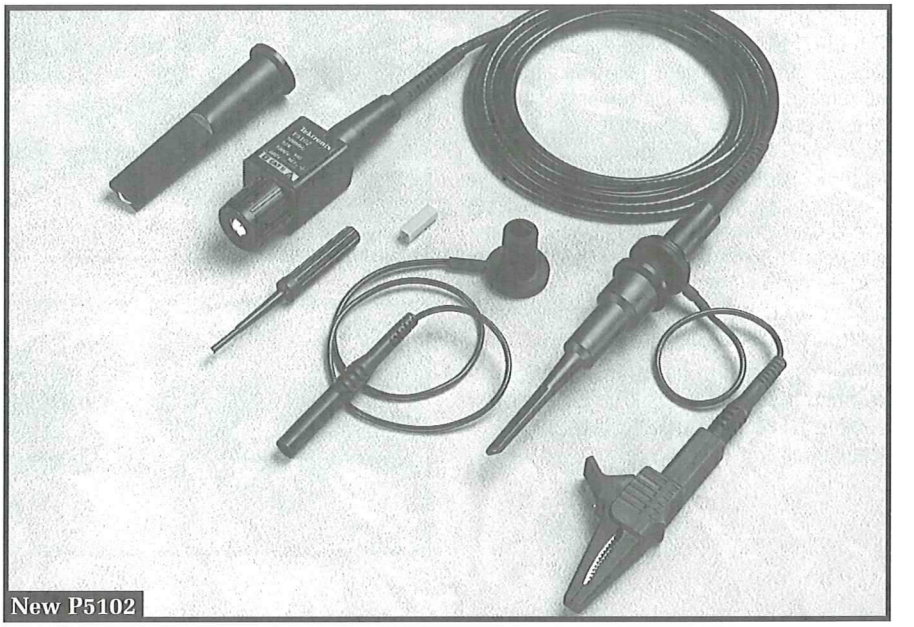
Passive Voltage Probes

New P5102

Features

P5102 – FOR THS 700 AND OTHER FLOATING CHANNEL APPLICATIONS

- 100 MHz Bandwidth
- 10X Attenuation
- IEC1010 and UL 3111-1 Certified


New P5102

Isolated Channel Applications

In many applications, it is important to be able to isolate the measurement from earth ground and also to isolate the common voltage between channels. With the P5102 and the THS 700 Series handheld digital storage oscilloscope you have not only the isolation for the measurement from earth ground, but you also have full isolation between the two channels.

The P5102 was designed to give you this isolated channel performance for up to 1000 V AC RMS on the 100 MHz probe. A variety of screw-on accessories provides easy connection to the device under test.

Characteristics

Nominal Length – 2 m.
Attenuation – 10X.
Bandwidth – 100 MHz.
Rise Time – ≤3.5 ns.
Loading – 5 MΩ/11.2 pF.
Max Input V – 1000 V AC RMS.
Input C – 24 to 28 pF.

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P5102
10X, High Voltage Probe for THS 700 Series.

Includes: Large Retractable Hook Tip, Small Retractable Hook Tip, 6 in. Common Lead, 18 in. Common Lead, Large Crocodile Clip, Colored Cable Markers, Adjustment Tool, Instruction Manual (070-9294-01).

Passive Voltage Probes

New YT5100 • YT5060

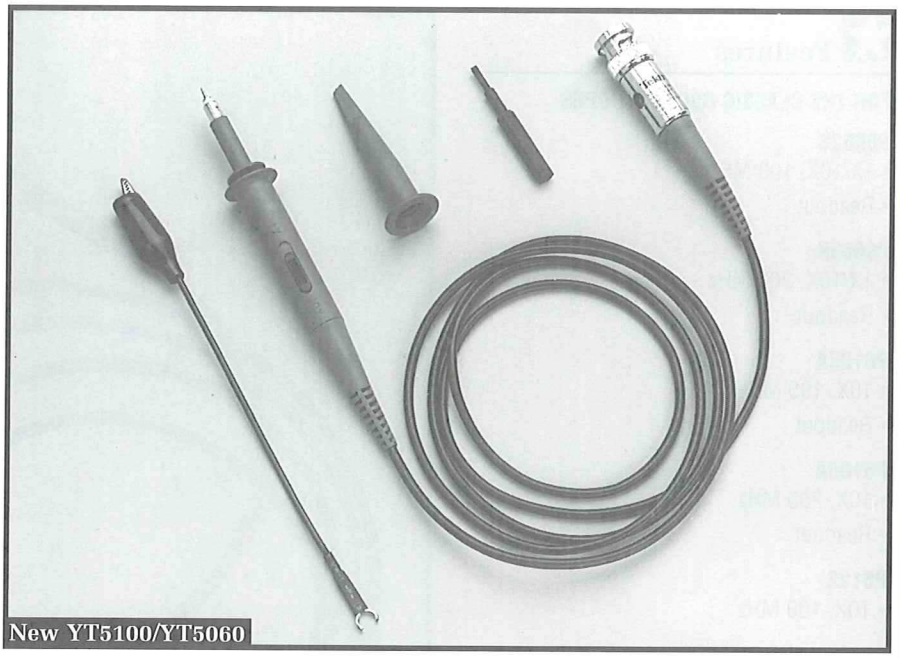
Features

YT5100

- 1X/10X Attenuation
- 100 MHz Bandwidth
- 1.5 Meter Length
- UL Certified

TY5060

- 1X/10X Attenuation
- 60 MHz Bandwidth
- 1.5 Meter Length
- UL Certified



New YT5100/YT5060

YT5100 and YT5060 Passive Voltage Probes

The YT5100 100 MHz and YT5060 60 MHz Passive Voltage Probes permit selection of 1X or 10X attenuation, using a switch located on the probe head.

Both probes are compatible with general purpose oscilloscopes having an input capacitance between 20 and 40 pF.

Characteristics

X10 POSITION

Bandwidth – DC: 100 MHz (YT5100), DC: 60 MHz (YT5060).

Probe Length – 1.5 m.

Attenuation Ratio – 10:1.

Compensation Range – 20 to 45 pF.

Input Capacitance – 16.6 pF.

Input Resistance – 10 MΩ.

Maximum Input Voltage – 500 V (DC + pk AC).

X1 POSITION

Bandwidth – DC: 5 MHz (YT5100), DC: 4 MHz (YT5060).

Probe Length – 1.5 m.

Attenuation Ratio – 1:1.

Compensation Range – All scopes with 1 MΩ input.

Input Capacitance – 110 pF.

Input Resistance – 1 MΩ.

Maximum Input Voltage – 250 V (DC + pk AC).

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ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

YT5060
1X/10X, 60 MHz Passive Voltage Probe.
Includes: Retractable Hook Tip (013-0107-07), 6 in Ground Lead (196-3120-00), Instruction Manual (070-9323-00).

YT5100
1X/10X, 100 MHz Passive Voltage Probe.
Includes: Retractable Hook Tip (013-0107-07), 6 in Ground Lead (196-3120-00), Instruction Manual (070-9323-00).

RECOMMENDED ACCESSORIES
See pages 482 to 483.

Passive Voltage Probes

P6062B • P6063B • P6105A • P6106A • P6122

Features

FOR THE CLASSIC OSCILLOSCOPES

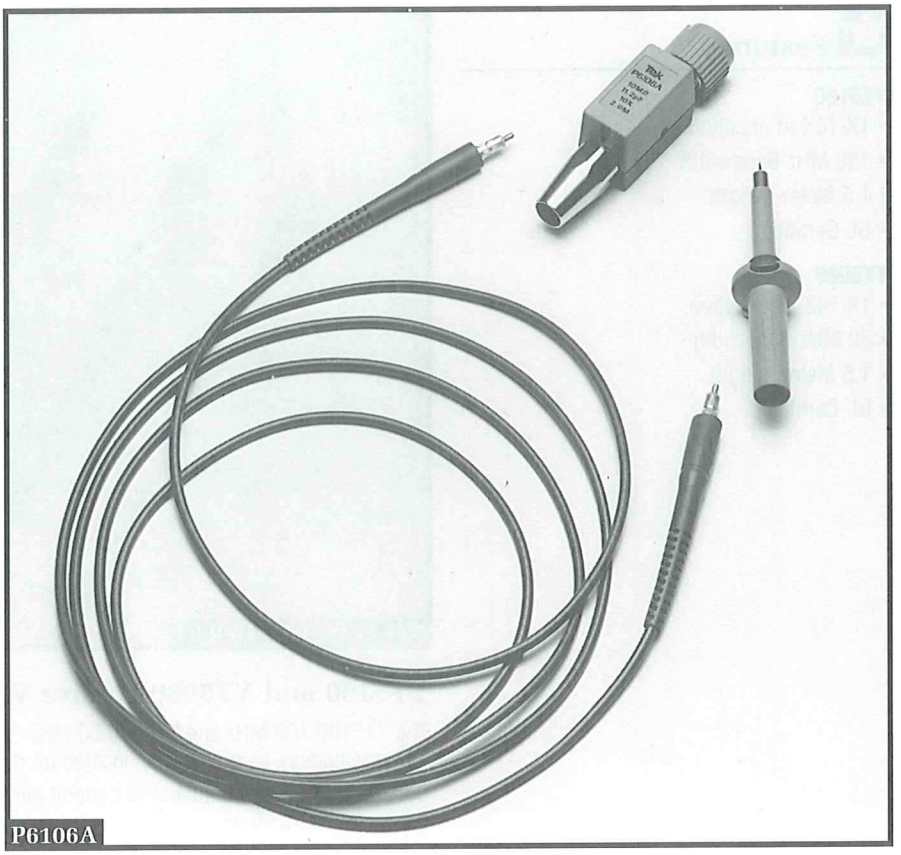
P6062B
- 1X/10X, 100 MHz
- Readout

P6063B
- 1X/10X, 200 MHz
- Readout

P6105A
- 10X, 100 MHz
- Readout

P6106A
- 10X, 250 MHz
- Readout

P6122
- 10X, 100 MHz


P6106A

Modular Probes

During our first 40 years, Tektronix introduced many innovative oscilloscopes which established the standards for form and function that are still followed today. Technological gains have allowed performance improvements over time, but the basic look and feel established by Tektronix remains. Because of this, Tektronix scopes ten and even 20 years old are still being used. We call these the Classics. Some of these older instruments have special probe requirements. The passive voltage probes found on these pages are for oscilloscopes introduced prior to 1986.

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 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. Modularity, rugged construction and highly reliable hybrid circuitry make these Tektronix probes a cost effective probing solution.

Tektronix modular passive probes are used to acquire high fidelity signals from low source impedance circuits. Each probe, except the P6122, will automatically scale the readings on oscilloscopes equipped with the readout feature. In addition, these same probes provide a ground reference button on the probe head for quick trace identification.

PROBE/SCOPE COMPATIBILITY

Probe	Scope/Product
P6062B	300 Series, 400 Series, 5000 Series, TM 500 Series, TM 5000 Series, 7D20
P6063B	400 Series, 7A13, 7A15A, 7A26
P6105A	434, 455, 464, 464M, 465, 466, 468, 475, 485, 7A16, SC504
P6106A	475, 485, DC 503A, DC 5009, DC 5010
P6122	2201, 2205, 2212, 2214, 2225

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

Passive Voltage Probes

P6062B • P6063B • P6105A • P6106A • P6122

PROBE SPECIFICATIONS CHART

Type	Cable Length meters (m)	Attenuation	Bandwidth Megahertz (MHz)	Comp. Range Picofarads (pF)	System Input Resistance Megaohms (MΩ)	Typical Input C Picofarads (pF)	Ground Reference	Readout
P6062B	2	1X/10X	6.5/100	15 to 47	1/10	14/105	√	√
Opt. 01	1.5		8/100			13/100		
Opt. 03	3		4.5/100			17/135		
P6063B	2	1X/10X	6/200	15 to 24	1/10	14/105	√	√
Opt. 01	1.5		12/200			11/80		
P6105A	2	10X	100	15 to 35	10	11	√	√
Opt. 01	1		100			9		
Opt. 03	3		90			13		
P6106A	2	10X	250	15 to 35	10	11	√	√
Opt. 01	1		250			9		
Opt. 03	3		150			13		
P6122	1.5	10X	100	15 to 35	10	11		

Note: Maximum voltage DC + peak AC ≤500.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P6062B
1X/10X, 100 MHz Switchable Probe with Ground Reference and Readout Functions.
Includes: Retractable Hook Tip; Probe Tip Ground Cover; 5 in. Ground Lead, 12 in. Ground Lead; Hook Tip; Two Replaceable Tips; Probe Holder; Alligator Clip; Instruction Sheet (062-2927-00).

P6063B
1X/10X, 200 MHz Switchable Probe with Ground Reference and Readout Functions.
Includes: Same as P6062B; Instruction Sheet (062-2928-01).

P6105A
1X, 100 MHz Modular Probe.
Includes: Retractable Hook Tip; Probe Tip Ground Cover; 5 in. Ground Lead, 12 in. Ground Lead; Alligator Clip; 4 Pairs of Colored Cable Markers; Adjustment Tool; Instruction Sheet (070-5516-01).

P6106A
10X, 250 MHz Modular Probe.
Includes: Same as P6105A except 3 in. Ground Lead instead of 12 in. Ground Lead; Instruction Sheet (070-5517-01).

P6122
10X, 100 MHz Modular Probe.
Includes: Same as P6105A; Instruction Sheet (070-5512-00).

OPTIONAL CABLE LENGTHS
(P6105A, P6106A)
Opt. 01 – 1 Meter Cable.
Opt. 03 – 3 Meter Cable.

RECOMMENDED ACCESSORIES
Also see pages 482 to 483.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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Passive Voltage Probes

P6131 • P6133 • P6134C • P6136 • P6137 • P6138 • P6139A

Features

TDS SERIES, 2400 SERIES AND 11000 SERIES OSCILLOSCOPES

P6131
- 10X, 300 MHz
- 2.5 mm Subminiature Probe Tip

P6133
- 10X, 150 MHz
- 2.5 mm Subminiature Probe Tip
- 3.5 mm Compact Probe Tip Optional

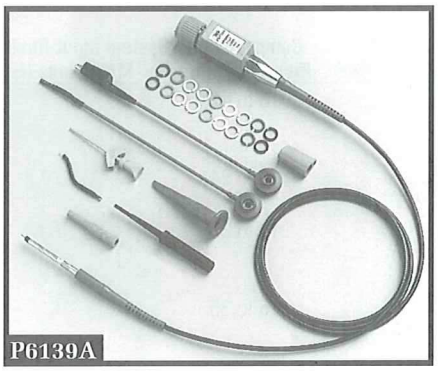
P6134C
- 10X, 400 MHz
- 3.5 mm Compact Probe Tip

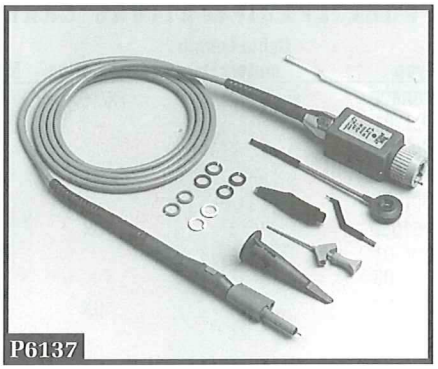
P6136
- 10X, 350 MHz
- 2.5 mm Subminiature Probe Tip
- 3.5 mm Compact Probe Tip Optional

P6137
- 10X, 400 MHz
- 3.5 mm Compact Probe Tip

P6138
- 10X, 350 MHz
- 3.5 mm Compact Probe Tip

P6139A
- 10X, 500 MHz
- 3.5 mm Compact Probe Tip


P6139A


P6137

Modular Subminiature Probes

- Small geometry tips – Easier circuit access
- Readout for 10X attenuation factor – Reduces confusion and errors in measurement readings
- Flexible lightweight cable – Easier to use and reduces mechanical stress to device under test
- HYBRID/SMT Circuitry – Provides improved performance and reliability
- Modularity – Provides lower cost of ownership
- Compact size accessories – Provides compatibility with existing adapters
- UL safety certification

The P613X family of oscilloscope probes sets the standard for high performance passive voltage probes. Continued growth of the family paces Tektronix' new series of high performance bench top oscilloscopes, the TDS 700A Series, and high performance portable oscilloscopes, and the TDS 400/A Series.

Both probes feature modular construction, HYBRID/SMT circuitry, a smaller probe head/cable assembly than traditional passive probes, 10X attenuation readout encoding, and a full complement of attachment accessories. Smaller probe tips and lightweight cable assemblies allow easy negotiation of dense circuitry or tight spaces.

The compact probe head/tip assembly is compatible with the full line of compact accessories. When the Subminiature/Compact-to-Miniature probe tip adapter (013-0202-02) is installed over the probe head/tip, the P6138 and P6139A probes are fully compatible with all miniature tip accessories.

The P6139A probe has been specifically designed for the TDS 500A/600(A/B)/700A Series of oscilloscopes to provide 500 MHz bandwidth at the probe tip, while presenting an 8 pF/10 MΩ input impedance to the circuit under test. Similarly, the P6138's design meets the TDS 400/A Series signal path requirements, helping to ensure the highest accuracy ever in a general purpose oscilloscope.

PROBE/SCOPE COMPATIBILITY

Probe	Scope/Product
P6131	2400 Series (2445, 2465)
P6133	2400 Series (2430/A/M, 2445A, 2445B)
P6134C	11000 Series (11A32, 11A34)
P6136	2400 Series (2431L, 2439, 2455 A/B, 2465A, 2467)
P6137	2400 Series (2432/A/M, 2440/M, 2445B, 2465B, 2467B/HD)
P6138	TDS 400/A Series
P6139A	TDS 500/A, 600/A/B, and 700A Series

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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Passive Voltage Probes

P6131 • P6133 • P6134C • P6136 • P6137 • P6138 • P6139A

CHARACTERISTICS

Type	Cable Length meters (m)	Bandwidth Megahertz (MHz)	Attenuation	Comp. Range Picofarads (pF)	Input C Picofarads (pF)	System Input Resistance Megaohms (MΩ)	Readout	ID/ Ground Ref.
P6131	1.3	300	10X	14 to 18	10.8	10	√	
Opt. 02	2	250			13.5			
Opt. 03	3	150			14.5			
P6133	2	150	10X	10 to 25	12.7	10	√	
Opt. 01	1.3	150			11.4			
Opt. 03	3	120			14.5			
Opt. 25	1.3	150			10.8			
P6134C	1.5	400	10X	12 to 18	11.3	10	√	√
P6136	1.3	350	10X	12 to 18	10.8	10		
Opt. 25	1.3	350			10.8			
P6137	1.5	400	10X	12 to 18	10.8	10	√	√
P6138	1.3	350	10X	12 to 18	10.0	10	√	√
P6139A	1.3	500	10X	8 to 12	8.0	10	√	√

Note: Maximum voltage DC + peak AC ≤ 500; Option 25 substitutes Compact for Subminiature tip.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P6131
10X, 300 MHz Modular Subminiature Probe.
Includes: Retractable Hook Tip; Adjustment Tool; 8 in. Alligator Ground Lead; 6 in. Microhook Ground Lead; 2 in. Ground Lead; Probe Holder; 4 Pairs of Colored Cable Markers.
Opt. 02 – 2 Meter Cable.
Opt. 03 – 3 Meter Cable.

P6133
10X, 150 MHz Modular Subminiature Probe.
Includes: Same as P6131 except Instruction Sheet (070-5795-01).
Opt. 01 – 1.3 Meter Cable.
Opt. 03 – 3 Meter Cable.
Opt. 25 – 1.3 Meter Cable and Compact Tip. Includes: Same as P6137 except Instruction Sheet (070-5795-01).

P6134C
10X, 400 MHz Modular Compact Probe.
Includes: Adjustment Tool; Retractable Hook Tip; 2 in. Ground Lead; 6 in. Ground Lead; Miniature Alligator Clip; SMT KlipChip™, 4 Pairs of Colored Cable Markers; Instruction Sheet (070-7676-00).

P6136
10X, 350 MHz Modular Subminiature Probe.
Includes: Same as P6131 except Instruction Sheet (070-6025-01).
Opt. 25 – 1.3 Meter Cable and Compact Tip.
Includes: Same as P6137 except Instruction Sheet (070-6025-01).

P6137
10X, 400 MHz Modular Compact Probe.
Includes: Adjustment Tool; Retractable Hook Tip; 2 in. Ground Lead; 6 in. Ground Lead with 0.025 in. Square-pin Receptacle; 6 in. Ground Lead with Alligator Clip; SMT KlipChip™, Low Inductance Lead Ground Collar; 4 Pairs of Colored Cable Markers; Instruction Sheet (070-6432-00).

P6138
10X, 350 MHz Modular Compact Probe.
Includes: Adjustment Tool; Retractable Hook Tip; 2 in. Ground Lead; 6 in. Ground Lead with 0.025 in. Square-pin Receptacle; 6 in. Ground Lead with Alligator Clip; SMT KlipChip™, Low Inductance Lead Ground Collar; 2 in. Low Inductance Ground Lead; 4 Pairs of Colored Cable Markers; Accessory Pouch; Instruction Sheet (063-0835-00).

P6139A
10X, 500 MHz Modular Compact Probe.
Includes: Same as P6138 except Instruction Sheet (063-0870-00).

OPTIONAL ACCESSORIES
Conversion Kit – Subminiature Tip to Compact Tip.
P6131. Order 040-1251-02.
P6133. Opt. 01. Order 040-1250-02.
P6136. Order 040-1253-02.

RECOMMENDED ACCESSORIES
See pages 478 to 483.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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Small Geometry Probes

P6561AS • P6562AS • P6563AS • P6243 • P6245

Features

FOR SURFACE MOUNT DEVICES

SMD PACKAGE SUPPORT
- 50 mil SO/SOIC
- 50 mil QUAD
- 25 mil JEDEC
- 0.5 mm EIAJ
- 0.65 mm EIAJ

CIRCUIT COMPATIBILITY
- CMOS
- BiCMOS
- FastCMOS
- TTL
- ECL

SCOPE COMPATIBILITY
- TDS Series
- TAS Series
- 2400 Series
- 11000 Series

P6561AS
- 10X – 200 MHz
- <11 pF Loading
- Readout

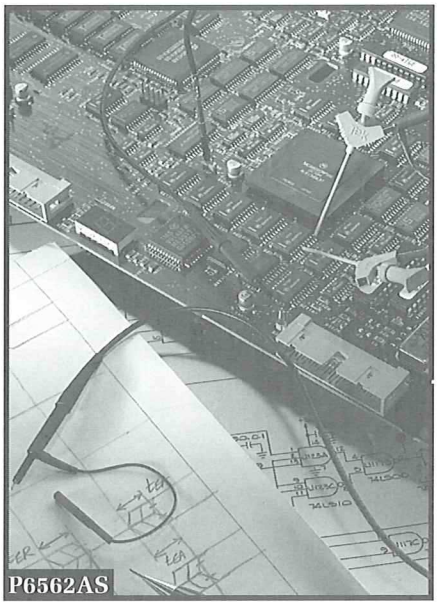
P6562AS
- 10X – 350 MHz
- <11 pF Loading
- Readout

P6563AS
- 20X – 500 MHz
- <5 pF Loading
- Readout

P6243/P6245
- 10X – 1 GHz (P6243 only)
- 10X – 1.5 GHz (P6245 Only)
- ≤1 pF Loading
- DC Offset (P6245 Only)
- For 11000 and TDS Series
- See page 448 for complete information

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com


P6562AS


SMD Standard Accessories

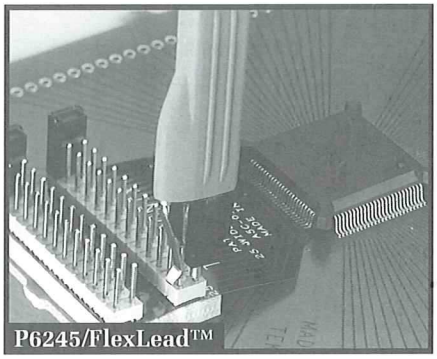
The P6561AS, P6562AS, and P6563AS are scaled for surface mounted IC packages.

Their low-mass probe body is only 1.5 inches long and 100 mils wide.

Bundled in sets to match the oscilloscope's performance and channel count, these probes provide solutions for the most popular EIAJ and JEDEC surface mount packages.

SURFACE MOUNT DEVICE PROBING

While instrumentation improvements have provided a steady stream of digital troubleshooting tools, the physical challenges associated with probing small geometry ICs have gone unaddressed until now. SMD probes from Tektronix provide circuit designers the first complete, off-the-shelf solution for probing small geometry IC packages.


P6245/FlexLead™

UNIQUE UTILITY

The basic contact of the SMD probe family is a 25 mil socket that accepts square or round pins. A variety of tip adapters permits convenient, non-destructive, temporary connection to the most popular EIAJ and JEDEC surface mount packages.

EXCEPTIONAL PERFORMANCE

Each SMD probe is designed to minimize capacitive loading on TTL, ECL, CMOS, FastCMOS, and BiCMOS circuits. The probe and oscilloscope form a measurement system optimized for circuit designers by providing fast transient response, high system bandwidth, and low capacitive circuit loading.

Figure 1 presents a sample conversion of the SMD probe family's capacitive circuit loading to an equivalent number of typical CMOS gates. Being aware of the potential effects of probe loading on the circuit under test can eliminate chasing false indicators, reduce test times, and lead to more accurate and repeatable measurements.

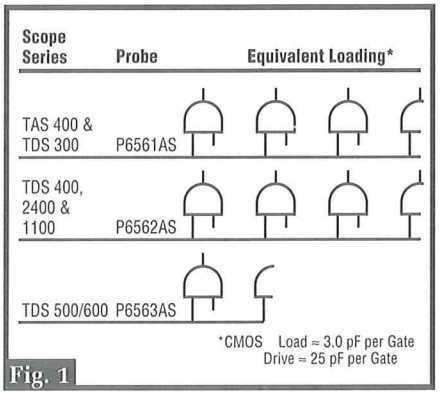
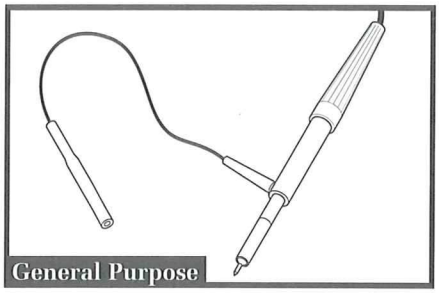


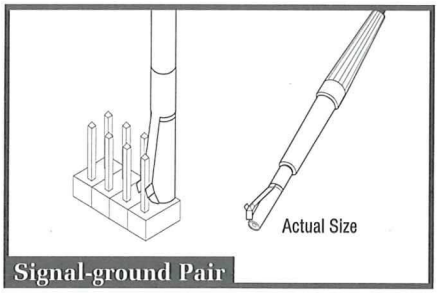
Fig. 1

Small Geometry Probes

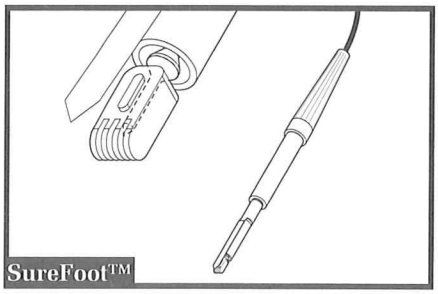
P6561AS • P6562AS • P6563AS • P6243 • P6245



General purpose handheld probing.



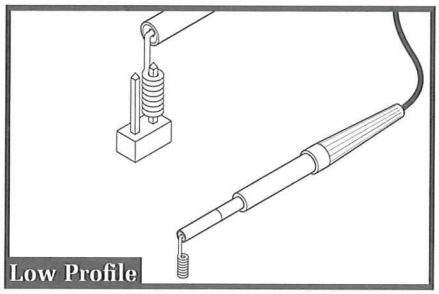
Signal-ground Pair – 25 mil Square-pin headers on 100 mil centers.



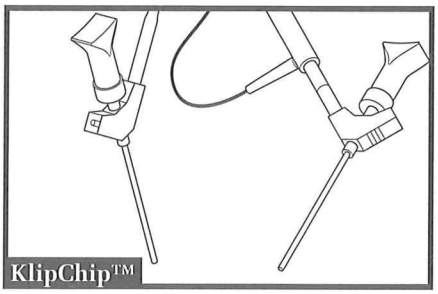
PQFP and Quad Packages – JEDEC 25 mil center lead spacing. EIAJ 0.5 and 0.65 mm center lead spacing.

SMD PROBE CHARACTERISTICS

Probe Set (Replacement Probe)	P6561AS (P6561A)	P6562AS (P6562A)	P6563AS (P6563A)
Digitizing Oscilloscopes	TDS 300	TDS 400A, 2400, 11000	TDS 500/600/700 Series
Analog Oscilloscopes	TAS 400	2400	
Scope Plug-ins		11A32, 11A34/V	
Probes per Set	2	4	4
Bandwidth (–3 dB)	200 MHz	350 MHz	500 MHz
Rise Time (typical)	<1.85 ns	<1.1 ns	<800 ps
Uniform Signal Delay	±150 ps	±125 ps	±100 ps
Attenuation	10X	10X	20X
Device Loading Capacitance (typical)	<11 pF	<11 pF	<5 pF
Device Loading Resistance	10 MΩ	10 MΩ	9.5 MΩ
Maximum Non-destructive Input Voltage	42 V (DC + peak AC)	42 V (DC + peak AC)	42 V (DC + peak AC)
Compensation Range	15 pF – 35 pF	12 pF – 35 pF	7 pF – 30 pF
Length	1.3 m	1.3 m	1.3 m



Circuit Boards in System Enclosures – 25 mil Square-pin headers on 100 mil centers.



SOIC/SOP Small Outline Packages – 50 mil center lead spacing.

PROBING TIP

For improved signal fidelity and probing convenience, a short ground blade is included. To use it, form a ground plane of copper clad on top of the IC to be probed. Attach short jumper wires from the device ground to the copper clad. Then, with the SureFoot™ probe tip installed, probe the device and display a cleaner signal on the scope.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P6561AS
200 MHz, 10X, SMD Probe.
Includes: 2 ea. P6561A Probe, Probe Tips, 2 ea. of 3 Pitches SureFoot™ Tip Guides, 4 in. Ground Leads, Signal-ground Adapters, Blade-ground Adapters, and 1 ea. Adjustment Tool and Instruction Sheet.

P6562AS
350 MHz, 10X, SMD Probe.
Includes: 4 ea. P6562A Probe, Probe Tips, 2 ea. of 3 Pitches SureFoot™ Tip Guides, and 1 ea. 4 in. Ground Lead, Signal-ground Adapter, Blade-ground Adapter, Adjustment Tool and Instruction Sheet.

P6563AS
500 MHz, 20X, SMD Probe.
Includes: 4 ea. P6563A Probes, Probe Tips, 2 ea. of 3 Pitches SureFoot™ Tip Guides, 4 in. Ground Leads, Signal-ground Adapters, Blade-ground Adapters, and 1 ea. Adjustment Tool and Instruction Sheet.

P6243
Active FET Probe (See page 448).

P6245
Active FET Probe (See page 448).

RECOMMENDED ACCESSORIES
See page 476.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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FlexLead™ Adapters

FlexLead™ Series • PJ (JEDEC) • PE (EIAJ)

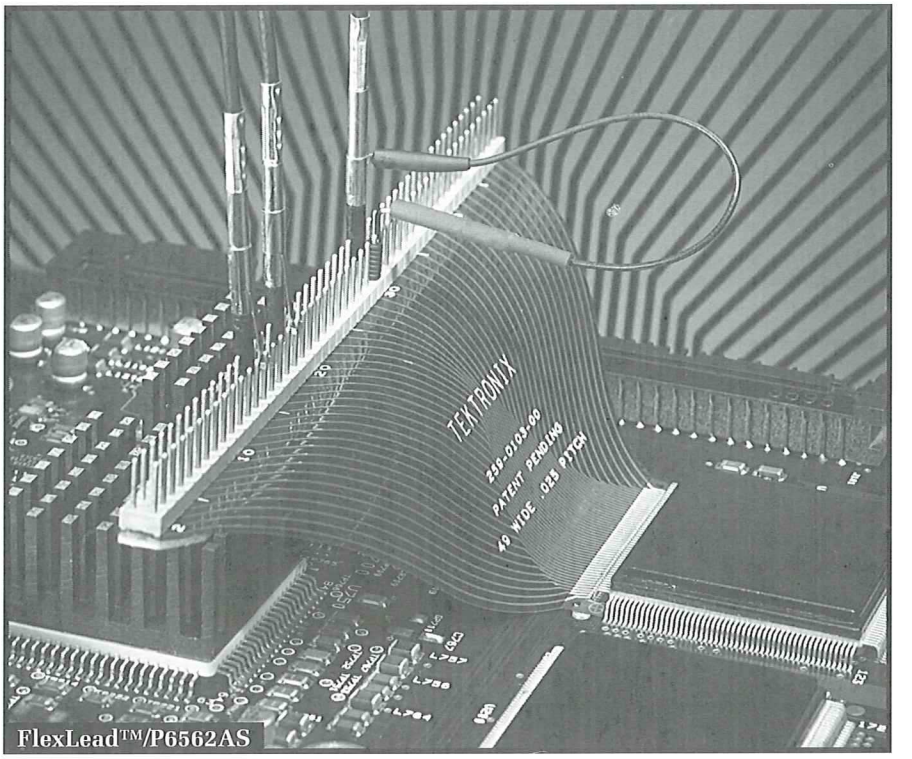
Features

FINE PITCH SURFACE MOUNTED DEVICES

FLEXLEAD™ FAMILY

25 MIL JEDEC, 0.65 MM EIAJ, 0.5 MM EIAJ

- Convenient Probing of 25 mil Pitch and Smaller Packages
- Minimum Circuit Loading
- Adapts to Many of the Most Common JEDEC and EIAJ Packages
- Compatible with Any Oscilloscope or Logic Analyzer Probe or Podlet
- 100 mil Interface for Easy Probe Connection



Surface and Device Probing

As the pitch and lead spacing on surface mount packages gets smaller, connecting a probe to these packages becomes increasingly difficult. At a pitch of 25 mils or smaller, the leads will no longer mechanically support a probe without potentially damaging the package. At this fine pitch, it also becomes difficult to hand hold a probe without shorting to adjacent leads or causing mechanical damage to the package. The Tektronix FlexLead™ Adapters make it possible to conveniently connect to fine pitch Gull-wing Leaded QFP (Quad Flat Pack) packages while reducing the risk of both mechanical and electrical damage to the part.

FlexLead™ ADAPTERS

The FlexLead™ Adapters have a standard 100 mil interface on one end to which any oscilloscope probe or logic analyzer podlet will directly connect, both signal and ground leads. The opposite end of the adapter has a row of solder pads, matching the leads of the package that are soldered to the package leads. After the necessary probing is complete, the adapters are intended to be unsoldered and discarded. The are intended to be used only once and are low-priced enough to make this practical.

AVAILABLE FlexLead™ ADAPTERS

There are twenty-five FlexLead™ Adapters available to adapt to the larger volume Gull-wing surface mount packages, both JEDEC and EIAJ standards. Additional FlexLead™ Adapters will be offered as demand dictates.

Characteristics

Series Resistance – Less than 100 milli Ω (typical).

Inductance – Less than 100 nH (typical).

Capacitance – Less than 2 pF (typical).

Maximum Voltage – 42 V.

Maximum Current – 750 mA.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

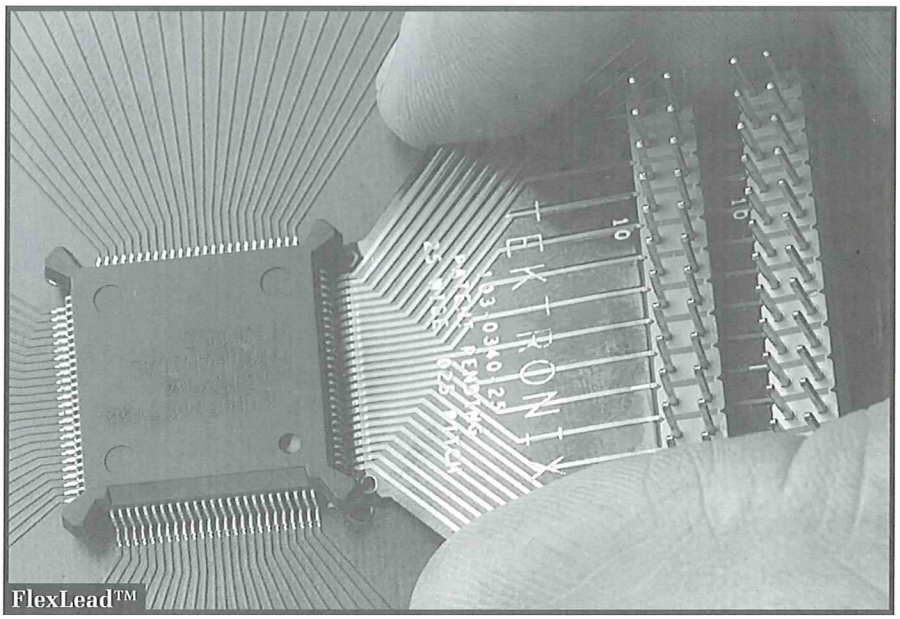
See Tektronix on the World Wide Web: http://www.tek.com

FlexLead™ Adapters

FlexLead™ Series • PJ (JEDEC) • PE (EIAJ)

Videotape and Flux Applicator

We have done two things to help in overcoming customers' concerns about soldering the FlexLead™ Adapters to fine pitch packages. First, the customers can order a free videotape of soldering instructions. Second, we are adding easy-to-use flux applicators to each package of FlexLead™ Adapters. The part numbers for the videotapes are: NTSC 068-0320-04, PAL 068-0320-06, SECAM 068-0320-07.



FlexLead™

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

Package Type	Includes	Ordering Number
JEDEC, 25 mil, 68 leads (17X17)	Eight 17 lead adapters	PJ25X17
JEDEC, 25 mil, 80 leads (20X20)	Eight 20 lead adapters	PJ25X20
JEDEC, 25 mil, 84 leads (21X21)	Eight 21 lead adapters	PJ25X21
JEDEC, 25 mil, 100 leads (25X25)	Eight 25 lead adapters	PJ25X25
JEDEC, 25 mil, 120 leads (30X30)	Eight 30 lead adapters	PJ25X30
JEDEC, 25 mil, 100 leads (20X30)	Four 20 lead and four 30 lead adapters	PJ22030
JEDEC, 25 mil, 132 leads (33X33)	Eight 33 lead adapters	PJ25X33
JEDEC, 25 mil, 164 leads (41X41)	Eight 41 lead adapters	PJ25X41
JEDEC, 25 mil, 196 leads (49X49)	Eight 49 lead adapters	PJ25X49
JEDEC, 25 mil, 208 leads (52X52)	Eight 52 lead adapters	PJ25X52
JEDEC, 25 mil, 240 leads (60X60)	Eight 60 lead adapters	PJ25X60
EIAJ, 0.5 mm, 80 leads (20X20)	Eight 20 lead adapters	PE50X20
EIAJ, 0.5 mm, 100 leads (25X25)	Eight 25 lead adapters	PE50X25
EIAJ, 0.5 mm, 104 leads (26X26)	Eight 26 lead adapters	PE50X26
EIAJ, 0.5 mm, 144 leads (36X36)	Eight 36 lead adapters	PE50X36
EIAJ, 0.5 mm, 152 leads (38X38)	Eight 38 lead adapters	PE50X38
EIAJ, 0.5 mm, 160 leads (40X40)	Eight 40 lead adapters	PE50X40
EIAJ, 0.5 mm, 208 leads (52X52)	Eight 52 lead adapters	PE50X52
EIAJ, 0.5 mm, 240 leads (60X60)	Eight 60 lead adapters	PE50X60
EIAJ, 0.5 mm, 304 leads (76X76)	Eight 76 lead adapters	PE50X76
EIAJ, 0.65 mm, 80 leads (20X20)	Eight 20 lead adapters	PE65X20
EIAJ, 0.65 mm, 112 leads (28X28)	Eight 28 lead adapters	PE65X28
EIAJ, 0.65 mm, 144 leads (36X36)	Eight 36 lead adapters	PE65X36
EIAJ, 0.65 mm, 160 leads (40X40)	Eight 40 lead adapters	PE65X40
EIAJ, 0.65 mm, 184 leads (46X46)	Eight 46 lead adapters	PE65X46

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

Surface Mount Device Interconnects

SMG50 • SMCK1 • SMQK1 • SureFoot™

Features

SureFoot™

- Hand Probe Fine Pitch SMD Packages
  - 25 mil JEDEC
  - 0.65 mm EIAJ
  - 0.5 mm EIAJ
- SF50X for P656XAS, P6245 and P6243 (3.5 mm)
- New SF20X for P613X Family 3.5 mm (P6133 Opt. 25, P6134C, P6136 Opt. 25, P6137, P6135A, P6138, P6139A)

SMG50/SMT KlipChip™

- Access to 0.050 in. Centers PLCC, SOIC, and Other Packages

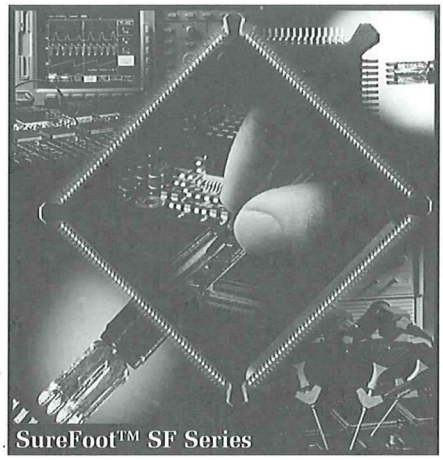
SMCK1/SMQK1 SOIC/PLCC ADAPTER KITS

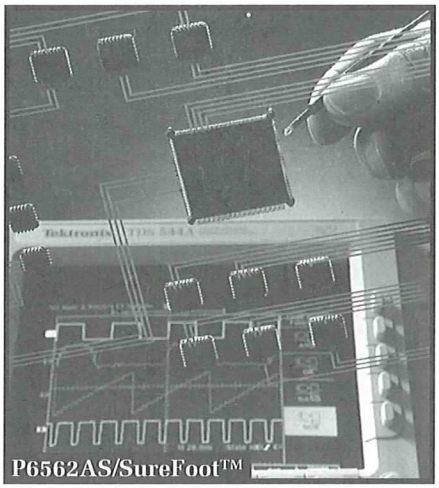
- Assortment of SOIC or PLCC Clips
- Leads and SMT KlipChip™ Included
- Signal Insertion and Temporary Lead Jumpers Without Soldering

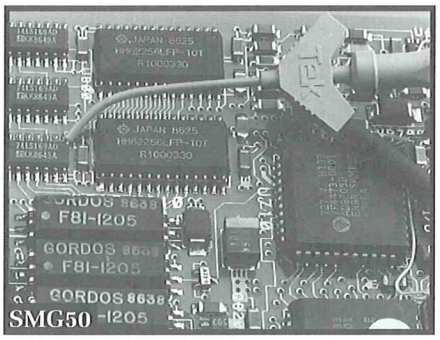
Applications

- Research and Design
- Manufacturing Test of SMD Circuitry
- Servicing of SMD Circuitry
- Prototype Debug and Design

Note: For Complete line of SMD Products, see pages 466-473.


SureFoot™ SF Series


P6562AS/SureFoot™



SMT KlipChip™ used on SOIC package.

Surface Mount Device Probing and Interconnects

The increasing use of surface mount technology (SMT) brings many benefits to electronic circuit board (ECB) design and manufacture. Among these are increased circuit density, increased product reliability, and lower assembly costs.

Troubleshooting and device interconnection, however, have become more difficult due to decreased device size, tighter lead spacing and increased ECB densities. Tektronix' offering of the following SMT probing and inter-connect devices meets these demanding requirements.

SureFoot™

PROBING 25 Mil JEDEC, 0.65 AND 0.5 mm EIAJ PACKAGES

SureFoot™ (patent pending) is an integral probe tip and miniature guide that enables fault-free "hands-on" probing of fine-pitch SMD packages. Guided by the IC's leads, SureFoot's miniature plastic tines align the probe before electrical contact is made. The tines also form a shield between IC leads, preventing the probe tip from shortening adjacent pins.

SureFoot™ conforms to EIAJ (Electronic Industry Association of Japan) or JEDEC (Joint Electron Device Engineering Council) packaging standards, assuring quick and reliable probe contact with fine-pitch IC leads.

Several color coded versions of SureFoot™ are available, addressing the most common SMD packages with leads spaced on 0.65 mm (EIAJ) and 25 mil (JEDEC) centers. A crystal orange version fits the tighter 0.5 mm lead spacing of several EIAJ packages.

SMT KlipChip™

The SMT KlipChip™ is an interface device for attachment of logic and analog probes to today's SMDs, DIPs, and discrete components. The SMT KlipChip™ is capable of attaching to components with maximum lead diameters of 0.095 inches and stackable on lead centers of 0.050 inches. Dual sided 0.025 inch lead contacts allow this grabber to be used in multiple signal insertion/acquisition.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

Surface Mount Device Interconnects

SMG50 • SMCK1 • SMQK1 • SureFoot™

PLCC Quad Clips

For easy connection to Plastic Leaded Chip Carriers (PLCC) with "J" leads on 0.050 inch centers. Gold-plated contacts maintain low contact resistance. 0.025 inch square pins provide contact for probes, flying leads, etc.

SOIC Clips

Simplify connection to Small Outline Integrated Circuits (SOIC). The spring design provides a strong and accurate fit. Compatible with gull-wing or "J" leads on 0.050 inch centers. Gold-plated contacts for low contact resistances; 0.025 inch upper square pins provide access for probe or flying lead connection.


SMQK1/PLCC Kit


SMCK1/SOIC Kit

SureFoot™ SELECTION GUIDE

Package Lead Spacing	Package Standard	Color Code	SureFoot™ Compatibility P613X (3.5mm)	Active SMD Probes P6243/P6245	SMD Probes P6561AS/2AS/3AS
50 mil	JEDEC	Yellow	SF201	SF501	SF501
25 mil	JEDEC	Blue	SF202	SF502	SF502
0.65 mm	EIAJ	Blue	SF202	SF502	SF502
0.5 mm	EIAJ	Red	SF203	SF503	SF503

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

SMG50
SMT KlipChip™.
Includes: 20 SMT KlipChip™.

SMCK1
SOIC Engineering Kit.
Includes: 1 each of 8, 14, 16, 20, 24-Pin SOIC Clips plus 4 SMT KlipChip™ Adapter; 8 Electrical Leads with (0.025 in.) Square-pin Connectors.

SMQK1
PLCC Engineering Kit.
Includes: 1 each of 20, 28, 44, 52, 68, 84-Pin PLCC Clips plus 4 SMT KlipChip™ Adapter; 8 Electrical Leads with (0.025 in.) Square-pin Connectors.

SF201 (50 mil pitch)
SureFoot™ for P613X (3.5 mm) Passive Probes.
Includes: 12 Yellow 50 mil/0.65 mm SureFoot™ Tip Guides.

SF202 (25 mil pitch/0.65 mm pitch)
SureFoot™ for P613X (3.5 mm) Passive Probes.
Includes: 12 Blue 25 mil/0.65 mm SureFoot™ Tip Guides.

SF203 (0.5 mm pitch)
SureFoot™ for P613X (3.5 mm) Passive Probes.
Includes: 12 Red 0.5 mm SureFoot™ Tip Guides.

SF501 (50 mil)
SureFoot™ for P6561AS, P6562AS, P6563AS, P6245 SMD Probes.
Includes: 12 Yellow 50 mil (25 mil-pin) SureFoot™ Tip Guides.

SF502 (25 mil/0.65 mm Pitch)
SureFoot™ for P6561AS, P6562AS, P6563AS, P6245 SMD Probes.
Includes: 12 Blue 25 mil/0.65 mm (25 mil-pin) SureFoot™ Tip Guides.

SF503 (0.5 mm Pitch)
SureFoot™ for P6561AS, P6562AS, P6563AS, P6245 SMD Probes.
Includes: 12 Red 0.5 mm (25 mil-pin) SureFoot™ Tip Guides.

Electrical Leads – for SMQK1 and SMCK1 Package of 10 each with 0.025 in. Square-pin Receptacles.
4 in. length. Order 198-5817-00.
6 in. length. Order 198-5818.00.
8 in. length. Order 198-5819-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

Probing Stations and Articulated Arms

PPMS100 • PPMS200 • PPM203B • PPM203C

Features

MECHANICALLY ASSISTED PROBING

PPMS100
- High-resolution Probing Station

PPMS200
- Fine-pitch Probing System

PPM203B
- 3 Axis Articulated Arm with Hi-mass Base

PPM203C
- 3 Axis Articulated Arm with Chassis Clamp

119-4839-00
- Microscope Assembly

NEW 119-4841-00
- Ground/Lead Positioner

NEW 119-4842-00
- Ground/Lead Positioner

Applications

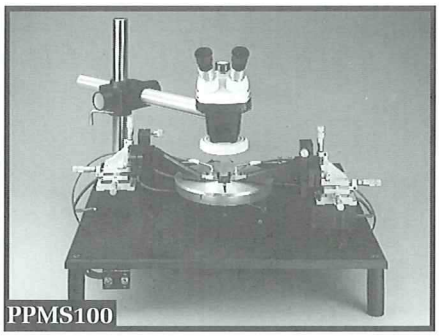
- Research and Design
- Prototype Design

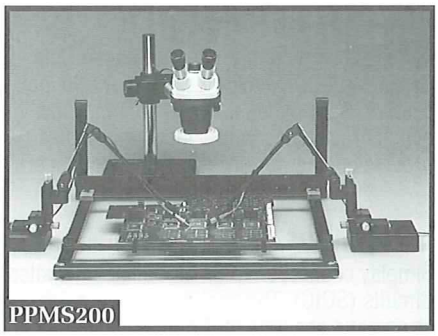
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See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.


PPMS100


PPMS200

Probing Fine Pitch Devices

Probing today's designs with their delicate fine pitch devices is safer and more convenient with the new Tektronix PPMS Series of probing stations and articulating arms. The PPMS Series allows designers to guide microwave and standard handheld probes onto the small geometries of fine-pitch interconnects, SMD packages, MCMs (multi-chip-modules), hybrids, and ICs.

The PPMS probing stations and articulating arms provide high accuracy and resolution mechanically assisted probe positioning, helping designers meet the physical demands of probing the constantly shrinking geometry of devices.

PPMS100
The PPMS100 is a complete probing station intended for those applications requiring high resolution: positioning microwave probes as an optional accessory to the Tektronix IPA 310 Interconnect Parameter Analyzer. The IPA 310 is a TDR (Time Domain Reflectometry) oscilloscope designed to characterize and extract modeling parameters from packages, interconnects, MCMs and ICs.

THE PPMS200
The PPMS200 is a more general purpose probing system designed to position conventional oscilloscope probes. It is an accessory to the TDS Series of oscilloscopes and other models of oscilloscopes. It is designed to be used for probing PC Boards, Hybrids and MCMs that employ fine pitch devices and interconnects.

PPM203B AND PPM203C
The PPM203B and PPM203C have a three axis arm system. They are general purpose benchtop probing aids designed to be used when probing PC Boards, Hybrids, and MCMs that employ fine pitch devices and interconnects.

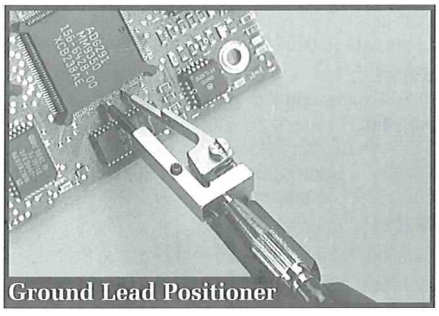
The PPM203B incorporates a weighted base that makes it well suited to probing fine pitches in benchtop applications. The PPM203C has a clamp that permits the probing of fine-pitched devices while the arm is clamped to a variety of different chassis types.

119-4839-00 MICROSCOPE ASSEMBLY
The 119-4839-00 binocular microscope is intended as a companion to the PPM203B and PPM203C when assistance to vision is required. It incorporates a weighted base and convenient boom mount for ease of benchtop use.

GROUND LEAD POSITIONERS
Ground Lead Positioners allow independent positioning of signal and ground leads using only one articulating arm. The positioners maintain a short ground for enhanced performance, and their spring loaded ground tips make it easier to maintain contact with the probed device.

Ground Load Positioners mount on the end of any of Tektronix' articulating arms and accept most Tektronix probes.

The 119-4841-00 accepts the Tektronix SMD (P656X) Series probes. The 119-4842-00 may be used with Tektronix 2.5 mm subminiature, 3.5 mm compact, and 4mm active probes.


Ground Lead Positioner

Probing Stations and Articulated Arms

PPMS100 • PPMS200 • PPM203B • PPM203C


PPM203B/P6245

Characteristics

PPMS100

Platform – Dimensions: 23.5 in. by 23.5 in. Material: Aluminum. Surface: Black matte. BNC Connectors: 5 female-to-female connections. Vacuum Distribution: 1 switched vacuum connection, 5 manifold connections. Microscope Mounting: 3 E-arm mounting positions.

Substrate Holder – Holder Diameter: 8 in. (20 cm). Holder Surface Flatness: ±0.0005 in. maximum (±0.013 mm). Holder Material: Stainless steel. Holder Theta Adjust: 360°. Hold Down Method: Vacuum.

Manipulator – X,Y and Z axis travel (min.): 0.5 in. (1.27 cm). Theta Adjust (min.): 4°. Planarity Adjust (min.): 4°. Axis Control: Micrometer adjust at 40 threads per inch. Probe Mount: Accepts standard Tektronix TMP or other microwave probes with two hole configuration. Attachment Method: Vacuum hold down with manual release button.

Microscope – Type: Binocular. Magnification range: 0.8X to 4X. Eyepieces: 10X. Objective: 1/3X. Illuminator: 120 V AC fluorescent ring. UL/CSA certified.

Vacuum Pump – Power Requirement: 120 V AC, 50-60 Hz.

PPMS200

Articulated Arm and Manipulator – Number of Manipulator Axes: 3 (X,Y and Z). Manipulator Travel: 1 in. min. in all axes. Manipulator Lead Screw Pitch: 10 threads per inch. Probe Mounting: Accepts most Tektronix probes including SMD, 2.5 mm, 3.5 mm, 4 mm, 5 mm and P6245 probe styles. Attachment Method: Manually positioned with weighted base. Articulated Arm Reach: X,Y: 14 in., Theta: 180°.

Circuit Board Holder – Circuit Board Size, Max.: 12 by 18 inches. Circuit Board Thickness: 0.085 Max.

Microscope – Type: Binocular. Magnification Range: 0.8X to 4X. Eyepieces: 10X. Objective: 1/3X. Illuminator: 120 V AC fluorescent ring. UL/CSA certified.

PPM203B/C

Number of Manipulator Axes – PPM203B/C, 3 Axis (X,Y and Z)

Manipulator Travel – PPMS203B/C, 1 in. min.

Manipulator Lead Screw Pitch – PPM203B/C, 10 threads per inch.

Probe Mounting – Accepts most Tektronix probes including SMD, 2.5 mm, 3.5 mm, 4 mm, 5 mm and P6245 probe styles.

Attachment Method to Work Surface – PPM203B, manually positioned with weighted base. PPM203C, manually positioned with chassis clamp.

Articulated Arm Reach – X,Y: 14 in., Theta: 180°.

119-4839-00 MICROSCOPE ASSEMBLY:

Type – Binocular.

Magnification range – 0.8X to 4X.

Eyepieces – 10X.

Objective – 1/3X.

Illuminator – 120 V AC fluorescent ring. UL/CSA certified.

Ground Lead Positioners – For Tektronix SMD probes and Tektronix 2.5 mm subminiature, 3.5 mm compact, and 4mm active probes. Reach: (signal lead to ground lead) 40°, >1 inch. Travel: (spring loaded ground pin) >0.1 inch.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

PPMS100
Probing Station, High Resolution.
Includes: Platform, Substrate Holder, 1 each Right Hand Precision Manipulators, 1 each Left Hand Precision Manipulator, Vacuum Chuck, Microscope and Vacuum Pump.

A set of six probe adapters, one each for each of the families of Tektronix probes, is supplied with each of the Articulated Arms.

PPMS200
Probing System, Fine Pitch.
Includes: Microscope; 2 each Articulated Arms, Circuit Board Holder; set of five probe adapters for each arm to attach various probe styles.

PPM203B
Articulated Arm, 3 Axis with Hi-mass Base.
Includes: Articulated Arm; Hi-mass Base; 6 probe adapters to attach various probe styles.

PPM203C
Articulated Arm, 3 Axis with Chassis Clamp.
Includes: Articulated Arm; Hi-mass Base; 6 probe adapters to attach various probe styles.

Ground Lead Positioners – Includes one year warranty.
For Tektronix SMD Probes. Order 119-4841-00.
For 2.5 mm Subminiature Active Probe. Order 119-4842-00.
For 3.5 mm Compact Active Probe. Order 119-4842-00.
For 4 mm Active Probe. Order 119-4842-00.

Microscope Assembly – Stereo zoom microscope and swivel boom stand. Order 119-4839-00.

Precision Manipulators – Additional Precision Manipulators for the PPMS100 can be ordered by the following part numbers. One each left and one each right come with the PPMS100 standard.

Precision Manipulator – Left. Order 119-4831-00.

Precision Manipulator – Right. Order 119-4832-00.

Probe Adapters – Additional probe adapters can be ordered by the following part numbers:
SMD Probes. Order 407-4365-00.
P6245. Order 407-4368-00.
4 mm, Active Probes. Order 407-4370-00.
2.5 mm, Subminiature Probes. Order 407-4366-00.
3.5 mm, Compact Probes. Order 407-4367-00.
5 mm, Miniature Probes. Order 407-4369-00.

CIRCUIT BOARD HOLDER
Bench Top 12 in. X 18 in. Order 119-4845-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

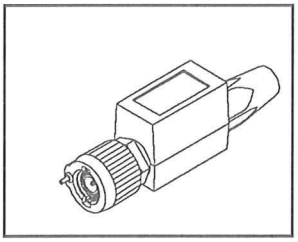
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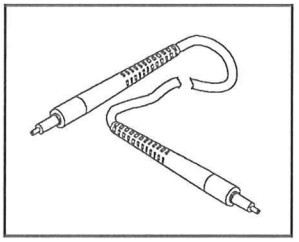
ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

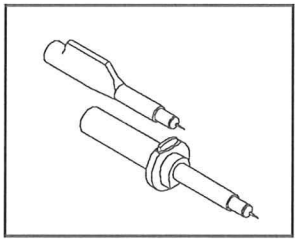
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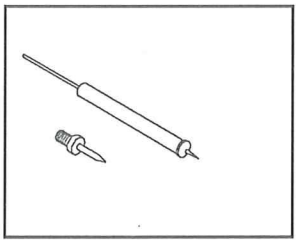
Replacement Parts

PASSIVE AND ACTIVE PROBE GENERAL REPLACEMENT PARTS









Probe	Length (m)	Connector/ Comp. Box	Probe Cable	Probe Head	Probe Tip/ Hybrid Tip
P6101B	2	N/A	N/A	N/A	131-4997-01*2
P6102A	2	206-0352-00	174-0976-00	206-0302-00	206-0338-01*2
P6103B	2	N/A	N/A	N/A	131-4997-01*2
P6105A	1	206-0331-00	174-0975-00	206-0328-00	206-0336-01*2
	2	206-0334-00	174-0976-00	206-0301-00	206-0337-01*2
	3	206-0320-02	174-0977-00	206-0302-00	206-0338-01*2
P6106A	1	206-0313-01	174-0975-00	206-0328-00	206-0336-01*2
	2	206-0319-01	174-0976-00	206-0301-00	206-0337-01*2
	3	206-0320-01	174-0977-00	206-0302-00	206-0338-01*2
P6107A	2	206-0247-02	174-0976-00	206-0217-02	206-0339-03*2
P6108A	1	206-0332-01	174-0975-00	206-0303-00	206-0336-01*2
	2	206-0318-02	174-0976-00	206-0304-00	206-0337-01*2
	3	206-0333-00	174-0977-00	206-0305-00	206-0338-01*2
P6109B	2	N/A	N/A	N/A	131-4997-01*2
P6111B	2	N/A	N/A	N/A	131-4997-01*2
P6113B	2	N/A	N/A	N/A	131-4997-01*2
P6119B	2	N/A	N/A	N/A	131-4997-01*2
P6121	1.5	206-0311-00	174-0967-00	206-0323-00	206-0341-01*2
P6122	1.5	206-0312-00	174-0967-00	206-0324-00	206-0342-01*2
	2	206-0318-00	174-0968-00	206-0325-00	206-0343-01*2
	3	206-0318-01	174-0969-00	206-0326-00	206-0344-01*2
P6129B	2	N/A	N/A	N/A	131-4997-01*2
P6148A	2	206-0255-02	174-0976-00	206-0217-02	206-0339-03*2
P6149A	2	206-0255-02	174-0976-00	206-0217-02	206-0339-03*2
P6201	1.8	N/A	N/A	N/A	206-0200-00*3
P6202A	2	N/A	N/A	N/A	206-0230-03*1
P6203*4	1.5	N/A	N/A	206-0391-00	131-4280-00*3
P6204*4	1.5	N/A	N/A	206-0390-00	131-4280-00*3
P6205*4	1.5	N/A	N/A	N/A	131-4280-00*3
P6206*4	1.7	N/A	N/A	N/A	131-4280-00*3
P6243*4	1.3	N/A	N/A	N/A	131-5638-10*1
P6245*4	1.3	N/A	N/A	N/A	131-5638-10*1
P6420	1	N/A	174-0975-00	206-0236-01	206-0230-03*1
	2	N/A	174-0976-00	206-0236-01	206-0230-03*1
	3	N/A	174-0977-00	206-0236-01	206-0230-03*1
P6561A	1.3	N/A	206-0417-10	206-0417-10	131-5638-10*1
P6562A	1.3	N/A	206-0417-10	206-0417-10	131-5638-10*1
P6563A	1.3	N/A	206-0459-00	206-0459-00	131-5638-10*1
P400		N/A	N/A	206-0426-00	N/A
P850		N/A	N/A	206-0427-00	N/A

**1 Probe tips in package of ten.*

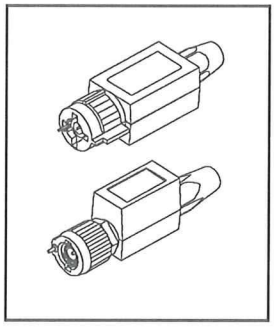
**2 Probe hybrid tip assemblies in packages two each.*

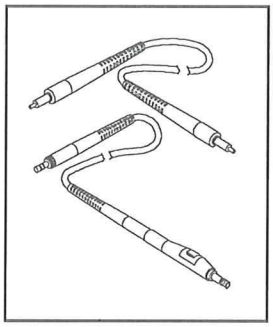
**3 Probe hybrid tip assembly in quantities of one.*

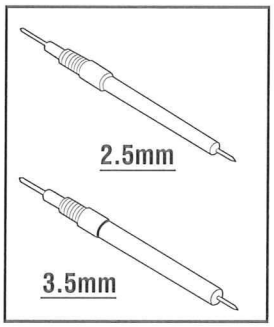
**4 131-1685-01 contact for readout + power (P6205, P6205, P6217, P6245, P6243, P6231).*

Replacement Parts

PASSIVE AND ACTIVE PROBE GENERAL REPLACEMENT PARTS







Probe	Length (m)	Connector/ Comp. Box	Probe Cable	Probe Tip/ Hybrid Tip	Probe Tip/ Hybrid Tip Color
P6053C	6	206-0421-00	174-2132-01	206-0422-01	tip – gray/tail – red
Opt. 01	3.5	N/A	174-2133-01	206-0392-00	tip – gray/tail – blue
Opt. 03	9	N/A	174-2134-01	206-0422-02	tip – blue/tail – red
P6130	1.5	206-0313-00	174-0970-00	206-0270-10*2	tip – brown/tail – yellow
	2	206-0319-00	174-0971-00	206-0270-12*2	tip – brown/tail – blue
	3	206-0320-00	174-0972-00	206-0270-11*2	tip – brown/tail – red
P6131	1.3	206-0314-00	174-0973-00	206-0265-10*2	tip – clear/tail – blue
	2	206-0321-00	174-0971-00	206-0265-12*2	tip – clear/tail – yellow
	3	206-0322-00	174-0972-00	206-0265-11*2	tip – clear/tail – red
P6133	2	206-0350-00	174-0971-00	206-0265-12*2	tip – clear/tail – yellow
Opt. 01	1.3	206-0349-00	174-0973-00	206-0265-13*2	tip – clear/tail – clear
Opt. 03	3	206-0351-00	174-0972-00	206-0265-11*2	tip – clear/tail – red
Opt. 25	1.3	206-0349-00	174-0973-00	206-0393-00*2	tip – clear/tail – natural
P6134C	1.5	206-0420-00	174-1081-04	206-0418-00*2	tip – black/tail – red
P6135A (13 to 17pF)*4	1.5	N/A	N/A	206-0416-00*3	tip – red/tail – natural
(18 to 22pF)*4		N/A	N/A	206-0419-00*3	tip – black/tail – yellow
(45 to 49pF)*4		N/A	N/A	206-0415-00*3	tip – blue/tail – natural
P6136	1.3	206-0359-00	174-0978-00	206-0265-10*2	tip – clear/tail – blue
Opt. 25	1.3	206-0359-00	174-0978-00	206-0392-00*2	tip – gray/tail – blue
P6137	1.5	206-0389-01	174-1081-04	206-0378-00*2	tip – black/tail – natural
P6138	1.3	206-0439-00	174-0978-00	206-0392-00*2	tip – gray/tail – blue
P6139A	1.3	206-0440-00	174-0978-00	206-0441-00*2	tip – blue/tail – yellow
P6150*1 (10X)	1	N/A	174-1341-00	206-0399-03*2	N/A
(1X)		N/A		206-0398-00*2	N/A
P6156 (10X)	1.5	N/A	174-1127-00	206-0380-00*2	tip – blue/tail – black
Opt. 25 adds 100X tip		N/A	N/A	206-0382-00*2	tip – red/tail – black
20X tip		N/A	N/A	206-0381-00*2	tip – gray/tail – black
1X tip		N/A	N/A	206-0379-00*2	tip – black/tail – black
P6230	1.6	N/A	N/A	206-0279-10*2	tip – yellow/tail – blue
P6231*5	1.5	N/A	N/A	206-0279-10*2	tip – yellow/tail – blue

*1 *Not pictured above.*

*2 *Probe hybrid tip assembly in quantities of one.*

*3 *Consists of a matched pair.*

*4 *Scope Input Capacitance Range.*

*5 *131-1685-01 contact for readout + power (P6205, P6205, P6217, P6245, P6243, P6231).*

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Probe Accessories

SMD (P656XAS) and P6240

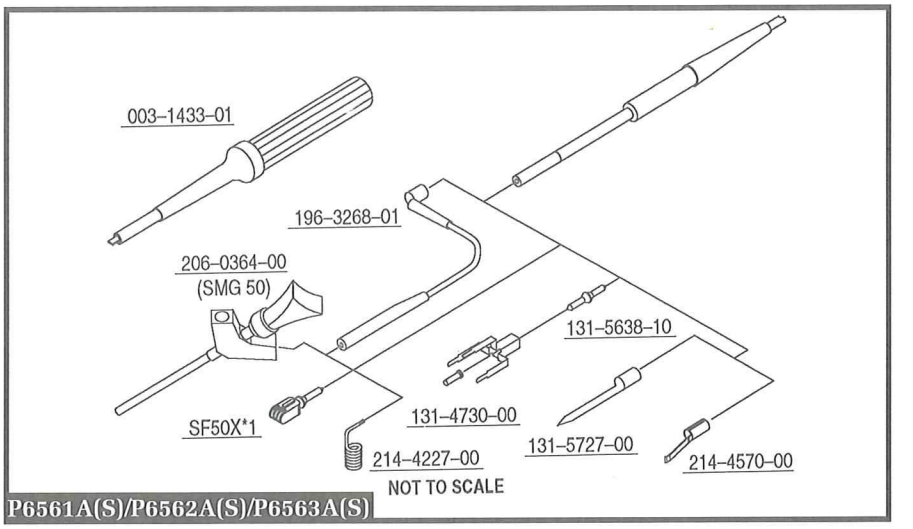
ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P6561A(S)/P6562A(S)/P6563A(S)

Part Number	Description
003-1433-00	Adjustment Tool.
003-1433-01	Adjustment Tool pkg. of 5.
131-5727-00	Low Inductance Ground Lead.
131-4730-00	SMT Probe Tip Circuit Board Test Points, pkg. of 5.
131-5638-10	Receptacle Tip for P656X/AS, pkg. of 10.
196-3268-01	Ground Lead with 0.025 in. Receptacle, pkg. of 5.
206-0364-00	SMT KlipChip™, 1 each.
214-4227-00	Right Angle Square-pin Adapter.
214-4570-00	100 mil Square-pin Ground Adapter.
FlexLead™ Adapter	(See page 468)
SMG50	SMT KlipChip™, 20 each.
SF501	SureFoot™ Probe Tip Adapter, pkg. of 12, Yellow, 50 mil Pitch.
SF502	SureFoot™ Probe Tip Adapter, pkg. of 12, Blue, 25 mil/0.65 mm Pitch.
SF503	SureFoot™ Probe Tip Adapter, pkg. of 12, Red, 0.5 mm Pitch.

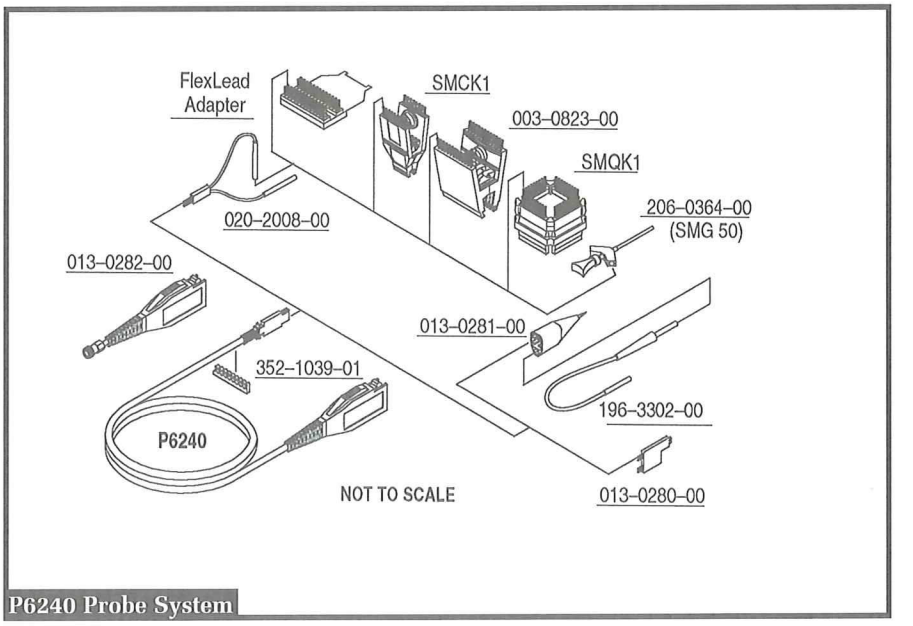
**1 See SF501/SF502/SF503 above or page 471 for complete selection information.*



P6561A(S)/P6562A(S)/P6563A(S)

P6240 PROBE SYSTEM FOR TLS216

Part Number	Description
003-0823-00	24-Pin DIP, Clothespin Style.
013-0280-00	One to Two Adapter.
013-0281-00	Handheld Probe Tip Adapter w/ Tips.
013-0282-00	50 to 75 Ω Converter.
196-3302-00	6 in. Ground Lead.
020-2008-00	Y Lead Adapter, pkg. of 10.
206-0364-00	SMT KlipChip™, 1 each.
352-1039-01	Probe Cable Loom, pkg. of 6.
SMG50	SMT KlipChip™, 20 each.
SMCK1	SOIC Engineering Kit. (See page 471 for included items.)
SMQK1	PLCC Engineering Kit. (See page 471 for included items.)



P6240 Probe System

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Probe Accessories

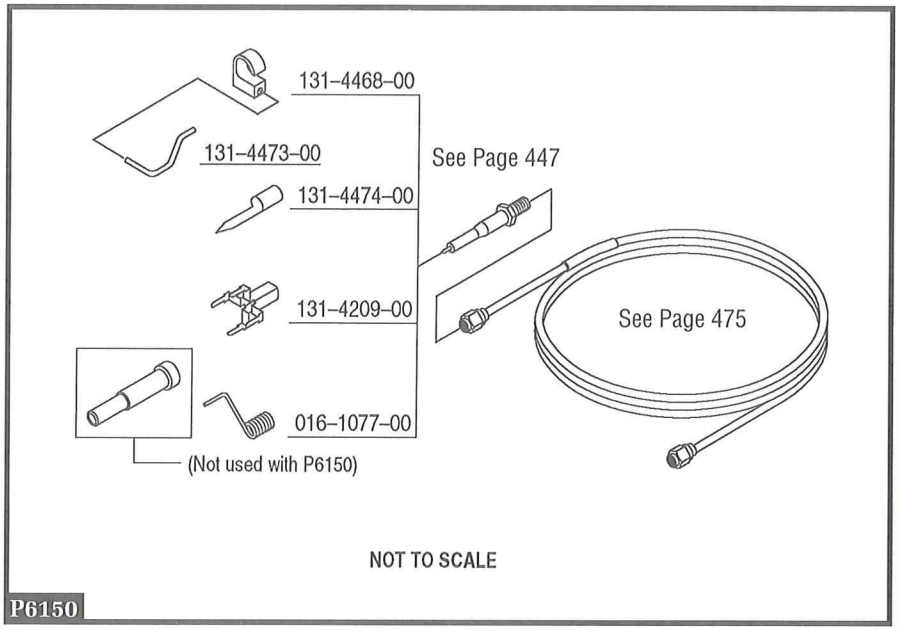
P6150(4mm) • P6207(4mm) • P6217(4mm) • SD-14(4mm)

ORDERING INFORMATION

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P6150

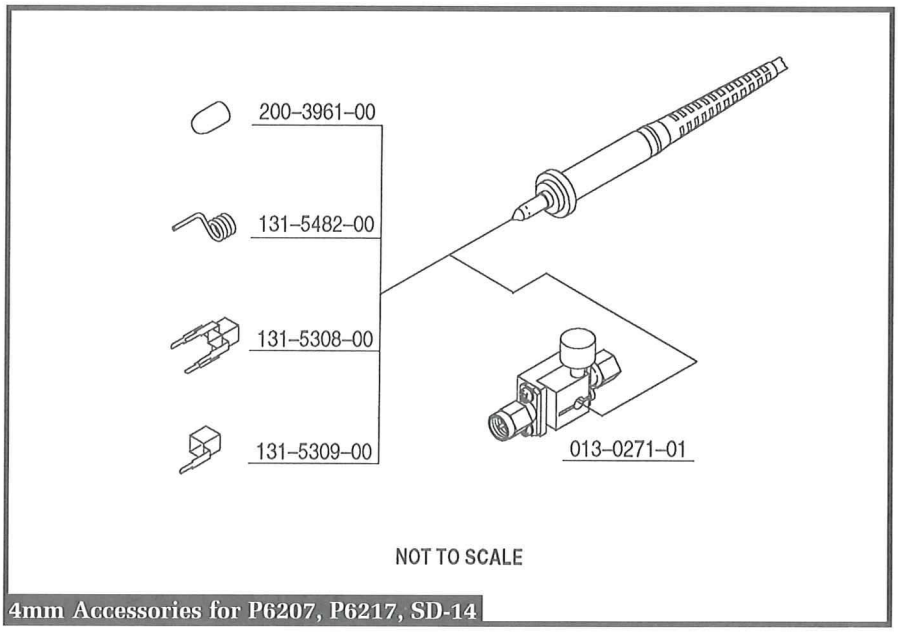
Part Number	Description
016-1077-00	Spring Ground Contact, 2 each of 5 Lengths.
131-4209-00	Probe Tip to CKT BD Adapter.
131-4468-00	Ground Collar.
131-4473-00	1/4 in. Ground Lead.
131-4474-00	1 Leg Ground Contact.



P6150

P6207, P6217, SD-14

Part Number	Description
013-0271-01	SMA Adapter to SD-14.
131-5308-00	4 Leg Ground Contact.
131-5309-00	1 Leg Ground Contact.
131-5482-00	Spring Ground Contact 2 each of 5 Lengths.
200-3961-00	ESD Protective Probe Tip Cover.



4mm Accessories for P6207, P6217, SD-14

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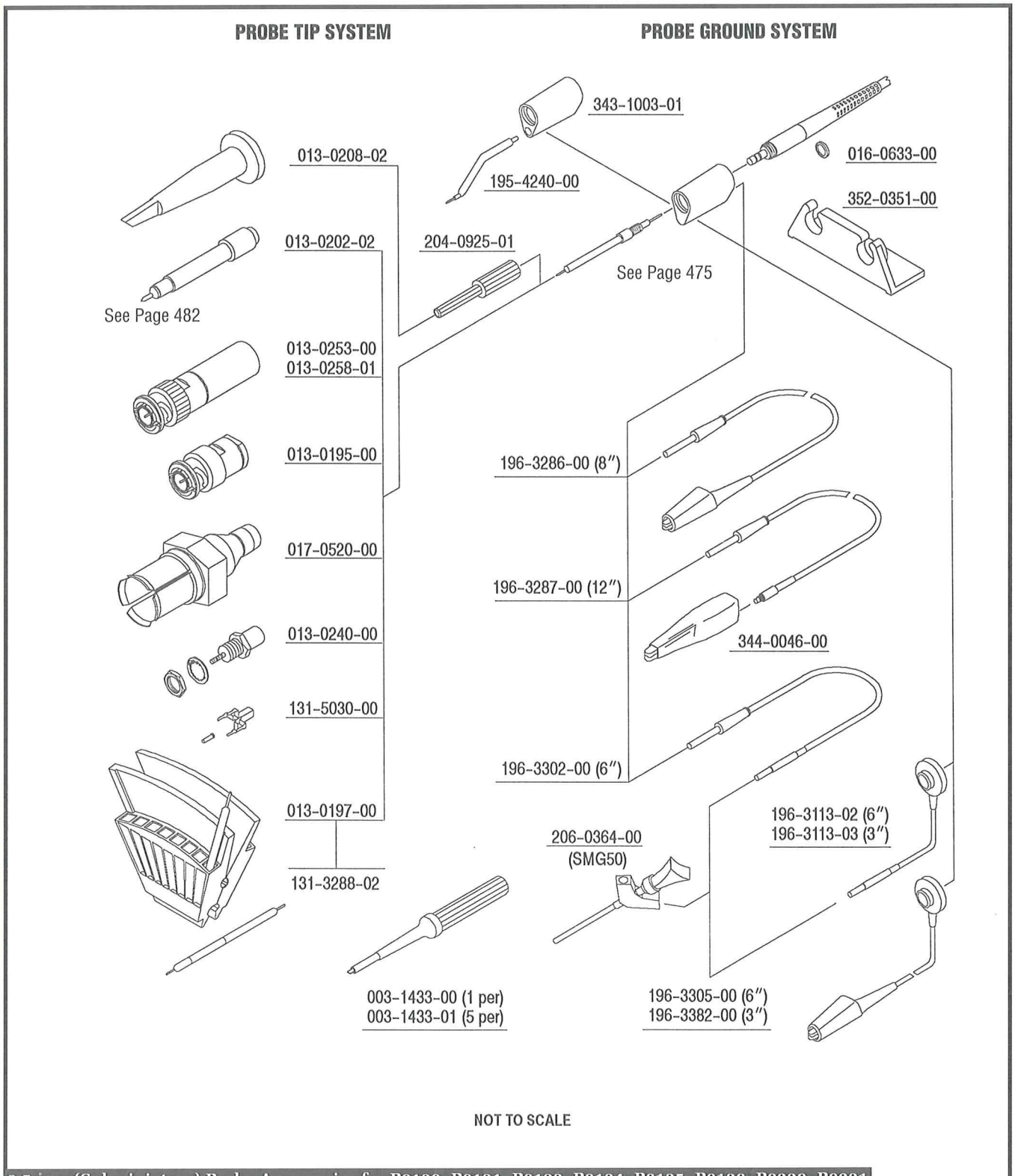
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Probe Accessories

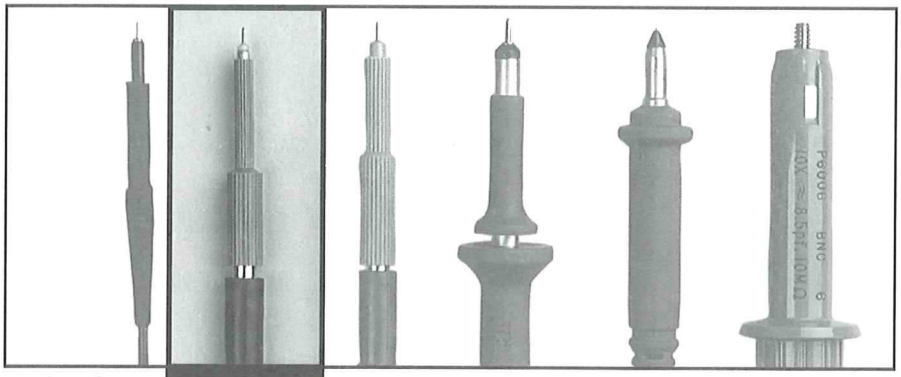
2.5mm (Subminiature) Probe System



2.5 mm (Subminiature) Probe Accessories for P6130, P6131, P6133, P6134, P6135, P6136, P6230, P6231

Probe Accessories

2.5mm (Subminiature) Probe System



Tip/Head Style: *SMD* | ***2.5 mm Subminiature*** | *3.5 mm Compact* | *5 mm Miniature* | *4 mm* | *6/32 Thread Monolithic*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

Part Number	Description
003-1433-00	Adjustment Tool.
003-1433-01	Package of 5 each of 003-1433-00, above.
013-0195-00	Subminiature Probe Tip to BNC Adapter.
013-0197-00	KLIP-KIT (includes two 16-Pin DIP Clips and four signal/ground pins)*[1].
013-0202-02	Subminiature/Compact-to-Miniature Probe to Adapter (allows use of miniature probe tip accessories). See page 482.
013-0208-02	Retractable Hook Tip for Subminiature Tip Probes.
013-0240-00	Subminiature Probe Tip Chassis Mount Test Jack.
013-0253-00	Subminiature Probe Tip to BNC Adapter Thread Locking (non-terminated).
013-0258-01	P6562 Subminiature Probe Tip to BNC Adapter, Thread Locking, 50 Ω Terminated.

[1] Subminiature (2.5 mm) Probes can be used in place of the Signal/Ground pins.

Part Number	Description
016-0633-00	Cable Marker Set for all Modular Cables (P610X/A/B, P612X, P613X/A, P62X, (except P6201, P6202A)).
017-0520-00	Subminiature Probe Tip to GR 50 Ω Termination Adapter.
131-3288-02	Signal/Ground Pins for KLIP-KIT (013-0197-00), (includes eight pins).
131-5030-00	Subminiature Probe Tip Circuit Board Test Points (Pkg. 25).
195-4240-00	Low Impedance Ground Contact.
196-3113-02	6 in. Slip-on Ground Lead.
196-3113-03	3 in. Slip-on Ground Lead.
196-3286-00	8 in. Alligator Ground Lead.
196-3287-00	12 in. Slip-on Ground Lead.
196-3302-00	6 in. Alligator Ground Lead (not compatible with P6137, P6134C, P6053C or P6156).

Part Number	Description
196-3305-00	6 in. Alligator Ground Lead.
196-3382-00	3 in. Alligator Ground Lead.
204-0925-01	Subminiature Probe Tip Attenuator Tip Cover.
206-0364-00	SMT KlipChip™ Adapter.
343-1003-01	Ground Collar.
344-0046-00	#6-32 Thread Alligator Ground Clip.
352-0351-00	Probe Holder, Self-adhesive Back, Black.
352-0670-00	Tip Holder (not shown).

SMD ATTACHMENT TOOLS

SMG50 SMT KlipChip™ Adapter, package of 2D.

See pages 466 to 473 for complete selection of SMD Tools.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

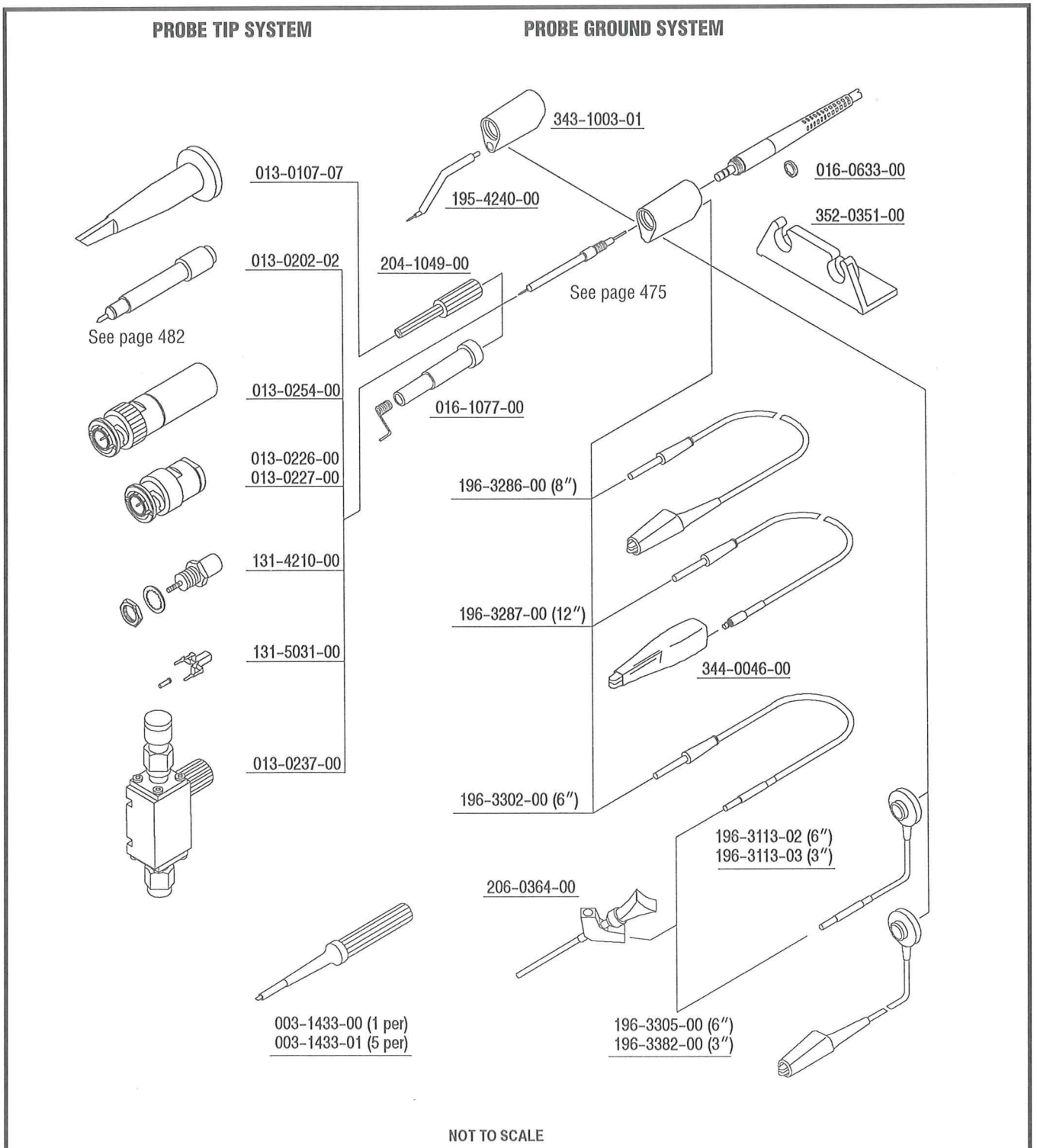
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Probe Accessories

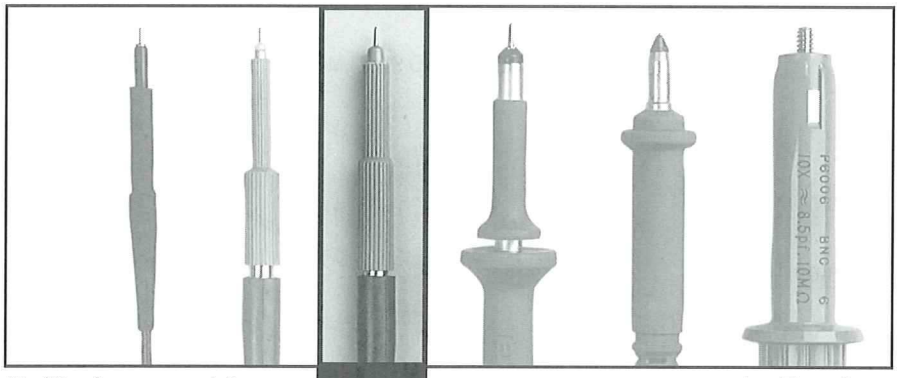
3.5mm (Compact) Probe System



3.5 mm (Compact) Probe Accessories for P6053C, P6133 Opt. 25, P6134C, P6135A, P6136 Opt. 25, P6137, P6138, P6139A, P6156

Probe Accessories

3.5mm (Compact) Probe System



Tip/Head Style: *SMD* | *2.5 mm Subminiature* | ***3.5 mm Compact*** | *5 mm Miniature* | *4 mm* | *6/32 Thread Monolithic*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

Part Number	Description
003-1433-00	Adjustment Tool.
003-1433-01	Package of 5 each of 003-1433-00, above.
013-0107-07	Retractable Hook Tip for Compact Tip Probes.
013-0202-02	Subminiature/Compact-to-miniature Probe to Adapter (allows use of miniature probe tip accessories). See page 482.
013-0226-00	Compact Probe Tip to BNC Adapter (non-terminated).
013-0227-00	50 Ω Compact Probe Tip to BNC Termination Adapter.
013-0237-00	Compact Probe Tip to SMA Adapter (50 Ω).
013-0254-00	Compact Probe Tip to BNC Adapter Thread Locking (non-terminated).
016-0633-00	Cable Marker Set For All Modular Cables (P610X/A/B, P612X, P613X/A, P623X, P62XX)(except P6201, P6202A).
016-1077-00	Ground Tip Contact for Compact Tip Probes. 2 ea. Five Different Probe Tip to Ground Contact Spacings.
131-4210-00	Compact Probe Tip Chassis Mount Test Jack.
131-5031-00	Compact Probe Tip Circuit Board Test Points (pkg. of 25).
195-4240-00	Low Impedance Ground Contact.
196-3113-02	6 in. Slip-on Ground Lead.
196-3113-03	3 in. Slip-on Ground Lead.
196-3286-00	8 in. Alligator Ground Lead.
196-3287-00	12 in. Slip-on Ground Lead.
196-3302-00	6 in. Alligator Ground Lead (not compatible with P6137 P6134C, P6053C or P6156).
196-3305-00	6 in. Alligator Ground Lead.
196-3382-00	3 in. Alligator Ground Lead.
204-1049-00	Compact Probe Tip Attenuator Tip Cover.
206-0364-00	SMT KlipChip™ Adapter.
343-1003-01	Ground Collar.
344-0046-00	#6-32 Thread Alligator Ground Clip.
352-0351-00	Probe Holder, Self-adhesive Back, Black.

SMD ATTACHMENT TOOLS

SMG50	SMT KlipChip™ Adapter, pkg. of 20.
SF201	SureFoot™ Probe Tip Adapter, pkg. of 12, Yellow, 50 mil Pitch.
SF202	SureFoot™ Probe Tip Adapter, pkg. of 12, Blue, 25 mil/0.65 mm Pitch.
SF203	SureFoot™ Probe Tip Adapter, pkg. of 12, Red, 0.5 mm Pitch.

See pages 466 to 473 for complete selection of SMD Tools.

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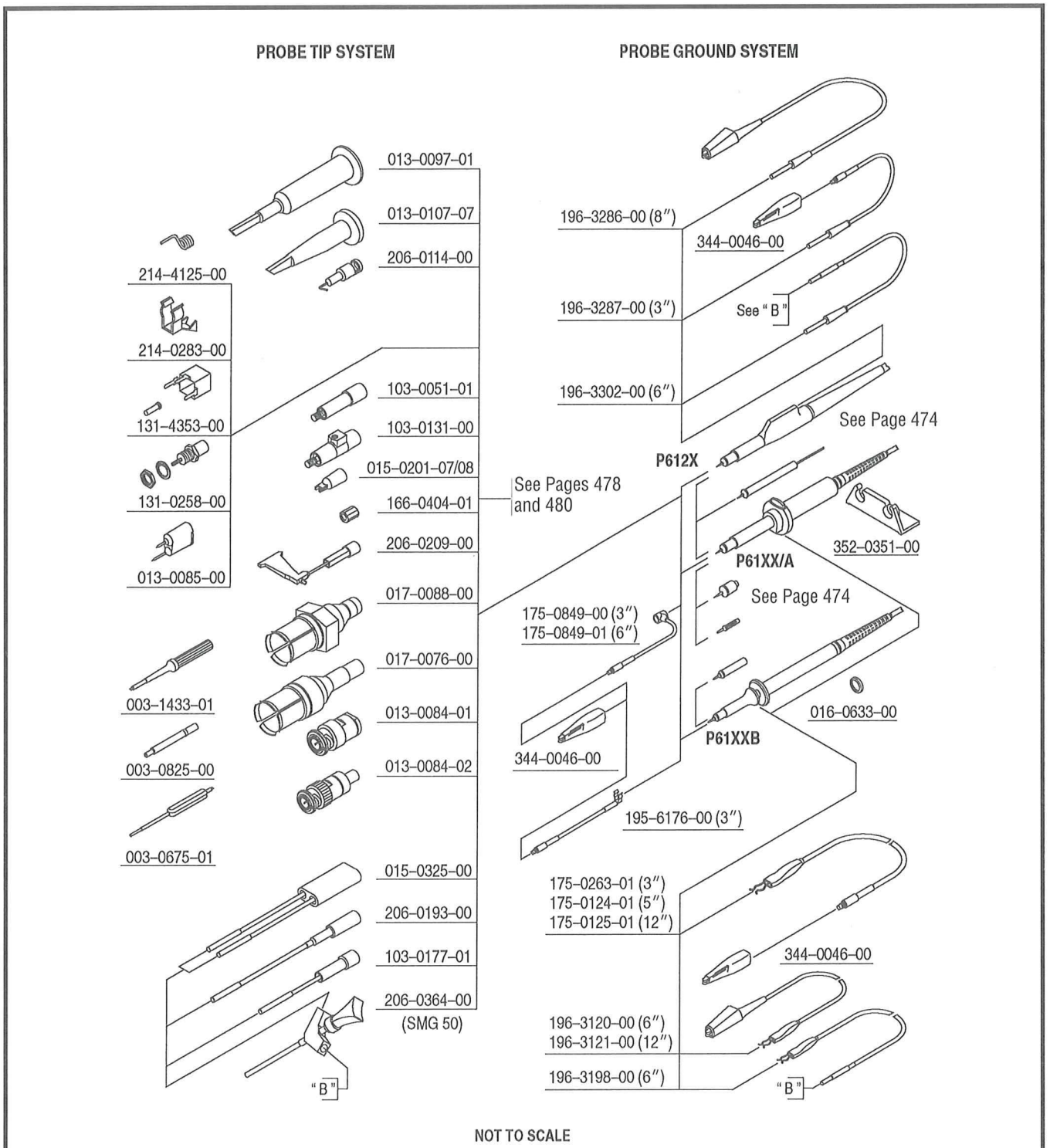
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Probe Accessories

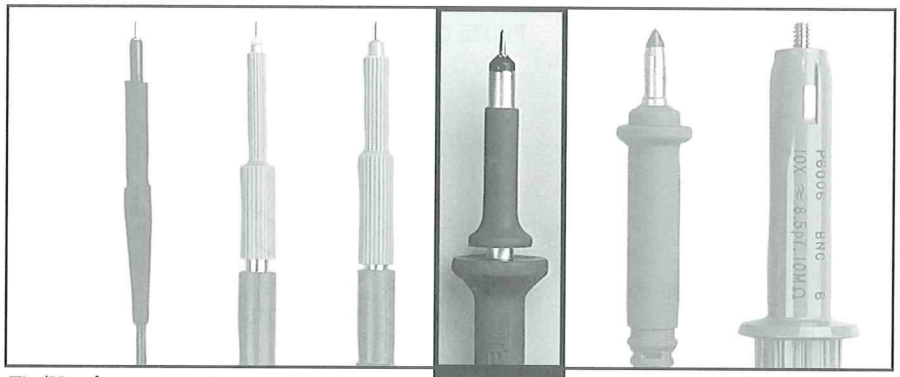
5mm (Miniature) Probe System



5 mm (Miniature) Probe Accessories for P6048, P6053, P6053B, P6055, P6056, P6057, P6062B, P6063B, P61XX/A Family, P612X Family, P61XXB Family, P6202A with Adapter, P6203, P6204, P6205, and P6206

Probe Accessories

5mm (Miniature) Probe System



Tip/Head Style: *SMD* | *2.5 mm Subminiature* | *3.5 mm Compact* | **5 mm Miniature** | *4 mm* | *6/32 Thread Monolithic*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

MINIATURE PROBE ACCESSORIES

Part Number	Description
003-0675-01	Adjustment Tool P6202A.
003-0825-00	Tip Extractor for Miniature Probes (except for P610X/"A" Version and P612X Family Probes).
003-1433-00	Adjustment Tool.
003-1433-01	Package of 5 each of 003-1433-00, above.
013-0084-01	Miniature Probe Tip to BNC Adapter (non-terminated).
013-0084-02	Miniature Probe Tip to BNC Adapter for All except P6202A, P6420, and P6201 Adapter.
013-0085-00	Bayonet Ground Assembly.
013-0097-01	Retractable Hook Tip for P6202A and P6420.
013-0107-07	Retractable Hook Tip (for all except P6202A and P6420).
015-0201-07	IC Test Ground Cover, Gray (100 mil spacing), package of 10.
015-0201-08	IC Test Ground Cover, Gray (100 mil spacing), package of 100.
015-0325-00	Dual Lead Adapter.
016-0633-00	Cable Marker Set for all Modular Cables (P610X/A/B, P612X, P613X/A, P623X, P62XX except P6201, P6202A).
017-0076-00	Miniature Probe Tip to GR Adapter.
017-0088-00	Miniature Probe Tip GR 50 Ω Termination Adapter.
103-0051-01	Screw Tip (#6-32).
103-0131-00	Screw Tip with Ground Connection (#6-32).
103-0177-01	Flexible Tip.
131-0258-00	Chassis Mount Test Jack.
131-4353-00	Circuit Board Test Point, package of 25.
166-0404-01	Insulating Ground Cover.
175-0124-01	5 in. Clip-on Ground Lead.
175-0125-01	12 in. Clip-on Ground Lead.
175-0263-01	3 in. Clip-on Ground Lead.
175-0849-00	3 in. Probe Tip Cap Lead for All Miniature Size Probe Tips.
175-0849-01	6 in. Probe Tip Cap Lead for All Miniature Size Probe Tips.
195-6176-00	3 in. Probe Tip Clip-on Lead for All Miniature Size Probe Tips.
196-3120-00	6 in. Clip-on Ground Lead.
196-3121-00	12 in. Clip-on Ground Lead.
196-3198-00	6 in. Clip-on Ground Lead (with 0.025 in. pin receptacle).
196-3286-00	8 in. Ground Lead.
196-3287-00	#6-32 Thread Ground Lead.
196-3302-00	6 in. Slip-on Ground Lead (with 0.025 in. pin receptacle).
206-0114-00	Hook Tip.
206-0193-00	Flex Tip for 0.025 in. Square Pin.
206-0209-00	Pin Tip (accepts 0.025 in. IBM SLT pin).
214-0283-00	Electrical Ground Contact.
214-4125-00	Electrical Contact Ground.
344-0046-00	#6-32 Thread Alligator Ground Clip.
352-0351-00	Probe Holder, Self-adhesive Back, Black.

SMD ATTACHMENT TOOLS

206-0364-00	SMT KlipChip™ (used with 0.025 pin receptacles).
SMG 50	Package of 20 each SMT KlipChip™ Adapters.

See pages 466 to 473 for complete selection of SMD Tools.

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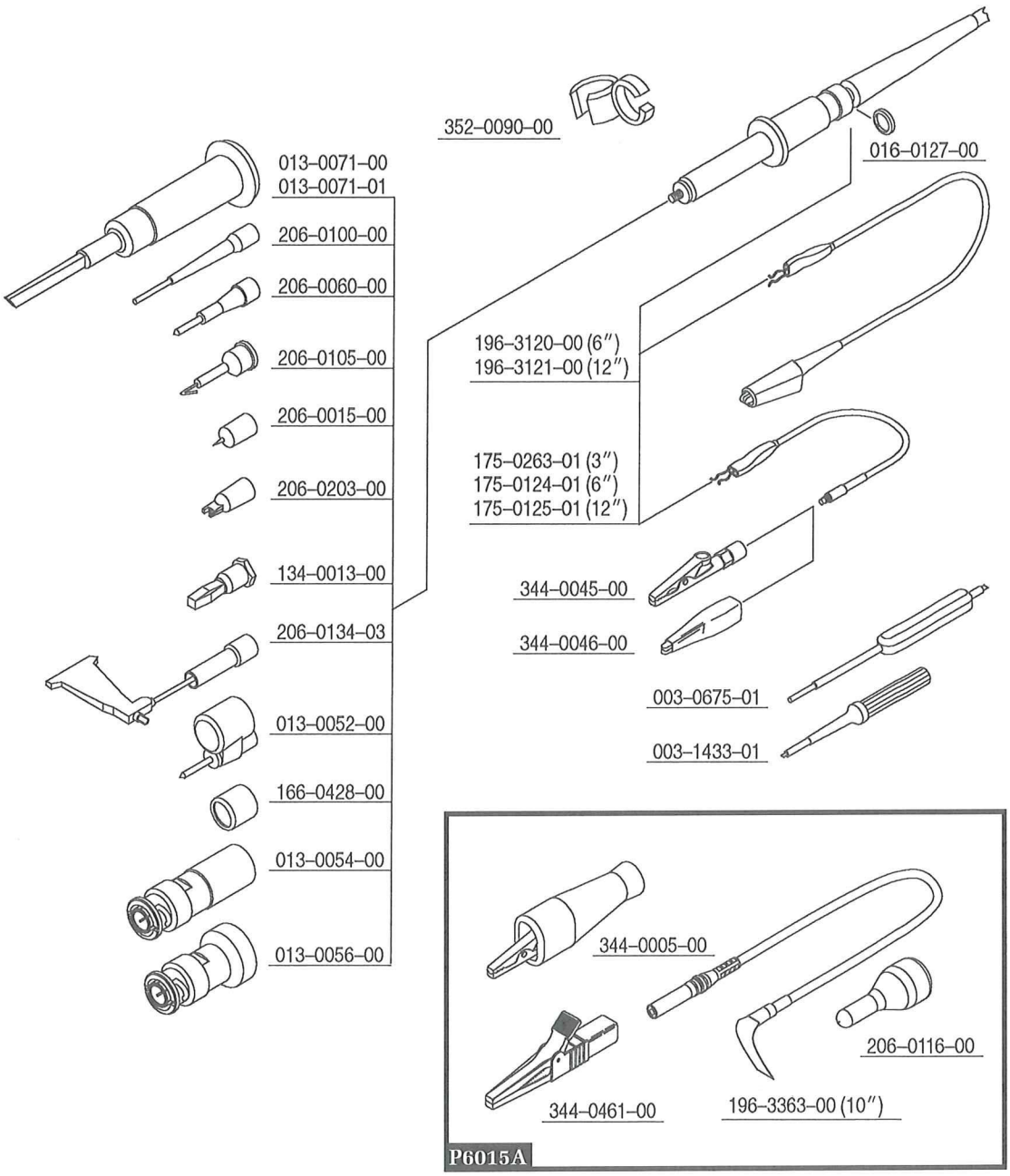
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Probe Accessories

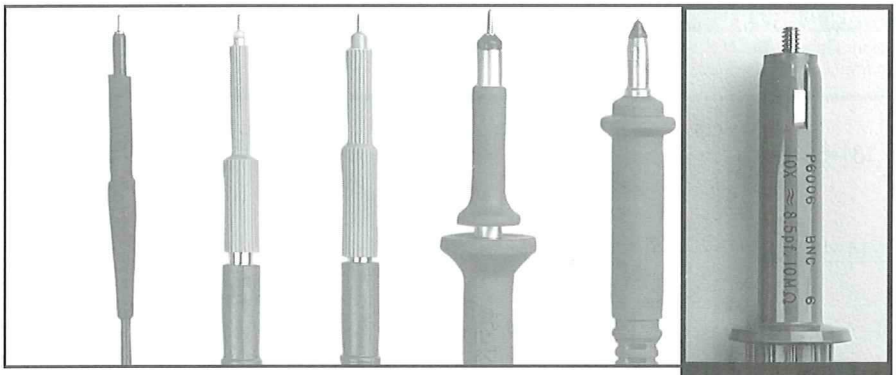
6/32 Thread (Monolithic) • P6015A • P6201



6/32 Thread (Monolithic) Accessories for P6006, P6007, P6008, P6009, P6028, P6060

Probe Accessories

6/32 Thread (Monolithic) • P6015A • P6201



Tip/Head Style: *SMD* *2.5 mm Subminiature* *3.5 mm Compact* *5 mm Miniature* *4 mm*

6/32 Thread Monolithic

ORDERING INFORMATION

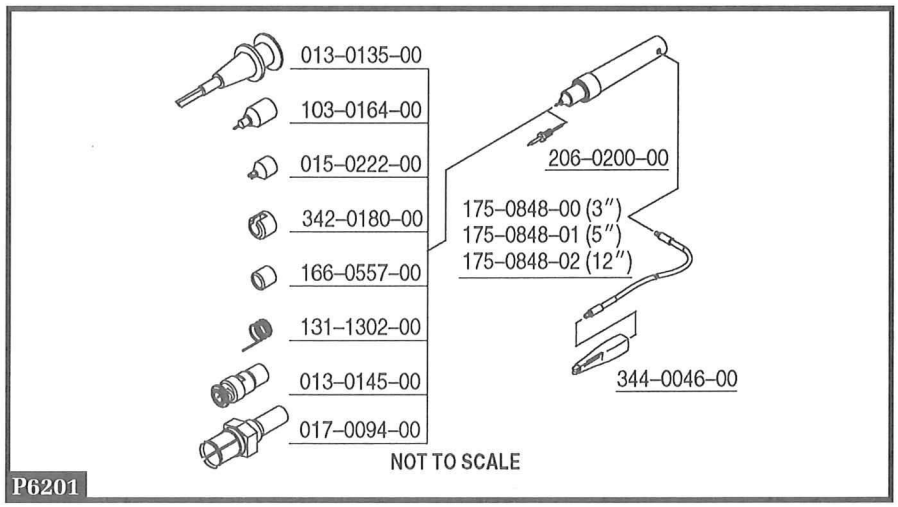
For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

MONOLITHIC PROBE ACCESSORIES
(For probes with #6-32 Screw Tips)

Part Number	Description
003-0675-01	Adjust Tool.
003-1433-00	Adjust Tool.
003-1433-01	Adjust Tool, pkg. of 5.
013-0052-00	Bayonet Ground Assembly.
013-0054-00	Probe Screw Tip to BNC Adapter.
013-0056-00	Probe Screw Tip to BNC Adapter for P6028.
013-0071-00	Retractable Hook Tip.
013-0071-01	Retractable Hook for P6008 Environmental Probe.
134-0013-00	Banana Tip (#6-32).
166-0428-00	Insulating Ground Cover for P6009.
175-0124-01	5 in. Ground Lead.
175-0125-01	12 in. Ground Lead.
175-0263-01	3 in. Ground Lead.
196-3120-00	6 in. Clip-on Ground Lead.
196-3121-00	12 in. Clip-on Ground Lead.
196-3363-00	10 in. Clip-on Ground Lead for P6015A.
206-0015-00	Straight Tip (0.055 in. dia.).
206-0060-00	Spring Tip (0.08 in. dia.).
206-0100-00	Calibration Tip (0.063 in. dia.).
206-0105-00	Hook Tip.
206-0116-00	Banana Tip (P6015 only) #10-32.
206-0134-03	Pin Tip (accepts 0.025 in. IBM SLT pin).
206-0203-00	IC Test Tip.
344-0045-00	Alligator Clip.
344-0046-00	Miniature Alligator Clip with Boot.

P6201 PROBE

Part Number	Description
344-0461-00	Crocodile Clip, 4 mm Socket.
352-0090-00	P600X Probe Holder.



013-0135-00	Retractable Hook Tip.
013-0145-00	Probe Tip to BNC Adapter.
015-0222-00	IC Test Ground Cover.
017-0094-00	Probe Tip to GR 50 Ω Termination Adapter.
103-0164-00	Probe Tip to Miniature Probe Tip Adapter. (See page 482 for compatible accessories.)
131-1302-00	Ground Contact.
166-0557-00	Insulating Ground Cover.
175-0848-00	3 in. Ground Lead.
175-0848-01	5 in. Ground Lead.
175-0848-02	12 in. Ground Lead.

P6201 PROBE

Part Number	Description
206-0200-00	Replaceable Probe Tip.
342-0180-00	Ground Contact Insulator.
344-0046-00	#6-32 Thread Alligator Ground Clip.

CABLE MARKER SETS

016-0127-00 For 3/16 in. dia. Cable.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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Probe Accessories

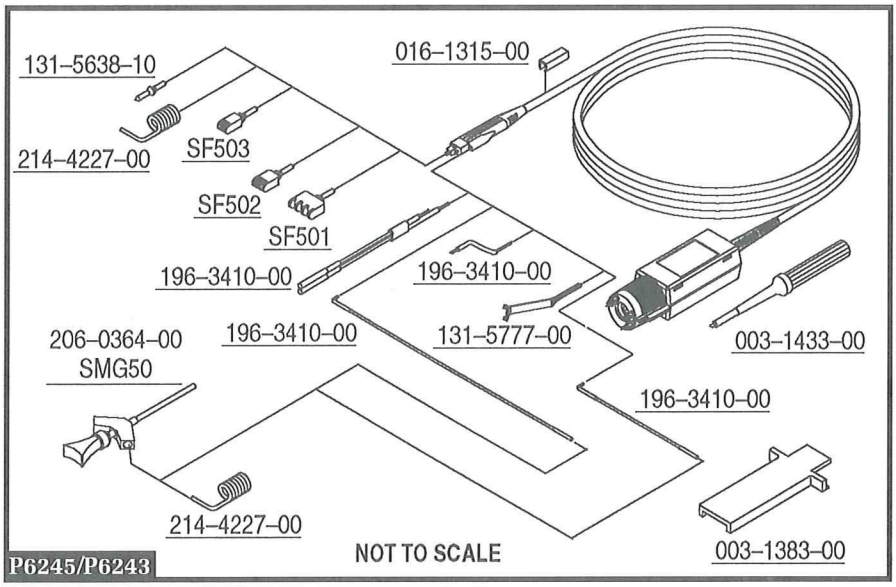
P6245 • P5100 • P5102

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

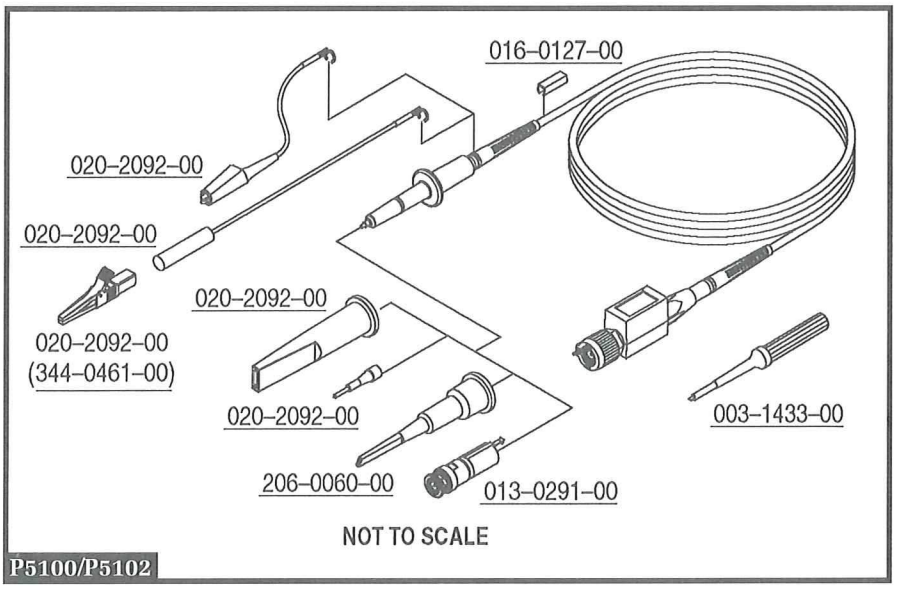
P6245/P6243

Part Number	Description
003-1383-00	Compensation Box Cover Removal Tool.
003-1433-00	Adjustment Tool.
003-1433-01	Package of 5 each of 003-1433-00.
016-1315-00	2 each – 5 Colors of Cable Markers.
131-5638-10	10 each – Solderable Probe Tips.
131-5777-00	100 mil Square-pin Ground Adapter.
196-3410-00	Ground lead set includes: 2 each – 1 in., 3 in., 6 in. Ground Leads w/Square Pin Receptacle; 2 each – Y Lead Adapters.
206-0364-00	SMT KlipChip™, 1 each.
214-4227-00	Right Angle Square-pin Adapter.
SF501	SureFoot™ Probe Tip Adapter, pkg. of 12, Yellow, 50 mil Pitch.
SF502	SureFoot™ Probe Tip Adapter, pkg. of 12, Blue, 25 mil/ 0.65 mm Pitch.
SF503	SureFoot™ Probe Tip Adapter, pkg. of 12, Red, 0.5 mm pitch.
SMG50	SMT KlipChip™, 20 each.



P5100/P5102

Part Number	Description
020-2092-01	P5100 Accessory Kit Includes: Regular Retractable Hook Tip, Large Retractable Hook Tip, 6 in. Ground Lead w/Alligator Clip, 18 in. Ground Lead w/4 mm Shielded Banana Plug, Large Crocodile Clip.
196-3424-00	P5102 Common Lead Set. (Not Shown)
003-1433-01	Package of 5 each of 003-1433-00, above.
013-0291-00	P5100 Probe Tip to BNC Adapter.
016-0127-00	Cable Marker Set.
206-0060-00	Spring Tip (0.08 in. dia.).
344-0461-00	Large Crocodile Clip.



For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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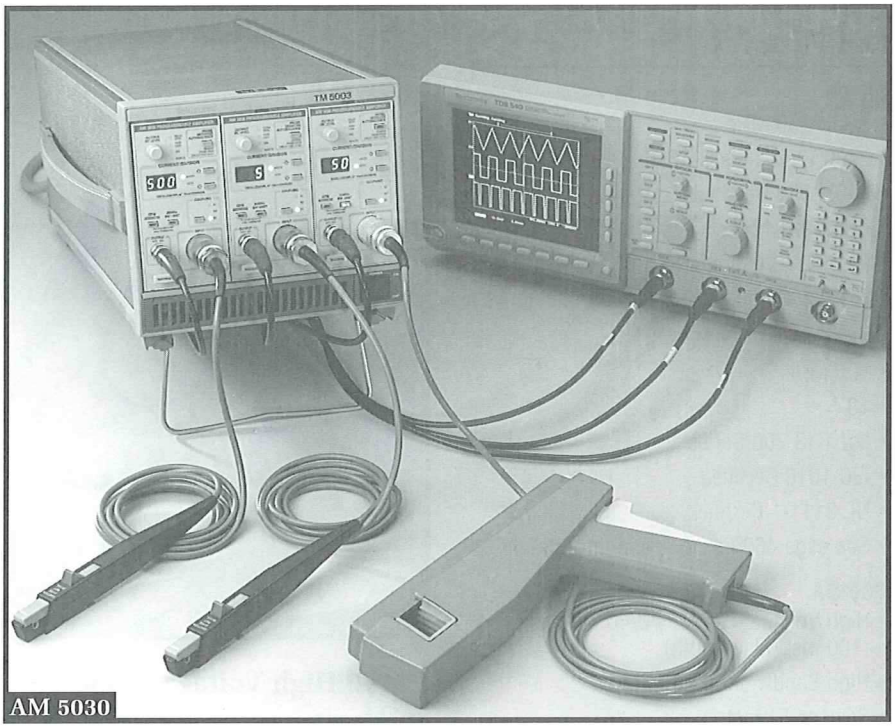
Tektronix Measurement products are manufactured in ISO registered facilities.

Power Measurements

Features

POWER MEASUREMENTS

- High Voltage
- Isolation
- Differential
- Current



AM 5030 Programmable Current Probe Amplifier with A6302 and A6303 Current Probes.

Power Measurements

Oscilloscopes measure voltages, presented at their inputs, to provide amplitude versus time displays and offer a wide range of analysis capabilities. These voltage signals are typically referenced to ground and less than 500 V. While providing valuable information about what is occurring in your device, it is clear that knowledge of currents, high voltages, and floating voltages may all be required to completely understand what is happening with your application.

In the following sections we describe a selection of probes and devices which enable you to safely and accurately capture current, high voltage, and floating signals – all converted to voltage inputs acceptable to your oscilloscope or other measurement instrument.

While current and differential voltage measurements are important to most electrical and electronic applications, higher current and voltage and isolated floating measurements are especially critical in power conversion applications. These applications include devices characterized by high currents and differential voltages which change rapidly as the devices switch on and off. In these applications, safety as well as accuracy is of critical importance. The special needs of these applications are addressed by the group of products we refer to as power measurement products.

In the following pages we describe each category of measurement products: current probes, high voltage probes, monolithic isolators, fiber optic isolation systems, and differential probes.

In each section, we describe product features and applications. We also provide information to help you select the right device to safely and accurately make your measurement. We will also provide valuable Data Sheets on how to make measurements specific to your application.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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High Voltage Probes

P5100 • P5102 • P6015A • P400 • P850

Features

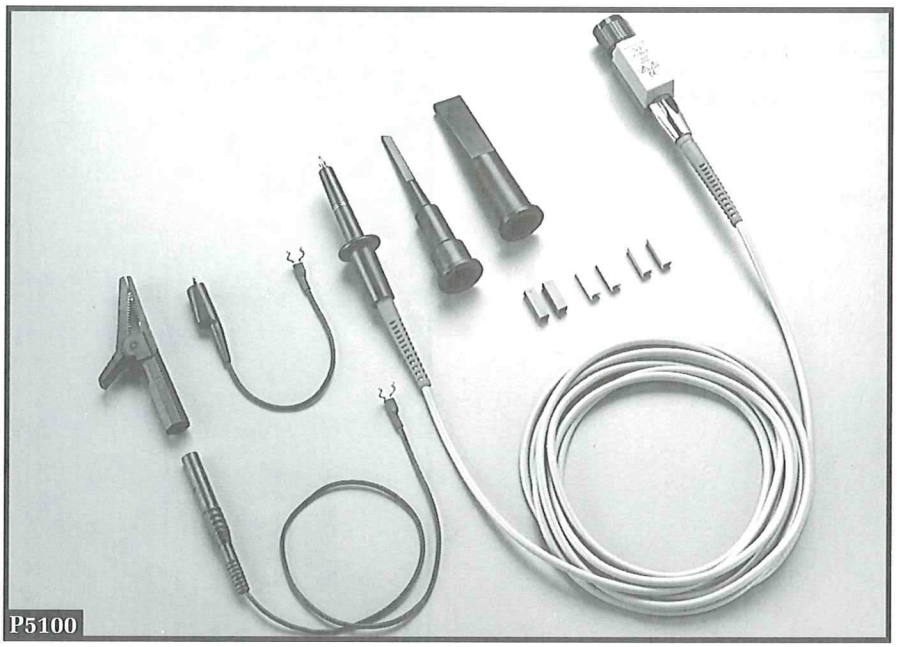
P5100
- DC to 250 MHz
- 2500 V DC + Peak AC
- 100X with Readout
- UL Listed 1244
- IEC 1010 Certified
- 7-30 pF Compensation Range

P5102
- 100 MHz
- 10X
- For THS 700 Series
- IEC 1010 Certified
- UL 3111-1 Certified
- See page 460 for complete information

P6015A
- High Voltage – 20 kV DC/40 kV Peak (100 ms Pulse Width)
- High Bandwidth – 75 MHz
- Silicone Dielectric
- Optional 1,000X Coding
- Wide Compensation Range (7-49 pF)
- Heavy Duty Versatile Ground Lead and Clip

P400
- 1X
- DC to 20 MHz
- UL Listed 1244
- For 22X Series

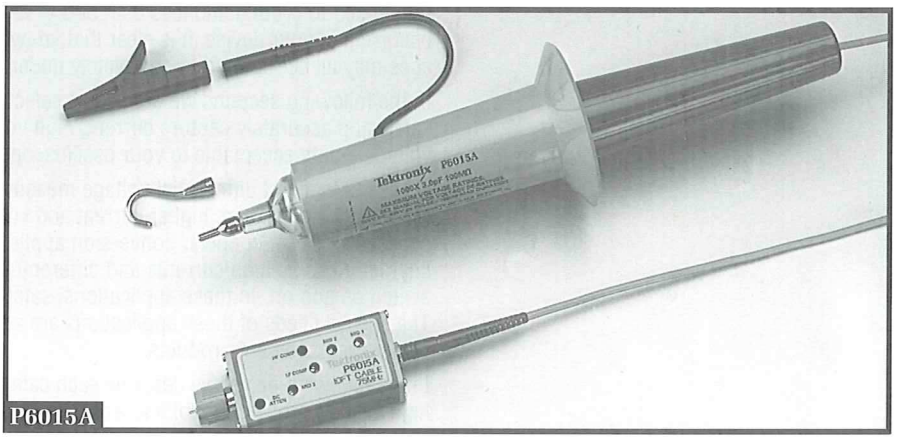
P850
- 10X
- DC to 60 MHz
- UL Listed 1244
- For 22X Series


P5100

P5100 High Voltage Probe

The P5100 is a low-input capacitance High Voltage (2.5 kV) Probe designed for higher frequency applications. The probe can be compensated to match plug-ins and oscilloscopes with nominal input capacitances of 7-30 pF. A variety of screw-on accessories provide easy connection to the device under test.

For additional information on P5100 request Data Sheet 56W-10262-0.



P6015A

P6015A High Voltage Probe

For heavy duty high-performance measurements of voltages over 2.5 kV, the P6015A is the industry standard. You can measure DC voltages up to 20 kV and pulses up to 40 kV. The 75 MHz bandwidth enables you to capture fast, high-voltage signals.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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High Voltage Probes
P5100 • P6015A

The P6015A uses an environmentally safe silicone compound for a dielectric and never needs refilling. Other features include: a 7-49 pF compensation range, small compensation boxes which fit on adjacent amplifier inputs, and a readout option for use with Tektronix digital scopes. With the readout option, displayed voltage amplitude values will be the actual signal value rather than understated by a factor of 1,000. Using the readout version with other than Tektronix digital scopes may result in an erroneous readout display.

For additional information on the P6015A, request P6015A Data Sheet 51W-8217-1.

CHARACTERISTICS

P6015A/P5100/P6007/P6009

Probe	Nominal Length	Attenuation	Bandwidth	Rise Time	Loading	Max Input V	Compensation Range In pF DC or RMS	Readout
P6015A	10 ft.	1000X	75 MHz	4.0 ns	100 MΩ/3 pF	20 kV	7 to 49	No
P6015A Opt. 1R	10 ft.	1000X	75 MHz	4.0 ns	100 MΩ/3 pF	20 kV	7 to 49	Yes
P6015A Opt. 25	25 ft.	1000X	25 MHz	14 ns	100 MΩ/4 pF	20 kV	7 to 49	No
P6015A Opt. 2R	25 ft.	1000X	25 MHz	14 ns	100 MΩ/4 pF	20 kV	7 to 49	Yes
P5100	10 ft.	100x	250 MHz	1.75 ns	10 MΩ/2.75 pF	2.5 kV	7 to 30	Yes
P5102	2 m	10X	100 MHz	≤ 3.5 ns	5 MΩ/11.2 pF	1,000 VRMS	24 to 28	No

P850/P400

	Nominal Length	Attenuation	Loading	Bandwidth			Max Input V		
				222A	222PS	224	222A	222PS	224
P400	3.5 ft.	1X	1 MΩ/30 pF	10 MHz	10 MHz	20 MHz	400 V	850 V	850 V
P850*[1]	3.5 ft.	10X	10 MΩ/4.5 pF	10 MHz	10 MHz	60 MHz	400 V	850 V	850 V

*[1] *The P850 is rated for 6 kV peak surge (≤250 µS) when used with the 222PS and 224, but not for the 222A.*

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P5100
100X, 10 ft. High Voltage Probe.
Includes: Two each three colors Cable Markers, One each Crocodile Clip, One each Adjustment Tool, One each Hooktip (Small), One each Hooktip (large), One each 18 inch Ground Lead, One each six inch Ground Lead, Instruction Manual (070-8151-00).

RECOMMENDED ACCESSORIES
Probe Tip to BNC Adapter – Order 013-0291-00.

0.080 in. Diameter Spring Tip – Order 206-0060-00.

Differential Probe Pair Kit – 2 Differential Ground Leads; 1 Long and 1 Short (either connects the probe grounds together at the tips). 12 "S" Clips (clips hold the ends of the probes together). Instruction Sheet (includes a procedure for twisting the probe leads together and adjusting the probes to maximize CMRR). Order 040-1487-00.

P5102
10X, High Voltage Probe for THS 700 Series.
See page 460 for complete information.

P6015A
1,000X, 10 ft. High Voltage Probe.
Includes: Hook Probe Tip (206-0463-00); Banana Plug Tip (134-0016-00); Crocodile Clip – plugs onto Ground Lead (344-0461-00); Ground Lead (196-3363-00); Carrying Case (016-1147-00); Instruction Manual (070-8223-02).

Opt. 1R – 10 ft. with Readout.

Opt. 25 – 25 ft. without Readout.

Opt. 2R – 25 ft. with Readout.

RECOMMENDED ACCESSORIES:
See page 486.

P400
1X, 3.5 ft. Voltage Probe.
Includes: Ground Lead (196-3337-00); Accessory Kit (020-1908-00); Data Sheet (063-0634-00).

P850
10X, 3.5 ft. Voltage Probe.
Includes: Ground Lead (196-3337-00); Accessory Kit (020-1908-00); Data Sheet (063-0634-00).

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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Floating Measurements

Features

P6046
- Active Differential Probe
- 100 MHz

ADA400A
- Active Differential Preamplifier
- Selectable Gain of 100, 10, 18, 0.1
- Selectable Low Pass Filters of 100 Hz, 3 kHz, 1MHz
- 1 MHz

P5200
- Active Differential Probe
- 1300 V Differential
- 25 MHz

P5205
- Active Differential Probe
- 1300 V Differential
- 100 MHz

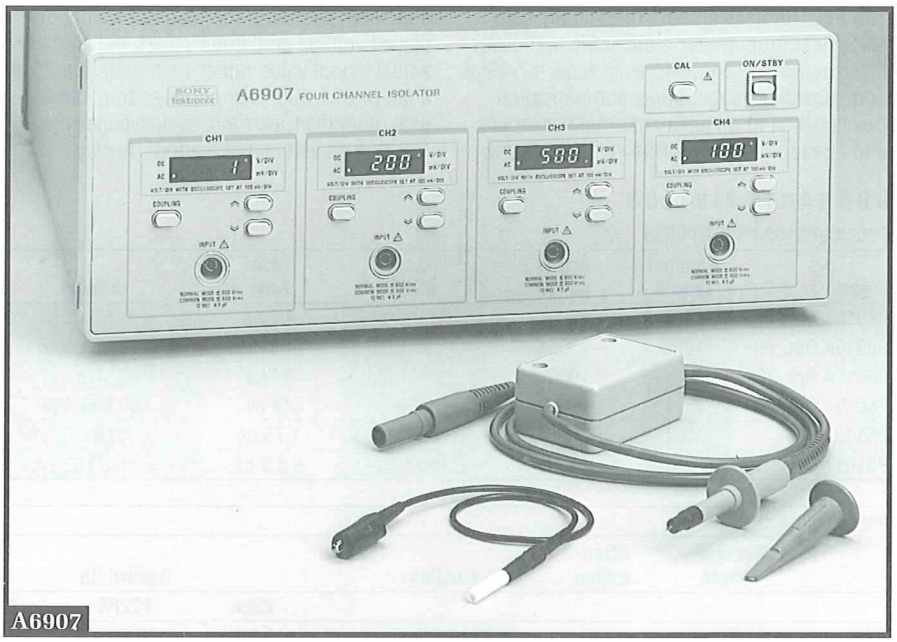
P6135A
- Differential Probe Pair
- High CMRR with All Tektronix Differential Amplifiers

A6907
- Monolithic Voltage Isolator
- 4 Channel
- 60 MHz

A6909
- Monolithic Voltage Isolator
- 2 Channel
- 60 MHz

A6905S
- Fiber Optic Isolation System
- Up to 100 m Separation
- 15 MHz

A6906S
- Fiber Optic Isolation System
- High Performance Measurements
- 100 MHz



A6907 Four Channel Monolithic Isolator.

Floating Measurements

Differential probes and isolators enable safe oscilloscope measurements of floating voltages or signals that are not referenced to ground. They are particularly useful for measuring signals in line-connected power electronics circuits such as switching supplies, motor drives, ballasts and uninterruptible power sources. Fiber optic isolators offer the additional benefit of physically separating the scope from the probe by up to 200 meters while maintaining up to 100 MHz of signal bandwidth.

Oscilloscope users often have to make measurements where neither point of the measurement is at ground (earth potential). Signal "common" may be elevated to hundreds of volts from ground. In addition, many of these measurements require the rejection of high common mode signals in order to evaluate low level signals riding on them. Extraneous ground currents can also add hum to the display. Too often, these problems force users into using dangerous measurement techniques.

For safe and accurate operation, an oscilloscope must be referenced to ground. "Floating" a scope by defeating the scope's protective grounding system not only presents a danger to the operator because of high voltage shock hazard on the entire scope, but also stresses the scope's power transformer insulation. Measurement accuracy is also degraded since the capitance of the scope chassis is now connected to your circuit. Common ways of defeating the scope ground are: non-monitored isolation transformers, isolating circuits and the traditional cutting off the ground prong or using a 3-to-2 wire adapter. All of these are dangerous!

Even when a measurement is ground referenced a differential measurement solution may be necessary for eliminating ground loops or ground bounce problems.

Fortunately, there are several solutions available which are not only safe but much more accurate than the dangerous procedures. These fall into three general categories: isolation amplifiers, differential measurement systems, and isolated input oscilloscopes.

For more information contact your local Tektronix representative and ask for "Differential Oscilloscope Measurements" publication #51W-10540-0.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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Floating Measurements

ISOLATION AMPLIFIERS

An isolation amplifier is connected between the circuit and the oscilloscope with the signal coupled across an isolation barrier. The A6905S and A6906S Fiber Optic Systems provide both isolation and physical separation for signals up to 850 V by using fiber optic cable as the isolation medium. This also enables up to 200 meters of physical separation between the probe and the measurement instrument. The monolithic four and two channel A6907/A6909 use electro-optical/transformer isolation and are also rated for up to 850 V.

DIFFERENTIAL MEASUREMENT SYSTEMS

Differential measurement systems compare the voltage levels at two different points in the circuit and provide the difference as an output. They will typically have better CMRR performance at higher frequencies than voltage isolators. The P6046, P5200, and ADA 400A are standalone systems which enable differential measurements to be displayed by Tektronix TDS and most other oscilloscopes. The P5205 works specifically with scopes with the TEKPROBE™ interface. The P6046 is well suited for fast, lower amplitude signals, while the P5200/P5205 can handle slower signals with higher voltage amplitudes. The ADA400A Differential Preamplifier provides the capability to display low frequency, very low amplitude differential signals even in high noise environments.

Passive differential probe pairs maximize the performance of differential amplifiers/comparators such as the 11A33. The P6135A supports all Tektronix differential amplifiers for input voltages up to 500 V.

ISOLATED INPUT OSCILLOSCOPES

The new 100 MHz THS 700 series of two channel handheld digital storage oscilloscopes enables completely isolated measurements. With the P5202 100X probe, fast signals up to 1000 V can be measured.

The 224 handheld oscilloscope also features dual input channels, individually isolated from the scope's chassis as well as from each other. With the 850 V rated P400 and P850 probes, floating measurements can be made safely and accurately.

For more information, request Floating Oscilloscope Measurements… And Operator Protection, 51W-10640-0.

COMMON MODE REJECTION RATIO

Differential measurements, simply stated, show you the difference in levels between two test points. Specifically, a floating measurement is a differential measurement which is not referenced to ground. To accurately make this measurement, the measurement system must reject the signal which is common to both test points and display the voltage difference.

WHAT IS CMRR?

CMRR stands for Common Mode Rejection Ratio. CMRR serves as a figure of merit for a differential amplifier defined by:
$CMRR = |A_d/A_c|$, where:

- A_d is the voltage gain for the difference signal
- A_c is the voltage gain for the common-mode signal

Ideally, A_d should be large, while A_c should equal zero. Since a perfect differential amplifier has a CMRR equal to ∞, the higher the CMRR for the differential measurement system, the closer it is to the ideal. For example, with a system CMRR of 10,000:1, a common-mode input of 5 V will result in an output of 0.5 mV. (5 V / 0.5 mV = 10,000:1 CMRR). CMRR is also expressed in dB with the relationship of: CMRR dB = 20 log CMRR. Hence, a CMRR of 10,000:1 would be 80 dB.

WHY CMRR IS IMPORTANT

CMRR defines the ability of a measurement system to accurately resolve difference measurements in the presence of common-mode signals. With a CMRR of 10,000:1 (80 dB), if our common-mode signal is 50 V, we will be able to distinguish voltage differences > 5 mV. With a CMRR of 100:1(40 dB), however, we would only be able to resolve differences >500 mV.

CMRR is degraded by an increase in signal frequency, differences in source impedance, inappropriate ground connections and mismatch in probes and scope input amplifiers. Since common mode signals in switching circuits contain significant high frequency components, CMRR at higher frequencies is critical for making accurate measurements.

For more information, request Floating Measurements Solutions Selection Guide, 51W-10457-0.

Differential Probes

P6046

Features

P6046

- Active Differential System
- DC to 100 MHz
- 1X/10X Differential
- Typically 10,000:1 CMRR Derating to 1,000:1 at 50 MHz
- ±250 V Maximum Voltage with 10X Attenuator

Applications

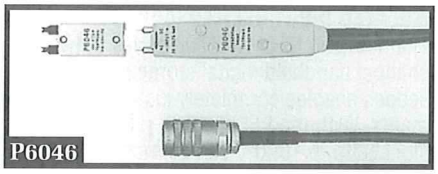
- Power Supplies
- Disk Drives
- Digital Design
- Telecommunications

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P6046 with 10X Attenuator.

Differential Measurements

Differential measurement systems enable you to simultaneously measure two voltage points in a circuit and provide as an output the difference between the two voltages.

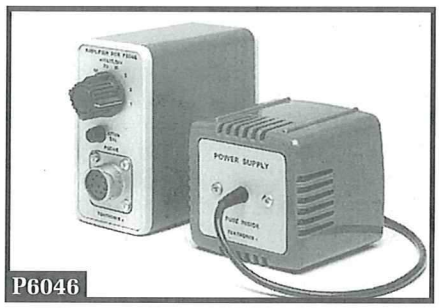
Tektronix offers two types of differential measurement probes: the active differential probe system and the passive matched pair of probes. The P6046 and P5200 are active differential amplifiers in probe form which connect to one channel of a standard scope amplifier. The P6135A is a passive probe pair designed to enhance the performance of a differential amplifier.

P6046 ACTIVE DIFFERENTIAL PROBE SYSTEM

The P6046 is a self-contained active differential system consisting of a Differential Probe, Amplifier and Power Supply. Active FET amplifiers at the dual-inputs reduce circuit loading. Combined with the differential processing occurring in the probe head, the P6046 provides superior common mode rejection ratios (CMRR) at high frequencies typically 10,000:1 out to 50 kHz, derating to 5,000:1 at 1 MHz.

Since the P6046 is self-contained, it provides a differential output into a single channel of any oscilloscope. System controls enable you to select AC or DC coupling, adjust the DC balance and select mV/div from 1 to 200 mV (10 mV to 2 V with attenuator head) in standard 1, 2, 5 steps.

A slip-on 10X attenuator is also included which increases the maximum input voltage from ±25 V to ±250 V and the common mode dynamic range from ±5 V to ±50 V.



P6046 Amplifier with Power Supply.

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 eight 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 – Typically 450 mV or less (tangentially measured).

Maximum Non-Destructive 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 the 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

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P6046
1X, 6 ft. FET Differential Probe with Amplifier and Power Supply.

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); Dual Attenuator Head (010-0419-01); Swivel Probe Tip; Spring Ground Contact; Connector Test Point Jack; Instruction Manual (070-7129-02).

Opt. A6 – Japan, 100 V, 50 Hz.
Power Supply with Amplifier – Order 015-0106-00.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

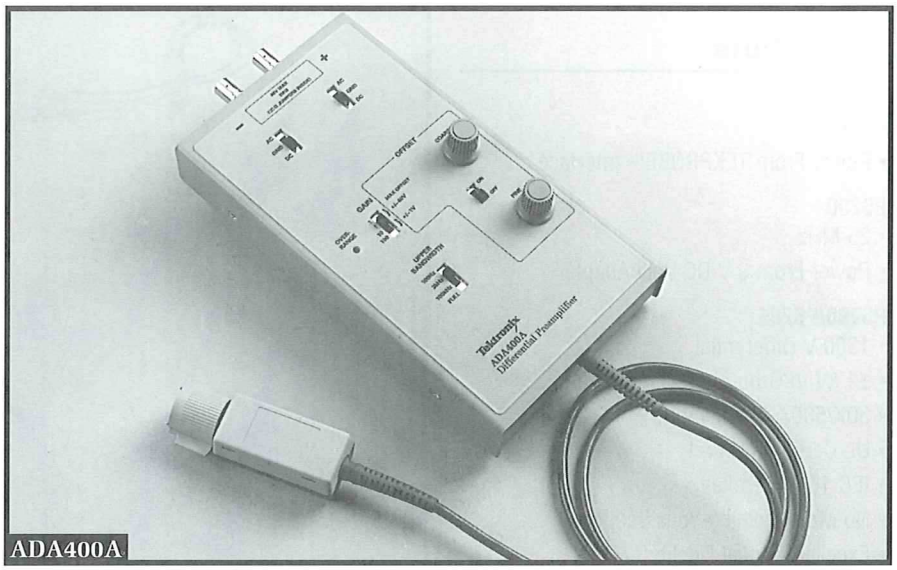
Differential Preamplifier
ADA400A

Features

ADA400A
- Active Differential Preamplifier
- 10 µV/div Sensitivity
- Typically 100 dB CMRR DC to 10 kHz
- Integral Probe Power with TEKPROBE™ BNC

Applications

- Biomedical Research
- Medical Equipment
- Mechanical Analysis
- Audio Design



ADA400A

ADA400A

The ADA400A Differential Preamplifier allows direct oscilloscope measurements of very low amplitude voltages and signals which are not ground referenced. The high impedance of both inputs eliminates the need to add additional ground points in the DUT, thereby avoiding circulating currents which disturb the measurement or the circuit.

The high gain and extremely high common mode rejection provide usable measurements of voltages as low as 5 µV, even in high noise environments. Selectable bandwidth limiting reduces normal mode noise from digital logic, switch mode power supplies, and line frequency sources. Adjustable differential offset allows the user to null out transducer bridge bias and galvanic potential from the test setup. An "infinite impedance" mode can be selected in the two highest gain ranges allowing accurate measurements of signals with high source impedance. Special circuitry greatly reduces annoying DC drift common in older differential preamplifiers.

The ADA400A is powered directly from TDS 400A, TDS 500A, TDS 600A, and TDS 700A Series oscilloscopes. It can also be used with other oscilloscopes when powered by a 1103 Probe Power Supply.

Characteristics

Gain – X100, X10, X1, X01.

CMRR – ≥100,000:1 DC - 10 kHz.

Gain	CM Range	Differential Range*1	MAX Offset
100	±10 V	0.1 V	±1.0 V
10	±10 V	1 V	±1.0 V
1	±40 V	10 V	±40 V
0.1	±40 V	80 V	±40 V

*1 *For higher voltages, attenuating probes may be used, but CMRR performance will be degraded.*

Bandwidth Limits – 100Hz, 3 kHz, 100 kHz, Full (≥1 MHz).

Input Impedance – 1 MΩ || ~ 50 pF (∞Ω Selectable in 100X and 10X gains).

Noise – Typically ≤30 µV RMS @ X100 Gain (Referred to Input).

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ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

ADA400A
Differential Preamplifier.
Includes: 070-9164-00 Instruction Manual, 159-0024-00 Spare Input Fuses (2).

RECOMMENDED ACCESSORIES
P6101B 1X Passive Probe (2 recommended).
P6135A 10X Passive Probe Pair.

Differential Probes

P5200 • New P5205

Features

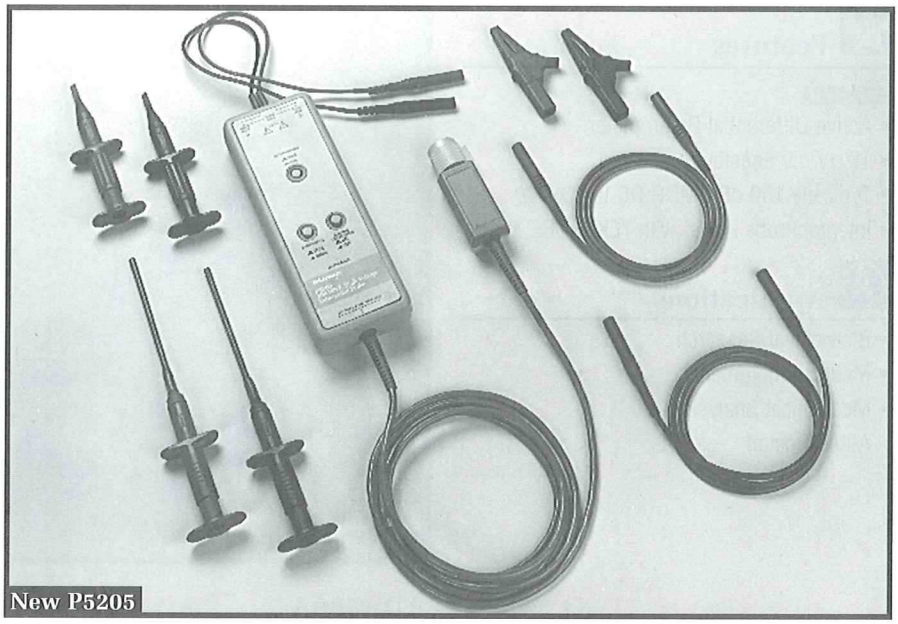
P5205
- 100 MHz
- Power From TEKPROBE™ Interface

P5200
- 25 MHz
- Power From 9 V DC Wall Adapter

P5200/P5205
- 1300 V Differential
- ±1 kV to Ground (Each Channel)
- 50X/500X Attenuation
- UL Certified 3111-1
- IEC 1010 Certified
- No More Floating Your Scope
- Excellent Signal Fidelity
- Easy Connection to ICs and Bus Bars
- Safe for User and DUT

Applications

- Floating Measurements
- Switching Power Supply Design
- TV/VCR Service and Repair
- Motor Drive Design


New P5205

New P5205 Differential Probe

The P5205 enables users to safely make measurements of floating circuits with their oscilloscopes grounded. The P5205 Active Differential Probe converts floating signals that can be displayed safely and easily on any ground referenced oscilloscope that has the TEKPROBE™ interface.

The P5205 safely measures up to 1,300 V differential and is ideally suited for measuring the fast dV/dt in switching power devices, such as IGBTs, power MOSFETs, thyristors, GTOs and bipolar transistors. The fast speed and excellent CMRR enable the user to clearly and accurately measure the high speed transitions of the switching waveform.

The P5205 is simple to use and protects the user from shorting any circuits or test equipment to ground. A true differential amplifier, both input leads are high impedance and have low parasitic capacitance to ground, eliminating the possibility of damaging the device under test. This is well-suited for education and service/repair when circuit diagrams may not always be available and there is a danger of connecting the oscilloscope ground to high voltage test points.

The P5205 has an overrange indicator that prompts the user to change ranges when the probe is operating outside the intended voltage range and the displayed signal may be misleading.

The P5205 comes with 30 cm (12 in.) input probe leads terminated by 4 mm shrouded banana plugs for easy connection to a variety of test points. The standard crocodile clip allows easy connection to bus bars and large bolts, while the long insulated plunger clamp allows the user to safely probe IC legs and discrete control components in dense circuit boards.

The P5205 operates from the TEKPROBE™ interface found on most Tektronix TDS oscilloscopes or from the 1103 if the interface is not available.

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Differential Probes

P5200 • New P5205

P5200 Differential Probe

The P5200 enables users to safely make measurements of floating circuits with their oscilloscopes grounded. The P5200 Active Differential Probe converts floating signals to low voltage ground referenced signals that can be displayed safely and easily on any ground referenced oscilloscope.

The P5200 safely measures up to 1,300 V differential and is ideally suited for measuring the fast dV/dt in switching power devices, such as IGBTs, power MOSFETs, thyristors, GTOs, and bipolar transistors. The fast speed and excellent CMRR enable the user to clearly and accurately measure the high speed transitions of the switching waveform.

The P5200 is simple to use and protects the user from shorting any circuits or test equipment to ground. A true differential amplifier, both input leads are high impedance and have low parasitic capacitance to ground, eliminating the possibility of damaging the device under test. This is well-suited for education and service/repair when circuit diagrams may not always be available and there is a danger of connecting the oscilloscope ground to high voltage test points.

The P5200 has an overrange indicator that prompts the user to change ranges when the probe is operating outside the intended voltage range and the displayed signal may be misleading.



The P5200 comes with 45 cm (18 in.) input probe leads terminated by 4 mm shrouded banana plugs for easy connection to a variety of test points. The standard crocodile clip allows easy connection to bus bars and large bolts, while the long insulated plunger clamp allows the user to safely probe IC legs and discrete control components in dense circuit boards.

The P5200 operates from a 9 V DC wall adapter (included).

Characteristics

P5200

Maximum Floating Voltage – ±1,000 V.
Maximum Differential Voltage – 1,300 V.
Bandwidth – 25 MHz.
CMRR (1 MHz) – 50 dB.
Input R – 4 MΩ each input.
Input C – 9 pF each input.
Certification – UL 3111/IEC1010.
Power – AC Transformer.

P5205

Maximum Floating Voltage – ±1,000 V.
Maximum Differential Voltage – 1,300 V.
Bandwidth – 100 MHz.
CMRR (1 MHz) – 50 dB.
Input R – 4 MΩ each input.
Input C – 7 pF each input.
Certification – UL 3111/IEC1010.
Power – TEKPROBE™ Interface.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P5200
Active Differential Probe.
Includes: 2 Crocodile Clips, 2 Plunger Clips, 9 V DC Power Supply, Manual (070-9018-00).

INTERNATIONAL POWER PLUG OPTIONS (P5200 ONLY)
Opt. A1 – Universal Euro 220 V, 50 Hz.
Opt. A2 – United Kingdom 240 V, 50 Hz.
Opt. A3 – Australian 240 V, 50 Hz.
Opt. A5 – Switzerland 220 V, 50 Hz.
Opt. A6 – Japan 100 V, 50 Hz.
See Customer Information Section for additional description.

ACCESSORY PACK
Order 020-2106-00
Includes: 2 7.5 in. plunger clamps; 2 each crocodile clips.

ACCESSORY PACK 5205 ONLY
Order 020-2140-00
Includes: 2 18 in. extender lead; 2 lead adapter; 2 plunger hook clip

P5205
Active Differential Probe.
Includes: 2 Plunger Clamps, 2 Crocodile Clips, 2 Plunger Clips, 2 Test Prods, Manual (070-9472-00).

SOFT CASE (P5205)
Order 016-1461-00

OPTIONAL ACCESSORY (P5205)
1103 TEKPROBE™ Power Supply for use with non-TEKPROBE™ Oscilloscopes.

[1] Contact your local Tektronix representative.

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Differential Probes

P6135A

Features

P6135A

- Attenuation Adjustable to 10X
- 10,000: 1 CMRR on 11A33 Differential Comparator; 20,000: 1 on 7A13 Differential Amplifier
- ±500 V Maximum Common Mode Voltage
- Matched Pair

Applications

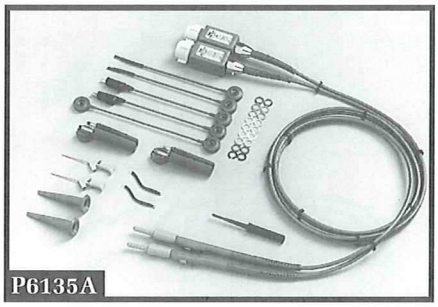
- Power Supplies
- Disk Drives
- Electronic Ballast
- Intelligent Motion
- Adjustable Speed Drives

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P6135A Differential Probe Pair

The P6135A 10X Differential Probe Pair is specifically designed to obtain the maximum in performance from a Tektronix differential measurement system. With differential amplifiers the P6135A provides CMRR ratios up to 20,000:1. Since a single 10X probe with accuracy of 1% or less gives a scope-to-probe CMRR of no better than 50:1, the P6135A is essential to obtain accurate results from your differential amplifier. Three pairs of carefully matched, precision-engineered hybrid tips enable the P6135A to be specifically matched with all Tektronix 11000, 7000 and 5000 Series differential amplifiers and comparators. It also provides excellent performance when used with plug-in amplifiers or oscilloscopes having input impedances of 1 MΩ/13-15 pF, 1 MΩ/18-22 pF and 1 MΩ/45-49 pF.

DIFFERENTIAL PROBE PAIRS

The P6135A differential probe pair is very carefully matched to minimize differences in capacitance and resistance (to minimize differences in impedance) and length (to minimize signal delay differences). Additionally, the attenuation adjusts to compensate for any remaining differences in the probes as well as differences in the attenuation of the plug-in or scope amplifier.

DIFFERENTIAL AMPLIFIERS/COMPARATORS AND THE P6135A

For high frequency applications, the P6135A with the 11A33 Differential Comparator provides a maximum bandwidth of 150 MHz and a minimum CMRR of 10,000:1 up to 1 kHz, decreasing to 100:1 at 20 MHz. For high CMRR measurements, the 7A13 Differential Amplifier and P6135A have a CMRR of 20,000:1 up to 1 kHz, decreasing to 100:1 at 20 MHz and a maximum bandwidth of 90 MHz. Combined with the ADA 400A, a differential signal can be displayed on a single channel of a TDS Series oscilloscope.

Characteristics

CMRR – On 11A33: 10,000:1 from DC to 1 kHz, derating to 100:1 at 20 MHz. On 7000 Series: 20,000:1 from DC to 1 kHz derating to 100:1 at 20 MHz.

Attenuation – Adjustable to 10X.

Input Resistance – 1 MΩ.

Input Capitance – 10.5 pF on instrument with 15 pF input capitance; 11.0 pF when used with instrument that has 20 pF input capitance; 13.7 pF when used with instrument that has 47 pF input capitance.

Maximum Useful Bandwidth – On 11A33: DC to 150 MHz; On 7A13: DC >90 MHz.

Typical Probe Rise Time – On 11A33: <2.33 ns; On 7A13: <3.89 ns.

Maximum Common Mode Voltage – 500 V (DC + pk AC) from DC to 1.3 MHz, derated to 50 V (DC + pk AC) at 100 MHz.

For more information about the P6135A and differential measurements, request Data Sheet 63W-8103.

Safety – UL Listed 1244.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P6135A
Pair of 10X, 150 MHz Differential Probes.
Includes: Adjustment Tool (003-1433-00); Two Retractable Hook Tips (013-0107-07); 6 in. Dual-ring Ground Lead (196-3295-00); Accessory Pouch (016-0708-00); Two 6 in. Ground Leads (196-3113-02); Two 6 in. Ground Leads with Alligator Clips (196-3305-00); Two SMT KlipChip™ (206-0364-00); Two Low Inductance GND Collars (343-1003-01); Two Probe Tip Holders (352-0670-00); 2 in. Ground Leads (195-4240-00); Cable Marker Rings; Instruction Manual (070-7675-00).

RECOMMENDED ACCESSORIES
Also see page 480.

Voltage Isolators

A6905S • A6906S • A6907 • A6909

Features

A6907
- Monolithic
- 4 Channels
- GPIB
- Mid Range Performance

A6909
- Monolithic
- 2 Channel
- GPIB Optional
- Mid Range Performance

A6905S
- Fiber Optic Separation up to 100 m
- Single Channel
- Battery Powered Transmitter

A6906S
- Fiber Optic Separation up to 200 m
- Single Channel
- GPIB
- Battery Powered Transmitter
- High Performance



Voltage Isolator Family A6905S, A6906S, A6907, A6909

Voltage Isolators

Tektronix offers the most complete line of isolation products to satisfy your high performance floating measurement requirements. The isolation product family includes four isolation instruments which provide a wide range of accurate and safe solutions to your measurement problems.

As discussed in the Floating Measurements overview, we define floating measurements as measurements in which neither reference point is ground. We provide four isolators for making floating measurements – one of which will be the most appropriate to your specific situation. All the isolators are third party safety certified.

MONOLITHIC VOLTAGE ISOLATORS

Monolithic voltage isolators provide multiple channels in a convenient portable package. These units are designed to be used next to the measurement instrument where physical separation is not a requirement. Because multiple channels are contained within a single unit, the cost per channel is lower and the circuit/instrument connections are simplified. Our monolithic four and two channel voltage isolators, the A6907/A6909, are an economical solution for isolation of power devices with switching speeds consistent with their dV/dt and slew rate characteristics.

ISOLATION SYSTEMS

The A6905S and A6906S Fiber Optic Isolation Systems not only provide exceptional isolation performance but the flexibility of physical separation as well. These systems consist of a specially designed floating probe connected to a battery powered transmitter unit. The transmitter converts the electrical signal to light which is transmitted via a fiber optic cable to the receiver unit. The receiver unit converts the light back to an electrical signal which is input into the measurement instrument via a 50 Ω BNC cable. The fiber optic cable not only provides total isolation, but has the advantages of EMI immunity, light weight and flexibility which has made it the standard for state of the art signal transmission.

ISOLATOR CHARACTERISTICS SUMMARY

	A6907	A6909	A6905S	A6906S
Bandwidth (–3 dB)	60 MHz	60 MHz	15 MHz	100 MHz
Maximum Voltage	±850 V	±850 V	±850 V	±850 V
Common to GND Slew Rate	20,000 V/µs	20,000 V/µs	10,000 V/µs	100,000 V/µs
Separation Distance	1.5 m	1.5 m	3 m, 15 m, 50 m, 100 m	3 m, 10 m, 20 m, 100 m, 200 m
CMRR*1 @ 60 Hz	105 dB	105 dB	100 dB	120 dB
@ 1 MHz	60 dB	60 dB	50 dB	60 dB
@ 10 MHz	50 dB	50 dB	30 dB	40 dB
Channels	4 (Monolithic)	2 (Monolithic)	1	1
Isolation Method	Optical/transformer	Optical/transformer	Fiber optic	Fiber optic
GPIB	IEEE 488.1	Option 10 (488.1)	N/A	IEEE 488.1
Recommended Environment	Ambient	Ambient	Controlled	Ambient
Battery Operating Time	N/A	N/A	10 hours	12 hours

*1 *With Probe.*

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Isolation Systems

A6907 • A6909

Features

A6907

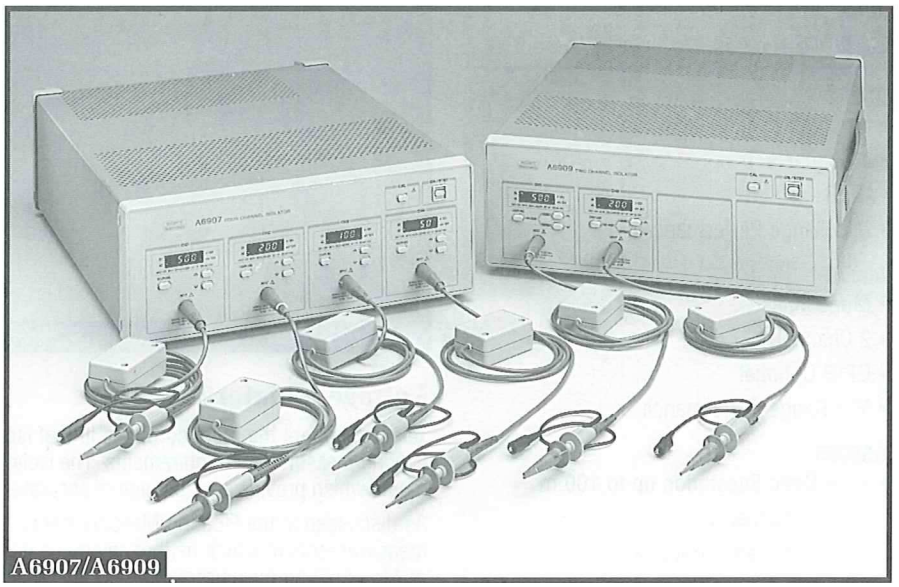
- For Floating Signals to ±850 V
- 60 MHz
- Monolithic
- 4 Channels
- CMRR: 60dB @ 1 MHz
- GPIB

A6909

- For Floating Signals to ±850 V
- 60 MHz
- Monolithic
- 2 Channels
- CMRR: 60dB @ 1 MHz
- GPIB Optional

Applications

- Motor Drives
- Power Supplies
- Electronic Ballast
- UPS Systems
- Switch Mode Control
- Power Semiconductors



A6907/A6909

A6907/A6909 Voltage Isolators

The A6907/A6909 monolithic voltage isolators are essential tools for power conversion design. Accurate floating measurements are required to design and verify high-performance switch mode circuits. The A6907 and A6909 offer safety, performance, multiple isolated channels (A6907-four/A6909-two), direct connection to the measurement instrument and simplified controls in a single box. The A6907/A6909 offer high performance and safety for the lowest cost per channel.

The A6907/A6909 Isolators feature a bandwidth of 60 MHz, slew rate of 20,000 V/µs and CMRR of 60 dB (1,000:1) at 1 MHz and GPIB control (standard on the A6907; available as Option 10 for the A6909) in a package the size of a Tektronix TDS Oscilloscope. The ±850 V probes plug directly into the isolator and are specifically designed for safe connection to floating circuits and enhanced CMRR.

These microprocessor controlled instruments feature push button self-calibration of offset and gain for increased accuracy and a very high degree of isolation between individual channels. Each channel can be individually set for coupling and attenuation.

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Isolation Systems

A6907 • A6909

Characteristics

ELECTRICAL

Attenuation Settings – 2,000X to 1X (100 mV/div to 200 V/div with oscilloscope set to 100 mV/div) in 1-2-5 steps.

Full Range Measurements – ±2 mV to ±850 V.

Frequency Response Bandwidth – 60 MHz (–3 dB).

Transient Response – Rise Time: <7.0 ns 100 mV/div and 200 mV/div. <5.8 ns 500 mV/div to 200 V/div.

Maximum Working Voltage – 600 V RMS, 850 V (DC + peak AC).

Input Impedance –
Resistance: 10 MΩ.
Capacitance: 4.5 pF, ±0.5 pF.

Output Impedance – 50 Ω.

Output Drive – ±500 mV into 50 Ω load.

Maximum Common to Ground Slew Rate – 20,000 V/µs.

Offset Accuracy – ±20 mV.

Delay – ≈30 ns with 1.5 m probe cable.

CMRR –
60 Hz: >105 dB (100 mV/div), >100 dB (1 V/div).
1 MHz: >60 dB (100 mV/div), >45 dB (1 V/div).
10 MHz: >50 dB (100 mV/div), >40 dB (1 V/div).

POWER REQUIREMENTS

Line Voltage Ranges – 90-250 V AC.

Line Frequency Range – 47-66 Hz.

Maximum Power Consumption – A6907: 48 W. A6909: 28 W.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

A6907
60 MHz Monolithic 4-CH Isolator (850 V Maximum).
Includes: Four 850 V Floating Probes (010-0576-00); 43 in. 50 Ω Cable Set (4) (012-1452-00); A6907/A6909 User Operator Instruction Manual (070-9094-00).

A6909
60 MHz Monolithic 2-CH Isolator (850 V Maximum).
Includes: Two 850 V Floating Probes (010-0576-00); 43 in. 50 Ω Cable Set (2) (012-0057-01); A6907/A6909 User Operator Instruction Manual (070-9094-00).

Opt. 10 – Add GPIB.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – United Kingdom 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.

See Customer Information Section for additional description.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

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Isolation Systems

A6906S • A6905S

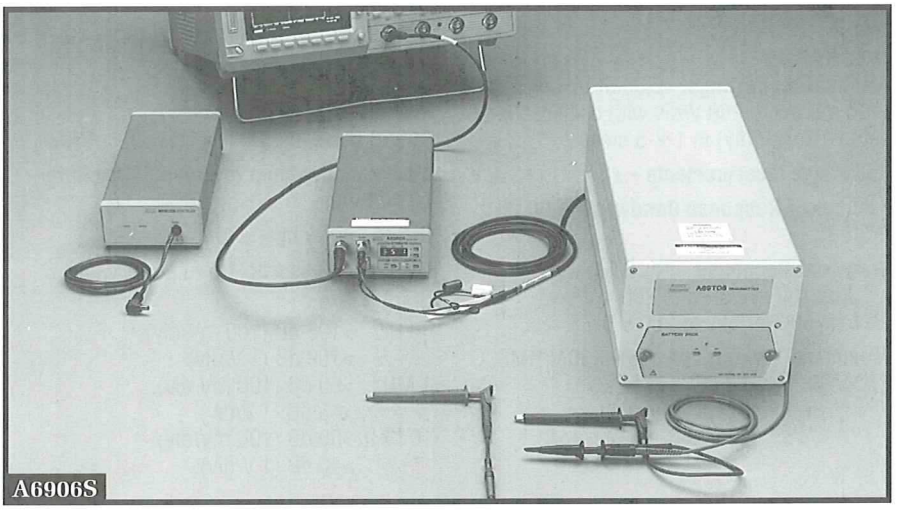
Features

A6906S

- 850 V of Isolation
- DC to 100 MHz
- CMRR: 40 dB @ 10 MHz
- Up to 200m of Probe-to-scope Fiber Optic Separation
- Selectable 20X to 5000X Attenuation
- GPIB Controllable
- 50 Ω and 75 Ω Output

A6905S

- 850 V of Isolation
- DC to 15 MHz
- Up to 100m of Probe-to-scope Fiber Optic Separation
- Selectable 10X, 100X, or 1000X Attenuation
- CMRR: 50 dB @ 1 MHz



A6906S

The A6906S is the highest performance Isolation System available. This is what you need to make floating measurements on state-of-the-art power control devices such as IGBTs used on fast motor drives and switching power supplies. The bandwidth is 100 MHz and an extraordinary 200 meters of fiber optic cable is available. All system parameters, including attenuation, can be controlled via a General Purpose Interface Bus. System CMRR with the probe is 60 dB (1,000:1) out to 1 MHz and 40 dB (100:1) at 10 MHz. This premium product will exceed your expectations for quality, performance and reliability.

The A6906S consists of a floating probe, battery powered transmitter unit, connecting fiber optic cable, receiver unit, and battery charger.

Order A6906S Fiber Optic Isolation System Data Sheet 51W-9086-0 for more information.

Characteristics

ELECTRICAL

Attenuation Settings – 5,000X to 20X in 1-2-5 steps.

Full Range Measurements – ±25 mV to ±850 V.

Frequency Response Bandwidth – 100 MHz (–3 dB).

Transient Response – Rise Time <3.5 ns.

Maximum Working Voltage – 600 V RMS, 850 V (DC + peak AC).

Input Impedance – Resistance: 10 MΩ ±2%. Capacitance: 2.9 pF.

Output Impedance – 50 Ω and 75 Ω ±5% at DC.

Output Drive – ±1V into 50 Ω load.

Max Common to Ground Slew Rate – 100 kV/µs.

Zero Drift with Temperature – 40 mV (10 to 40°C). 80 mV (0 to 50°C).

Delay – ≈ 50 ns for 3 meter fiber optic cable. Add ≈ 5 ns per meter for longer cables.

Common Mode Rejection Ratio –
60 Hz: >120 dB.
1 MHz: >60 dB.
10 MHz: >40 dB.

POWER REQUIREMENTS

Line Voltage Ranges – 90-250 V AC.

Line Frequency Range – 47-66 Hz.

Maximum Power Consumption – 10 W.

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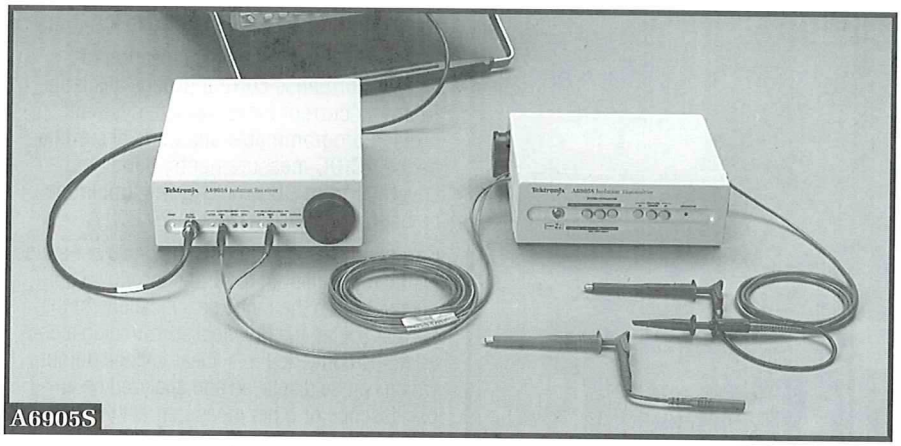
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Isolation Systems

A6906S • A6905S



A6905S

The A6905S is the mid-line power measurements work horse where physical separation is desired. It is especially appropriate for making floating measurements on mid-range switching power control devices such as motor drives, electronic ballasts and power supplies.

This single channel system is rated for up to 850 V of isolation capability, with a 15 MHz bandwidth and 10X, 100X and 1,000X attenuation settings. The three meter fiber optic cable is standard. 15 m, 50 m and 100 m lengths are also available, providing the capability to make high impedance measurements at extended distances from the signal connection point with no signal loss. The A6905S can handle signals characterized by common to ground slew rates of ≤10,000 V/µs.

The A6905S consists of a floating probe, a battery powered transmitter unit, connecting fiber optic cable and receiver unit which also serves as a battery charger. Two batteries are included so one can be charging while the other is powering the transmitter.

For more information on the A6905S order A6905S Fiber Optic Isolation System Data Sheet 51W-8987-0.

For information about using the A6905S with a TDS oscilloscope and AM 503S Current Measurement System, order Simplifying Power Measurements with TDS Oscilloscopes, Application Note 3GW-1091-0.

Characteristics

ELECTRICAL

Attenuation Settings – 10X, 100X, 1000X.

Full Range Measurements – ±10 V, ±100 V, ±850 V.

Frequency Response Bandwidth – 15 MHz (–3 dB).

Transient Response – Rise time <25 ns.

Maximum Working Voltage – 600 V RMS, 850 V (DC + peak AC).

Input Impedance at Probe Tip – Resistance: 10 MΩ ±2%. Capacitance: 2.9 pF.

Output Impedance – 50 Ω ±3%.

Output Drive – ±1V into 50 Ω load; ±2 V into 1 MΩ load.

Max Common to Ground Slew Rate – ≤10 kV/µS.

Tangential Noise – ≤1.5 mV.

DC Drift with Temperature – <2.5 mV/°C @ receiver output.

Delay – ≈ 80 ns for 3 meter Fiber Optic Cable. Add ≈ 5 ns per meter for longer cables.

Common Mode Rejection Ratio –

DC to 10 kHz:	> 100 dB.
10 kHz to 100 kHz:	> 90 dB.
100 kHz to 1 MHz:	> 50 dB.
1 MHz to 10 MHz:	> 30 dB.

POWER REQUIREMENTS

Line Voltage Ranges – 100 - 132 V, 200 - 242 V.

Line Frequency Range – 45 - 65 Hz.

Maximum Power Consumption – 15 W.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

A6906S
100 MHz Fiber Optic Isolation System (850 V Max).
Includes: One 850 V Floating Probe (010-0568-00); Industrial Lead Set (012-1392-00); 50 Ω Terminator (011-0049-01); 43 in. 50 Ω Cable (012-0057-01); Optical Fiber Cleaner (016-1218-00);1 Rechargeable Battery Pack (650-3022-00); A6906S User Operator Instruction Manual (070-8900-00).

Opt. 01 – Substitute 20 Meter Fiber Optic Cable.

Opt. 02 – Substitute 100 Meter Fiber Optic Cable.

Opt. 03 – Substitute 200 Meter Fiber Optic Cable.

Opt. 04 – Substitute 10 Meter Fiber Optic Cable.

GPIB Cable – Order 012-0991-00.

75 Ω BNC Cable – Order 012-0074-00.

75 Ω Termination – Order 011-0055-01.

Index Matching Oil – Order 252-0408-00.

Optical Fiber Cleaner Set – Order 016-1208-00.

A6905S
15 MHz Fiber Optic Isolation System (850 V Max).
Includes: One 850 V Floating Probe (010-0565-00), Industrial Lead Set (012-1392-00); 50 Ω Terminator (011-0049-01); 43 in. 50 Ω Cable (012-0057-01); 2 Rechargeable Battery Packs (118-9020-00); A6905S User Operator Instruction Manual (070-8773-00).

Opt. 01 – Substitute 15 M Fiber Optic Cable.

Opt. 02 – Substitute 100 M Fiber Optic Cable.

50 M Fiber Optic Cable – Order 174-3096-00.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – UK 240 V, 50 Hz.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection.

Opt. C5 – Adds five years of Calibration Services.

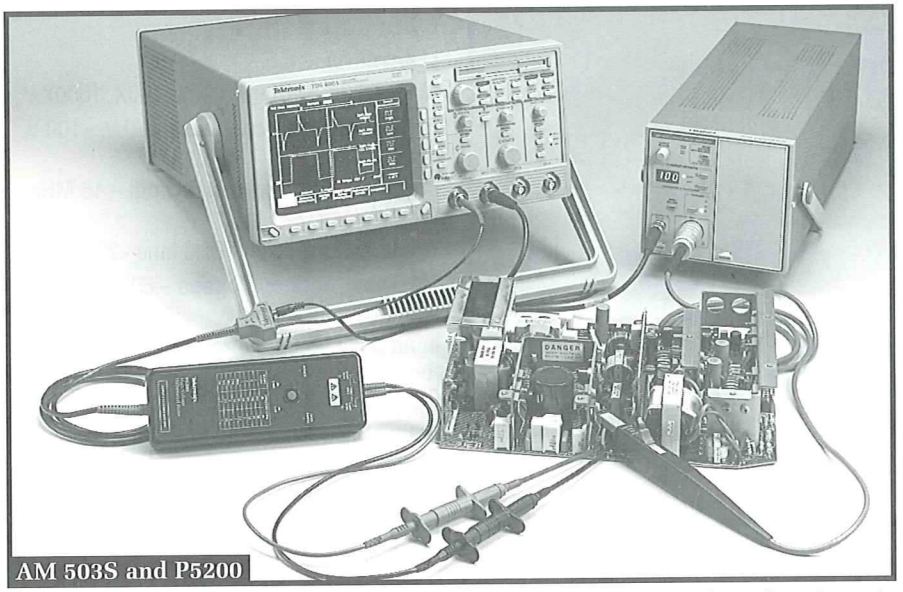
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Current Measurements



AM 503S current probe system with P5200 high voltage differential probe with TDS 460A.

Current Measurements

Tektronix offers the widest selection of high performance current probes available. Tektronix current measurement systems provide programmable and manual simultaneous AC/DC measurements, bandwidth coverage from DC to 1 GHz and amplitude measurements from mAs to 20,000 A.

Current probes measure the flux field generated by the movement of electrons through a conductor. Within the range specifications of the current probe, the flux field surrounding a conductor is converted to a linear voltage output which can be displayed and analyzed on an oscilloscope or other measurement instrument.

Tektronix provides current probes for AC only and AC/DC current measurements. The AC only probes are available in solid and split core configurations.

CURRENT PROBE SELECTION GUIDE

Type AM 503B or AM 5030 Amplifiers with:	Bandwidth Hz to MHz	Peak Pulse	Max AC p-p	Derate Below	Derate Above	Max DC	Amp*S Product	Current/Div Display Range	Rise Time	Insertion Impedance @ 1 MHz	Max Barewire Voltage	Max Conductor Diameter	Cable Length
A6302	DC to 50	50 A	40 A	N/A	20 kHz	20 A	$100x10^{-6}$	1 mA to 5 A*1	≤7.0 ns	0.1 Ω	500 V	0.15 in.	2 m
A6302 w/ CT-4	0.5 to 20	20 kA*2	2 kA*3	50 Hz	1.2 kHz	20 A	0.1	20 mA to 5 kA*1	≤17.5 ns	30 mΩ	3 kV	1.5 in.	2 m
A6302XL	DC to 17	50 A	40 A	N/A	20 kHz	20 A	$100x10^{-6}$	1 mA to 5 A*1	≤20 ns	0.1 Ω	500 V	0.15 in.	8 m
A6302XL w/ CT-4	0.5 to 13	20 kA*2	2 kA*3	50 Hz	1.2 kHz	20 A	0.1	20 mA to 5 kA*1	≤20 ns	30 mΩ	3 kV	1.5 in.	8 m
A6303	DC to 15	500 A	200 A	N/A	20 kHz	100 A	$10,000x10^{-6}$	5 mA to 50 A*1	≤23 ns	0.02 Ω	700 V	0.83 in.	2 m
A6303XL	DC to 10	500 A	200 A	N/A	1.8 kHz	100 A	$10,000x10^{-6}$	5 mA to 50 A*1	≤35 ns	500 MΩ	700 V	0.83 in.	8 m
A6304XL	DC to 2	700 A	700 A	N/A	1.8 kHz	500 A	0.4	500 mA to 200 A*1	≤175 ns	500 MΩ	700 V	0.83 in.	8 m

	Bandwidth Hz to MHz	Peak Pulse	Max AC p-p	Derate Below	Derate Above	Max DC	Amp*S Product	Current/Div Display Range	Rise Time	Insertion Impedance @ 1 MHz	Max Barewire Voltage	Max Conductor Diameter	Cable Length
P6021	120 to 60	250 A	15 A	300 Hz	5 MHz	0.5 A	$500x10^{-6}$	20 mA or 100 mA*1	≤5.8 ns	0.03 Ω	600 V	0.15 in.	2.75 m/1.5 m
P6021 w/ CT-4	120 to 20	20 kA*2	2 kA*3	300 Hz	1.2 MHz	20 A	0.5	400 mA or 100 A*1	≤17.5 ns	30 MΩ	3 kV	1.5 in.	2.75 m/1.5 m
P6022	935 to 120	100 A	6 A	3 kHz	10 MHz	0.2 A	$9x10^{-6}$	10 mA or 100 mA*1	≤2.2 ns	0.03 Ω	600 V	0.10 in.	2.75 m
CT-1	25K to 1000	12 A	1.4 A	–		0.3 A	$1x10^{-6}$	2 mA*1 (5 mV/mA)	≤0.35 ns	1 Ω	1000 V	0.070 in.	1.07 m
CT-2	1.2K to 200	36 A	7 A	–		0.3 A	$50x10^{-6}$	10 mA*1 (1mV/mA)	≤0.5 ns	0.04 Ω	1000 V	0.052 in.	1.07 m

*1 *Scope set at 10 mV/Div.*

*2 *Based on voltage breakdown.*

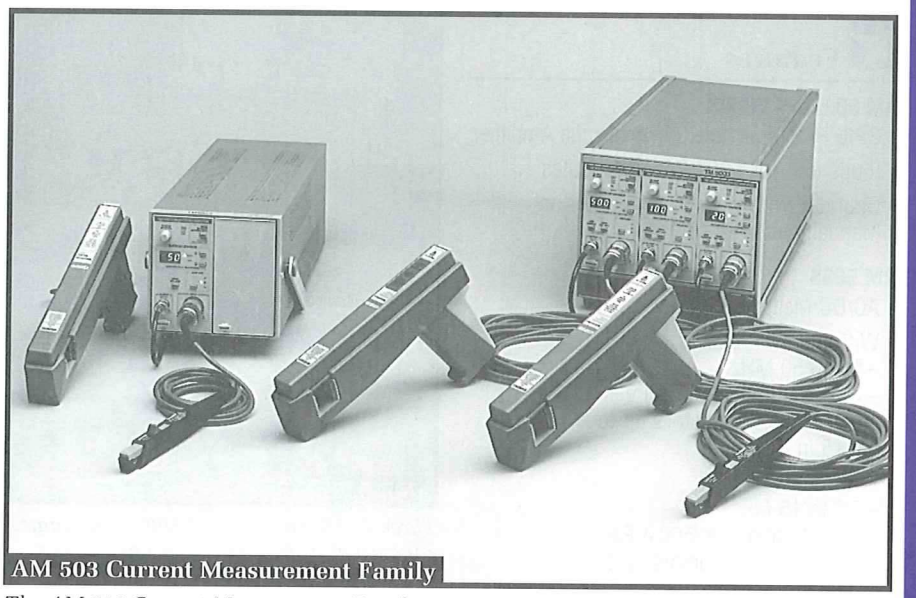
*3 *Based on thermal heating limits in CT-4.*

Current Measurements

AC AND DC CURRENT MEASUREMENTS

AC currents induce voltage in a transformer resulting from the buildup and collapse of flux fields as the current changes direction. AC current probes are passive in that they do not require external power. A steady state DC current, however, will not induce a current in a transformer. By taking advantage of the Hall Effect, a current biased semiconductor device will produce a voltage output in response to a DC generated flux field. Consequently, a DC current probe is an active device in that it requires external power.

Each type of current sensing device will roll off, or produce a non-linear output at a certain point. A given AC probe will roll off at a certain maximum current amplitude and frequency, as well as at a minimum amplitude and low-end frequency. DC current probes will be linear from DC to a maximum frequency and will have a minimum and maximum sensitivity level as well. Since we often encounter signals which contain both AC and DC components, it is important to be able to measure both simultaneously with a single probe. In addition, signals which may look like AC, such as a square wave switching on and off, but never fall below zero amps, actually have a significant DC component and cannot be accurately captured with a transformer only AC probe. The unique Tektronix solution is to combine both a Hall Effect device and a transformer to provide broadband current measurement capabilities within one system.



The AM 503 Current Measurement Family: AM 503B and AM 5030 current probe amplifiers with A6303, A6302, A6304XL, A6303XL and A6302XL AC/DC-current probes.

SPLIT VERSUS SOLID CORE

To accurately measure the flux field, we need to completely surround the conductor with the probe core. Tektronix offers two mechanical probe configurations: split core and solid core. Split core probes offer convenience. Precisely engineered and manufactured, the split core probes can be clipped onto a conductor without having to break the connection.

Solid core current transformers (CT) offer small size and very high frequency response for measuring very fast, low amplitude current pulses and AC signals. They are designed to be permanently or semi-permanently installed and have cables which are easily connected and disconnected to the CT.

In this Current Probe section we will describe the features and characteristics of each of the Tektronix Current Probes, as well as mention some of the primary applications of each.

AMP*SECOND PRODUCT

As mentioned in the current probe introduction, transformer core materials saturate and become nonlinear when they are subjected to too much current. "Too much current" is a function of both the amplitude of the current and the time it is applied. The product of the *average amplitude* times the *pulse width* is called the amp*second product. Each probe has an amp*second product specification (see the Current Probe Selection Guide). If the signal does not exceed this specification, the voltage output will be linear and the measurement accurate.

A special feature of the AM 503S Current Probe Systems utilizes the phenomenon that opposing currents are subtractive. The AM 503S senses the current level in the conductor under test and feeds an equal but opposite current through the probe. This "bucking current" nulls out the current in the transformer and eliminates any core saturation. The bucking current limit is 20 A in the A6302XL, 100 A in the A6303XL and 500 A in the A6304XL. Up to these amplitudes you need not be concerned about the amp*second product.

Current Measurement Systems

AM 5030 • AM 5030S • AM 503S • AM 503B

Features

AM 5030/AM 5030S

- GPIB Programmable Current Probe Amplifier
- Plugs into TM 5000 Power Modules
- Operated with External Controller or Manually from Front Panel

AM 503S

- AC/DC Measurements
- With A6302 Probe:
  - DC to 50 MHz
  - 20 A Continuous/50 A Peak
  - Clips onto Conductors up to 0.15 in. Diameter
- With A6303 Probe:
  - DC to 15 MHz
  - 100 A Continuous/500 A Peak
  - Clips onto Conductors up to 0.83 in. Diameter
- With A6304XL Probe:
  - DC to 2 MHz
  - 500 A Continuous/700 A Peak
  - Clips onto Conductors up to 0.83 in. Diameter

AM 503B

- Manual Current Probe Amplifier
- Push Button Auto Balance/Degauss
- Bright LED Current/Division Display
- Microprocessor Controlled
- Eliminates Need to Calibrate Amplifier with Specific Probes
- Plugs into TM 500/5000 Power Modules

Applications

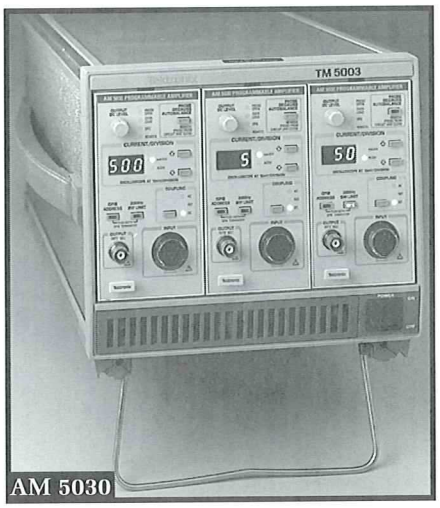
- Switching Power Supplies
- Disk Drives
- Electronic Ballasts
- Motor Drives
- Inverters
- All Mixed AC/DC Current Signals

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Three AM 5030's in a TM 5003 mainframe. All current measurement parameters can be set using a GPIB controller.

AM 503 Current Measurement Family

The AM 503 Current Measurement system family is the most sophisticated current measurement solution available. The split core probes incorporate both a transformer for AC and a Hall Effect device for DC measurements to provide broadband current measurements from DC to 50 MHz. The AM 5030 Programmable Current Probe Amplifier automates time consuming manual measurements via a GPIB command set. The industry standard AM 503S Current Probe System provides a complete current measurement system in a single package.

The XL Series of probes features eight-meter cables for convenient access to test points. The A6304XL enables measurements of 500 A at DC, 700 A Peak.

For more information about the AM 503 Current Measurement Family, order Data Sheet 51W-7955-2.

AM 5030 PROGRAMMABLE CURRENT PROBE AMPLIFIER

The AM 5030 Current Probe Amplifier with General Purpose Interface Bus (GPIB) adds programmability to the versatile AM 503B. The AM 5030 enables you to use automated techniques to make wide bandwidth AC/DC current measurements. The AM 5030 is a TM 5000 single-wide module that plugs into a 3-slot TM 5003 power module mainframe. While the non-programmable AM 503B will operate in either a TM 500 or TM 5000 power module mainframe, the AM 5030 works only in a TM 5000 mainframe. The AM 5030 uses A6302, A6303 and the XL Series of current probes and connects to any scope or analyzer via a BNC cable.

Like the AM 503B, the AM 5030 does not have to be calibrated with specific current probes. This is a tremendous operational improvement over the older AM 503. The AM 5030 and AM 503B also provide several improvements over the AM 503A, including a faster Degauss/self-calibration cycle and more responsive, reliable front-panel controls.

The AM 5030 uses the IEEE 488.1 bus standard. Using a simple command set, you can configure and confirm the settings of the amplifier or read the instrument's serial number. You can determine whether the current probe is open or closed, use bus commands to initiate a self-test or force a probe Degauss and DC balance operation. The AM 5030 bus address is set through the front panel and the address is retained when power is removed. The AM 5030 does not require an external controller to operate. It can be completely controlled using the front panel; however, when used with a controller, the front panel can be disabled to prevent manual operator adjustments.

For more information about the AM 5030, request the AM 5030 Programmable Current Probe Amplifier Data Sheet 51W-8941-0.

AM 5030S

The AM 5030S consists of an AM 5030 and a TM 5003. If you already own a power module, order only an AM 5030. If you need a power module, order an AM 5030S. Order the appropriate probes separately.

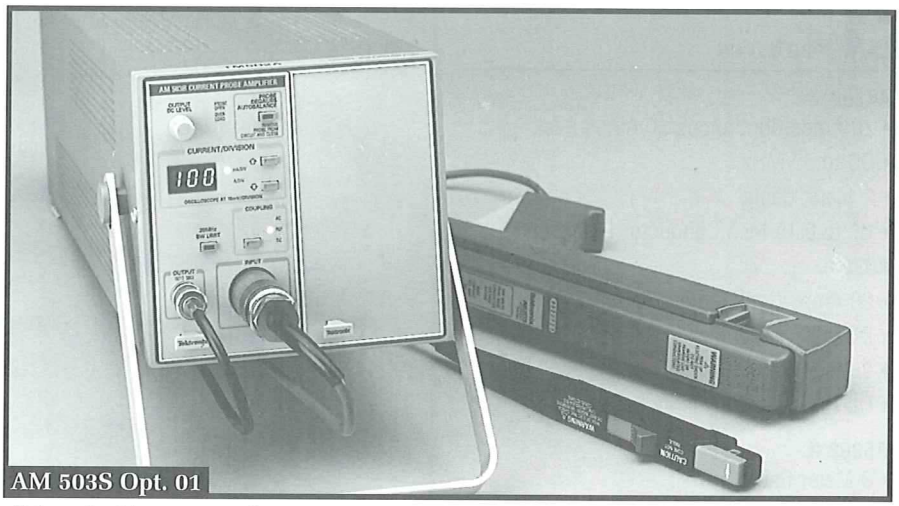
Current Measurement Systems

AM 5030 • AM 5030S • AM 503S • AM 503B

AM 503S CURRENT PROBE SYSTEM

The AM 503S Current Probe System is the most versatile current measurement system available. Since the probes incorporate both a transformer and a Hall Effect device, broadband AC/DC current can be measured simultaneously. Depending on the probe used, current from DC to 50 MHz and up to 700 A can be measured by clipping the split-core probes around the conductor. The AM 503S is truly a system, consisting of an AM 503B Current Probe Amplifier, a TM 502A two-wide Power Module, and an A6302 Current Probe. Options enable you to add or substitute an A6303 Current Probe or delete the A6302 Current Probe. If you require any of the XL current probes (longer length), then use Option 09 which deletes the A6302.

Order AM 503S Current Measurement System Data Sheet 51W-10226-0 for more information.



AM 503S Opt. 01

AM 503S with A6302 and A6303 probes.

AM 503B CURRENT PROBE AMPLIFIER

The AM 503B Current Probe Amplifier is the heart of the AM 503S System. The AM 503B amplifies and sums the voltage outputs from the transformer and Hall Effect device and outputs it to the measurement instrument. It also provides the Hall Effect Device bias voltage and a reverse "bucking" current which resists saturation of the A6302/A6303 Current Probe core.

The AM 503B Current Probe Amplifier replaces the AM 503A. All functions are microprocessor controlled, providing a significant improvement in ease of use and functionality. The AM 503B uses bright, easy-to-read LEDs to display current/Division settings which are controlled with up/down push buttons. A single push button provides both Degauss and auto-balance functions. An additional significant improvement with the AM 503B is that individual A6302/A6303 probes no longer need to be calibrated with a specific amplifier but can be interchanged between AM 503Bs and AM 5030s. The AM 503B and the AM 5030 both support the new XL Series of current probes. The AM 503 and the AM 503A do *not* support the XL Series.

The AM 503B operates in any TM 500/TM 5000 power module. The 50 Ω output of the AM 503B can be displayed on any oscilloscope or measurement instrument that has a sensitivity setting of 10 mV/Div. A 50 Ω output cable and termination is included with the AM 503B. The scope or measurement instrument requires at least a 200 MHz bandwidth to display the full bandwidth of the A6302 and 50 MHz for the A6303. You can select either AC only mode or a DC mode which allows you to display a combined AC/DC current signal.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

AM 5030
Programmable Current Probe Amplifier.
Includes: 50 Ω BNC Cable (012-0057-01); Instruction Manual (070-8766-02); Reference Card (070-8770-01).
The AM 5030 requires an A6302, A6303 or XL Series Current Probe and a TM 5003 or AM 5030S Power Module Mainframe.

AM 5030S
Programmable Current Probe Amplifier and Power Module.
Includes: AM 5030 Programmable Current Probe Amplifier and TM 5003 3-wide Power Module Mainframe. Order probes separately.

AM 503B
Current Probe Amplifier.
Includes: Same as AM 5030. The AM 503B requires one of the TM 500/5000 Series Power Modules, and an A6302, A6303 or XL Series Current Probe.

AM 503S
Current Probe System.
Includes: AM 503B Current Probe Amplifier; TM 502A Power Module; A6302 Current Probe; Instruction Manual (070-8766-02).

Opt. 01 – Adds A6303 Current Probe.

Opt. 03 – Substitutes A6303 Current Probe.

Opt. 09 – Deletes A6302 Current Probe.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – UK 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.

See Customer Information Section for additional description.

SERVICE ASSURANCE OPTIONS

Opt. R2 – Adds two years of post-warranty Repair Protection
AM 5030.
AM 5030S.
AM 503B.
AM 503S.

Opt. C5 – Adds five years of Calibration Services
AM 5030.
AM 5030S.
AM 503B.
AM 503S.

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Current Measurement Systems

A6302 • A6302XL • A6303 • A6303XL • A6304XL

Features

A6302
- 20 Amps Continuous/50 Amps Peak
- DC to 50 MHz
- 2 Meter Cable
- Up to 0.15 Inch Conductor Diameter

A6303
- 20 Amps Continuous/500 Amps Peak
- DC to 15 MHz
- 2 Meter Cable
- Up to 0.83 Inch Conductor Diameter

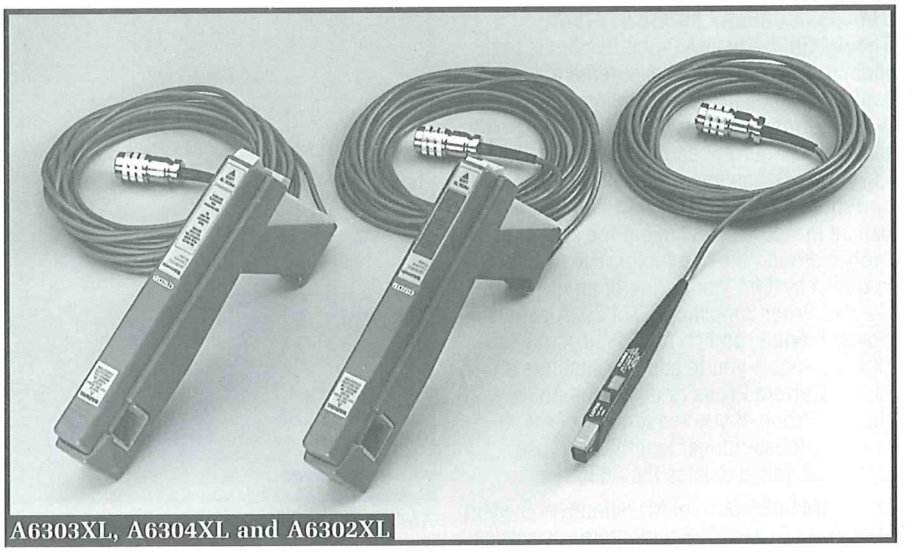
A6302XL
- 8 Meter Cable
- 20 Amps
- DC to 17 MHz

A6303XL
- 8 Meter Cable
- 100 Amps
- DC to 10 MHz

A6304XL
- 8 Meter Cable
- 500 Amps
- DC to 2 MHz

Applications

- Motor Drives
- Inverters
- Power Supplies
- Satellite Systems
- Transportation Systems
- Avionics



A6303XL, A6304XL and A6302XL

The eight-meter XL Series Current Probes.

AM 503 Family Current Probes

A total of five current probes is available for use with the AM 503B and AM 5030 Current Probe Amplifiers. Since all five probes are of the split-core mechanical design, they easily clip on and off of a conductor. All the probes provide simultaneous DC and AC current measurements with a wide range of current amplitude and bandwidth capabilities.

The AM 503 Current Probes convert the DC and AC flux field of a conductor to a voltage signal which is sent to an AM 503B or AM 5030 Amplifier. The probes include both a Hall Effect device, which senses the DC current, and a ferrite transformer which senses the AC current. The probes also utilize a bucking current from the Amplifier, which eliminates core saturation. The bucking current for the A6302XL is 20 A, 100 A for the A6303XL and 500 A for the A6304XL.

A6302 and A6303 Current Probes

The A6302 and A6303 offer a wide range of current measurement capability for the lab and bench environment. The A6302 covers frequencies from DC to 50 MHz. It clips onto conductors up to 3.81 mm (0.15 in.) and measures continuous currents up to 20 A and peak currents up to 50 A as long as they do not exceed the amp*second product of 100 A*µs. The larger A6303 measures higher amplitude, lower frequency currents. It clips onto conductors up to 21.1 mm (0.83 in.) in diameter. Its frequency range is DC to 15 MHz. It will measure continuous currents up to 100 A and peak currents up to 500 A, as long as the Amp*second product of 10,000 A*µs is not exceeded.

The A6302 and A6303 are also compatible with the 11A16 2-CH Current Probe Amplifier for the 11000 and DSA Series oscilloscopes. With the 11A16, the A6302 is rated for 10.5 A, and the A6303 for 52.5 A.

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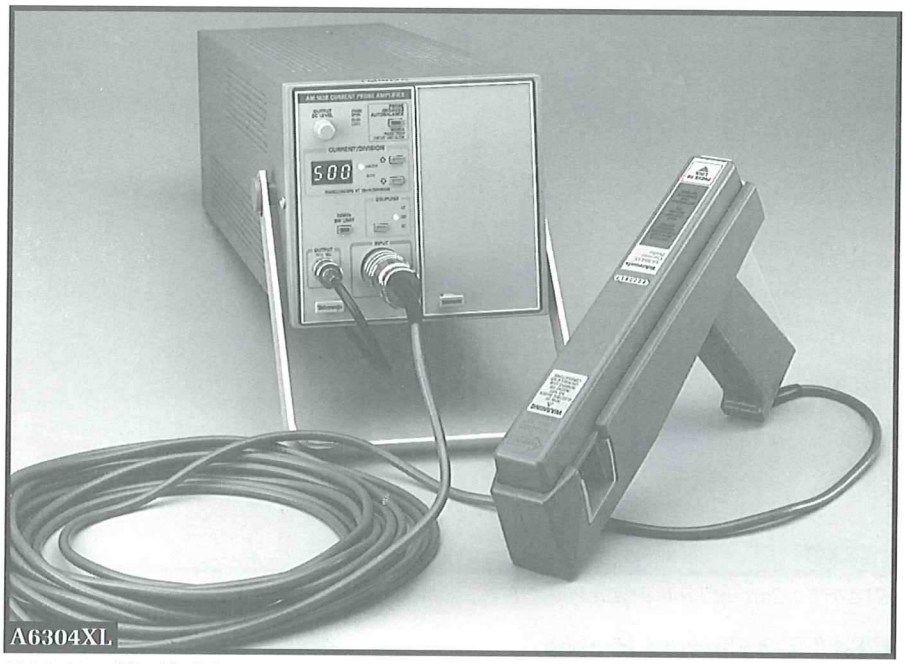
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Current Measurement Systems

A6302 • A6302XL • A6303 • A6303XL • A6304XL



500 A A6304XL with AM 503B in TM 502A Power Module.

XL Series Current Probes

The three XL current probes add both convenience and expanded current measurement capability. The XL probes are designed to operate with the AM 503B and AM 5030 Current Probe Amplifiers. They are incompatible with the older AM 503 and AM 503A amplifiers. The XL (for extra long) probes have eight-meter cables, which allow you to reach test points on large devices such as heavy duty motors or automobiles. In addition, connecting to test points on transportation platforms such as trains, ships, or aircraft is much easier with the XL probes.

The A6302XL and A6303XL are modified versions of the A6302 and A6303 probes. The A6302XL can measure 20 A continuous (50 A peak) signals from DC to 17 MHz. The A6303XL can measure 100 A continuous (500 A peak) signals from DC to 10 MHz.

The A6304XL is rated for 500 A continuous (700 A peak) and is the same size as the A6303XL. The A6304XL has a bandwidth of DC to 2 MHz and is especially well suited for measurements on high-performance inverters, motor drives, and other high current switch-mode control devices. The eight meter cable makes it very easy to access test points on devices physically separated from your measurement instrument.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

A6302
2 m, 20 A Current Probe.
Includes: 5 in. (130 mm) Ground Lead (175-0124-01); 3 in. (75 mm) Ground Lead (175-0263-01); 2 Miniature Alligator Clips (344-0046-00); A6302 and A6302/XL Instructions (070-3905-02).

A6303
2 m, 100 A Current Probe.
Includes: Carrying Case (202-0318-00); A6303 and A6303/XL Instructions (070-3906-02).

A6302/A6303 probes must be used with an AM 503, AM 503A, AM 503B or AM 5030 Current Probe Amplifier.

A6302XL
8 m, 20 A Current Probe.
Includes: Same as A6302 Current Probe.

A6303XL
8 m, 100 A Current Probe.
Includes: Same as A6303 Current Probe.

A6304XL
8 m, 500 A Current Probe.
Includes: Carrying Case (202-0318-00); A6304XL Instructions (070-8939-00).

Note: XL Probes work only with AM 503B or AM 5030 Current Probe Amplifiers.

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AC Current Probes

CT-1 • CT-2 • CT-4

Features

CT-1

- 25 kHz to 1 GHz
- 12 A Maximum Pulse Current
- 450 mA Maximum CW Current
- For 50 Ω Input
- AC Only
- Solid Core
- ESD Testing

CT-2

- 1.2 kHz to 200 MHz
- 36 A Maximum Pulse Current
- 2.5 A Maximum CW Current
- For 50 Ω Input
- AC Only
- Solid Core
- Disk Drive Read/Write Signals

CT-4

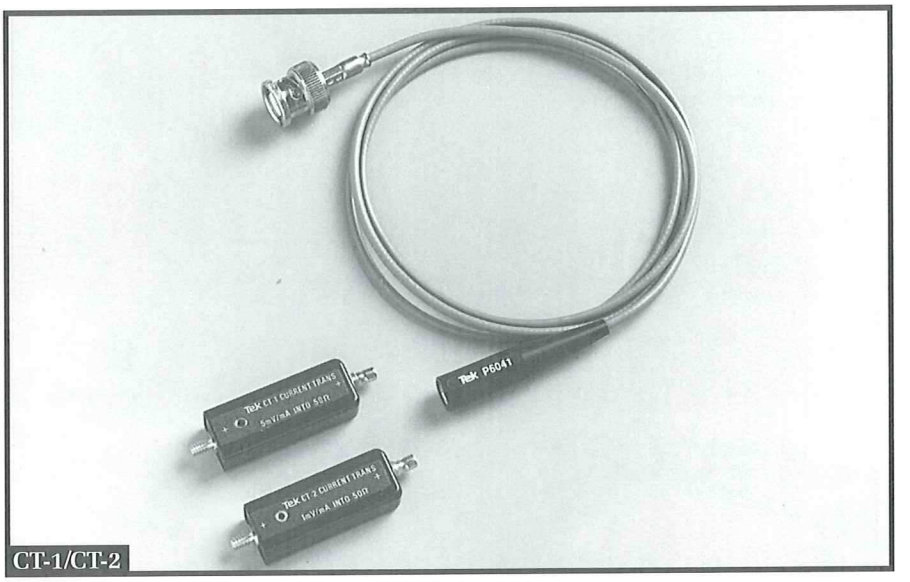
- Pulsed Currents to 20,000 A
- Continuous Currents up to 2000 A p-p
- Accepts 1.5 Inch Diameter Conductors
- Measurements on Bare Conductors to 3000 V
- AC
- Split Core
- Use with A6302/XL or P6021

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CT-1/CT-2 Current Probes with P6041 BNC Probe Cable.

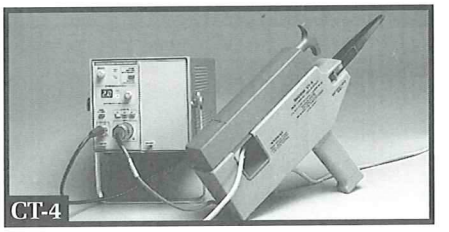
CT-1/CT-2 Current Probes

The CT-1 and CT-2 Current Probes are designed for permanent or semi-permanent in-circuit installation. Each probe consists of a current transformer and an interconnecting cable. The current transformers have a small hole through which a current carrying conductor is passed during circuit assembly.

The P6041 Probe Cable provides the connection between the CT-1 and CT-2 Current Transformers and a BNC oscilloscope input. A 50 Ω termination is required to terminate the cable when connected to a high impedance (1 MΩ) oscilloscope input. One probe cable can be used to monitor several current transformers that have been wired into a circuit.

CT-4 Current Probe

The CT-4 is a robust clip-on high current transformer that extends the measurement capability of the P6021 and A6302/XL clip-on current probes. Maximum low frequency performance down to 0.5 Hz is obtained using the AM 503S. Current amplitudes to 20,000 A may be measured using the A6302/XL or P6021 (with passive termination), provided the amp*second ratings are not exceeded.



AM 503S with CT-4 Current Transformer.

The CT-4 may be used with the P6021 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 in either 20:1 or 1000:1 step-down ratios.

The 1.5 inch square split-core 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 14 kV with the included high voltage bushing.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CT-1
Current Probe, Current Transformer and Probe Cable (42 in.).
Includes: Instruction Manual (070-7957-00).
Opt. 09 – Current Transformer only.

CT-2
Current Probe, Current Transformer and Probe Cable.
Includes: Instruction Manual (070-7957-00).
Opt. 09 – Current Transformer only.
P6041 – Probe Cable (42 in.) only.

CT-4
Current Probe, High Current.
Includes: Carrying Case (202-0318-00); 12 in. wide, 4 ft. long High Voltage Bushing (015-0194-00); Instruction Manual (070-6478-01).
DC Bucking Coil – (015-0190-00).

AC Current Probes

P6021 • P6022

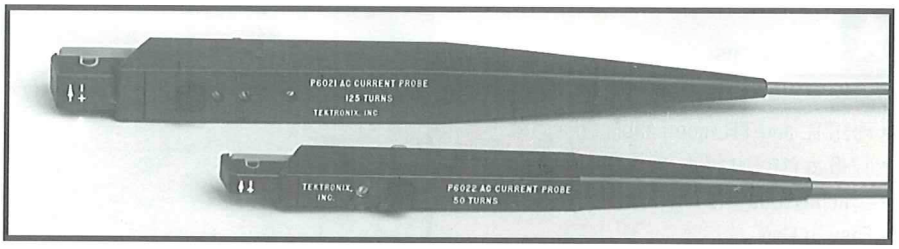
Features

P6021

- 120 Hz to 60 MHz
- 15 A Peak
- For 1 MΩ Inputs
- Shielded Probe Heads
- AC Only
- Split Core

P6022

- 935 Hz to 120 MHz
- 6 A Peak
- For 1 MΩ Inputs
- Shielded Probe Heads
- AC Only
- Split Core



P6021 and P6022 AC Current Probes.

P6021 and P6022 Current Probes

The P6021 and P6022 Current Probes provide versatile AC current measurements. Both probes provide accurate current measurements over a wide range of frequencies. The P6021 and P6022 allow current measurements without breaking the circuit by clipping onto the current carrying conductor. Shielded probe heads are not grounded when the slides are in their open positions, eliminating accidental grounding of the circuit under test.

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. The passive termination is switchable from 2 mA/mV to 10 mA/mV.

P6022 Current Probe

With a head size of 0.47 inches x 0.25 inches (10 mm x 6 mm, about half the size of the P6021) and a bandwidth of 935 Hz to 120 MHz, the P6022 is ideal for measuring currents in compact, high-performance circuits. Passive termination output is switchable between 1 mA/mV or 10 mA/mV.

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P6021
5 ft. Current Probe with Termination.
Includes: 5 in. (130 mm) Ground Lead (175-0124-01); 3 in. (75 mm) Ground Lead (175-0263-01); Two Miniature Alligator Clips (344-0046-00); Instruction Manual (070-0947-02).

Opt. 03 – 9 ft. with Termination.

P6022
5 ft. Current Probe with Termination.
Includes: Same as the P6021; Instruction Manual (070-0948-01).

Opt. 03 – 9 ft. with Termination.

Passive Termination only –
(P6021) – Order 011-0105-00.
(P6022) – Order 011-0106-00.

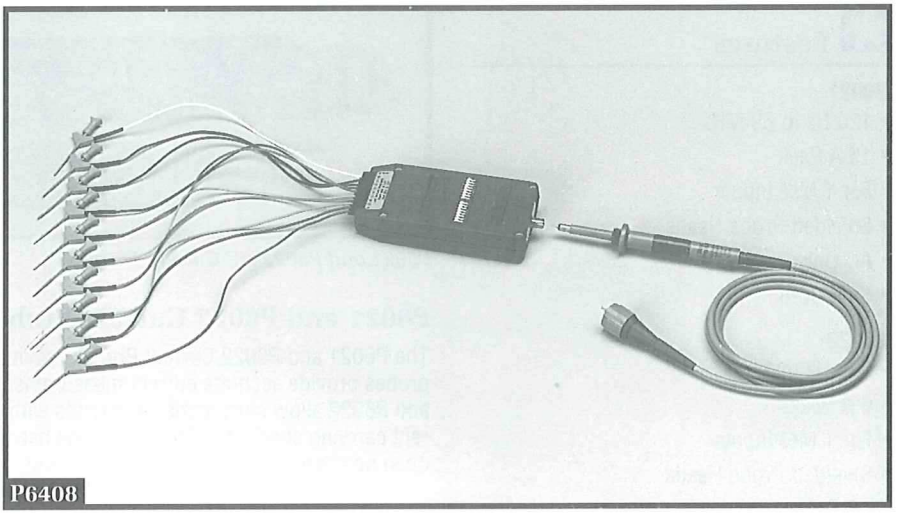
Word Recognizer Trigger Probe

P6408

Features

P6408

- For TTL and TTL-compatible Logic
- 17-Bits (16 Data Bits Plus Qualifier)
- Synchronous and Asynchronous Operation
- Easy to Use
- Simplifies Digital Troubleshooting and Debug
- Use with Any Oscilloscope



P6408

The P6408 is a 16-Bit word recognizer trigger probe for use with analog and digital storage oscilloscopes. It allows the oscilloscope to trigger on user defined logic states (rather than on analog levels), thus extending the utility of the oscilloscope into digital troubleshooting and debug applications.

The P6408 may also be used on oscilloscopes with 15 to 35 pF inputs, when used with the P6109B probe or other probes which have a miniature size probe tip. The P6408 trigger word is manually programmed via miniature DIP switches on the probe pod. The P6408 derives its operating power from the device under test +5 V bus.

Characteristics

Input Channels – Data (Clock/Qualifier)/Power (Ground): 16 (1)/1 (2).

Input Logic Level – HI (ONE)/LO (ZERO): ≥ 2.0 V/≤ 0.7 V.

Input Loading Current –
HI (ONE): 20 mA max @ 2.7 V;
LO (ZERO): –600 mA max @ 0.5 V.

Maximum Input Voltage Swing –
0 V to ≤ V cc.

Maximum Non-destructive Input Voltage –
1 V (LO) to +15 V (HI).

Word Recognizer Output Level –
HI (ONE)/LO (ZERO): ≥ 200 mV/≤ 70 mV.

ASYNCHRONOUS MODE
Maximum Trigger Frequency – 20 MHz.

Minimum Coincidence Between Data Inputs Resulting in a Trigger – 40 ns.

Maximum Coincidence Between any Two Data Inputs Without Producing a Trigger – 40 ns.

Delay of Input Word Coincidence to Word Out – 20 ns.

SYNCHRONOUS MODE
Power Requirements – +5 V ±0.25 V, 100 mA max.

Recommended Instrument – Any instrumentation with 8 to 35 pF inputs.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

P6408
Word Recognizer/Trigger Probe.
Includes: Two (10-wide) Lead Headers (012-0747-01); Pkg. of 20 SMT KlipChip™ Adapters (SMG50); P6109B Probe (complete package); Instruction Sheet (070-6938-00).

ADDITIONAL ACCESSORY
Probe Power Cable – Order 174-1342-00.
Used with 1101A Power Supply.

Probe Accessory Packs, Test Leads, Cables

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.



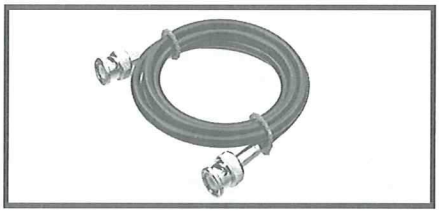
ACCESSORY PACK/P613X
COMPACT AND SUBMINIATURE
Order 020-1835-00.
Includes: Screwdriver (003-1433-00); Retractable Hook Tip (013-0107-07); Retractable Hook Tip (013-0208-02); 2 in. Ground Lead (195-4240-00); 3 in. Ground Lead (196-3113-03); 6 in. Ground Lead (196-3113-02); 12 in. #6-32 Stud Ground Lead (196-3287-00); 8 in. Ground Lead (196-3286-00); SMT KlipChip™ (206-0364-00); Ground Collar (343-1003-01); Alligator Clip for #6-32 Thread (344-0046-00); 6 in. Ground Lead With 0.025 in. Receptacle (196-3302-00); 6 in. Ground Lead w/Alligator (196-3305-00).

ACCESSORY PACK/MINIATURE PROBE TIPS
(Not shown)
Order 020-1724-00.
Includes: Screwdriver (003-1433-00); Retractable Hook Tip (013-0107-07); 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); SMT KlipChip™ (206-0364-00); Alligator Clip for #6-32 Thread (344-0046-00); IC Test Tip; 3.5 in. Ground Lead (195-6176-00); Spring Ground (214-4125-00).

ACCESSORY PACK FOR P612X PROBE TIPS
(Not shown)
Order 020-1836-00.
Includes: Screwdriver (003-1433-00); IC Test Tip; Tip Insulator (166-0404-01); 3.5 in. Ground Lead (195-6176-00); 6 in. Ground Lead (196-3302-00); 8 in. Ground Lead (196-3286-00); 12 in. Ground Lead (196-3287-00); Retractable Hook Tip (013-0107-07); Alligator Clip for #6-32 Connector (344-0046-00); SMT KlipChip™ (206-0364-00); Spring Ground (214-4125-00).

Test Leads

ALM01 (Not shown)
UL Listed Red and Black Test Lead Set with Miniature Size Probe Tips. Incorporates Shrouded Banana Plugs and Includes Two Retractable Hook Tips.



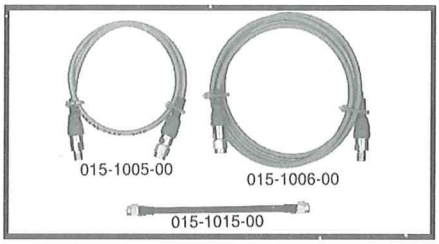
Cables

COAXIAL BNC CABLES
50 Ω

012-0057-01	42 in., Male-to-Male.
012-0076-00	18 in., Male-to-Male.
012-0104-00	18 in., Male-to-Female.
012-0208-00	10 in., Male-to-Male.
012-0482-00	36 in., precision (1%) Male-to-Male.
012-1341-00	36 in., Male-to-Male.
012-1342-00	24 in., Male-to-Male.

75 Ω

012-0074-00	42 in., Male-to-Male.
012-1337-00	60 in., Male-to-Male.
012-1338-00	36 in., Male-to-Male.
012-1339-00	24 in., Male-to-Male.
067-1232-00	75 Ω/50 Ω BNC Output, 50 Ω BNC Input.



COAXIAL SMA (3MM) 50 Ω CABLES
General Purpose Flexible Cables

174-1364-00	12 in., Male-to-Male.
174-1427-00	20 in., Male-to-Male.
174-1428-00	60 in., Male-to-Male.

Precision, Flexible Delay Cables

015-0560-00	2 ns, Male-to-Male.
015-0561-00	5 ns, Male-to-Male.
015-0562-00	1 ns, Male-to-Male.
015-1005-00	2 ns, Male-to-Female.
015-1006-00	5 ns, Male-to-Female.
015-1019-00	1 ns, Male-to-Female.

Semi-rigid Delay Cables

015-1015-00	500 ps, 4.5, Male-to-Male.
015-1017-00	750 ps, Male-to-Male.

BNC to Banana Plug-jack, 18 in.

012-0090-00	Black.
012-0091-00	Red.

Banana Plug-jack to Banana Plug-jack, 18 in.

012-0031-00	Red.
012-0039-00	Black.

Pin-jack to Pin-jack, 0.08 in. Dia-pin

012-0179-00	Red, 8 in.
012-0180-00	Red, 18 in.
012-0181-00	Black, 8 in.
012-0182-00	Black, 18 in.

INTERFACE CABLES (Not shown)
GPIB

012-0991-00	2m, double-shielded.
012-0991-01	1m, double-shielded.
012-0991-02	4m, double-shielded.
012-1282-00	0.5 m GPIB.

Centronics

012-1233-00	3 m, 4693 to Terminal.
012-1214-00	8 ft. male Centronics to PC 25-Pin D.
012-1284-00	9 ft., Male-to-Male.

RS-232C

012-0911-00	10 ft. DB25 male – DB25 female, straight through.
012-1285-00	9 ft. DB25 male – DB25 female, null modem.
012-1298-00	9 ft. DB25 male – DB9 female, null modem.
131-4923-00	DB25 male – DB25 male gender changer.
174-1453-00	For 222/224.
012-1241-00	RS-232C, 9-Pin female to 25-Pin male.
012-1379-00	RS-232C, 9-Pin female to 9-Pin male.
012-1380-00	RS-232C, 9-Pin female to 25-Pin male.
012-1398-00	9 in. RS-232C to plotter/printer.

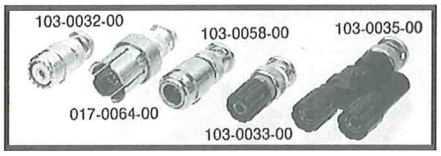
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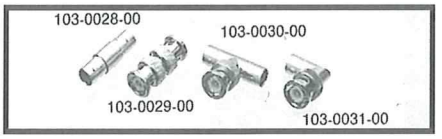
Adapters, Connectors and Adapter Kits

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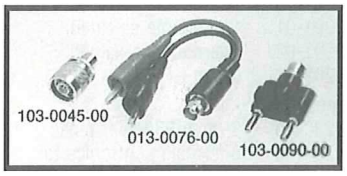




Adapters

BNC ADAPTERS

103-0032-00 BNC male to UHF female.
017-0064-00 BNC male to GR.
103-0058-00 BNC male to N female.
103-0033-00 BNC male to binding post.
103-0035-00 BNC male to dual binding post.



103-0045-00 BNC female to N male.
013-0076-00 BNC female to Clip Leads.
013-0076-01 BNC female to EZ ball (not shown).
103-0090-00 BNC female to dual banana.
131-4199-00 75 Ω BNC to 50 Ω Type N, Min Loss.
011-0112-00 75 Ω to 50 Ω Min Loss with Block.

N STYLE ADAPTERS

015-0509-00 N male to N female.
017-0062-00 N female to GR.
103-0058-00 N female to BNC male.
103-0045-00 N male to BNC female.

3.5 MM ADAPTERS (Not shown)

015-0551-00 Male-to-Male.
015-0550-00 Female-to-Female.
015-0552-00 Male-to-Female connector saver*[1].
015-0563-00 3.5 mm, 50 Ω, 2 ns, Male-to-Male.

SMA ADAPTERS (Not shown)

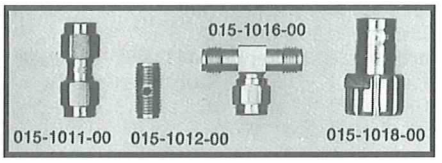
015-0369-00 SMA male to N.
015-0572-00 SMA female to BNC male.
015-0554-00 SMA male to BNC female.
015-1009-00 SMA male to N female.
015-0553-00 Threaded Female-to-Male slip-on connector.
015-0549-00 Male-to-Female connector saver*[1].
020-1693-00 SMA Kit.

*[1] *Used permanently installed on instrument to prolong life of instrument connector.*

Connectors

BNC CONNECTORS

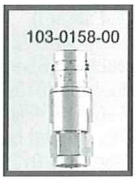
103-0028-00 BNC female to BNC female.
103-0029-00 BNC male to BNC male.
103-0030-00 BNC "T".
103-0031-00 BNC elbow male to female.



SMA CONNECTORS

015-1011-00 SMA Male-to-Male.
015-1012-00 SMA Female-to-Female.
015-1016-00 SMA "T".
015-1018-00 SMA male to BNC female.





MISCELLANEOUS CONNECTORS

013-0126-00 "F" female to BNC male.
103-0158-00 "F" male to BNC female.

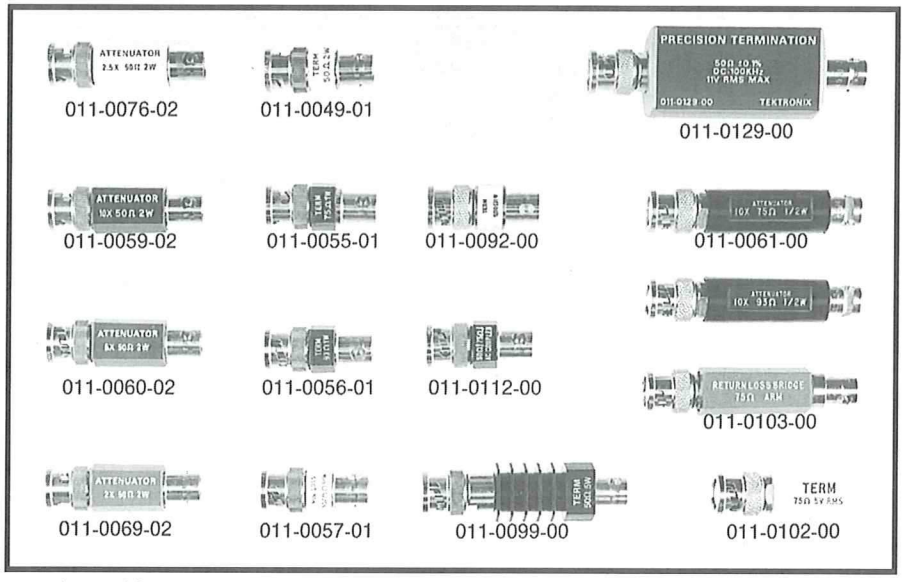
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Attenuators

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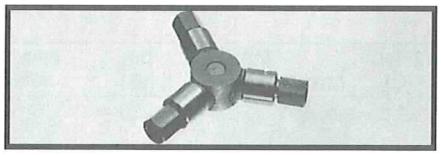
BNC (See table next page).

3.5 MM TERMINATIONS (Not shown)

011-0150-00 Female short-circuit.
011-0148-00 Male 50 Ω.
011-0151-00 Male short-circuit.

ATTENUATORS (Not shown)

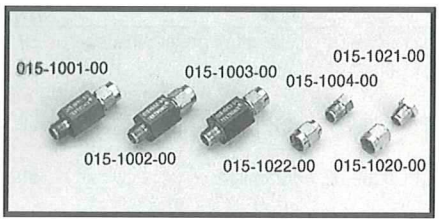
011-0118-00 75 Ω to 50 Ω matching, dBm to dBV.



50 Ω POWER DIVIDER

015-0565-00 SMA female connector.
015-1014-00 SMA male connector.
017-0082-00 GR connectors.

Designed for use in broadband 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 (see table next page).

50 Ω COUPLING CAPACITORS/DC BLOCK

Coupling Capacitor SMA (015-1013-00).

The coupling capacitor is a short length of coaxial line with a disk capacitor (5000 pF SMA) 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).

TRANSFORMERS

120-1883-00 75 Ω to 50 Ω matching, 50 kHz to 300 MHz.
120-1884-00 75 Ω to 50 Ω matching, 50 MHz to 1 GHz.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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Attenuators/Terminations

ATTENUATORS/TERMINATIONS SELECTION GUIDE

BNC 50, 75, and 93 Ω (see photo on previous page)

	Type	Impedance (Ω)	Z-Tol. (Ω)	Atten.	Atten. (dB)	Tol. (dB)	Freq. (DC to) (Watts)	Avg. Power (Watts)	Peak Power	Max. VSWR
011-0049-01	Feed-through termination	50	±1	NA	NA	NA	1 GHz	2	300	1.2 DC to 1 GHz
011-0059-02	Attenuator	50	±1	10X	20	±0.4 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 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 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 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 DC to 100 MHz
011-0056-01	Feed-through termination	93	±1	NA	NA	NA	100 MHz	1	300	1.1 DC to 100 MHz
011-0057-01	Min. loss attenuator	50 to 75	–	2.3X	7.2	±0.5	100 MHz	0.5	–	1.1 DC to 100 MHz
011-0061-00	Attenuator	75	–	10X	20	–	–	0.5	–	–
011-0092-00	Feed-through termination	600	±6	NA	NA	NA	1 MHz	1	–	–
011-0112-00	Min. loss attenuator	75 to 50	–	–	–	–	–	2	–	(AC coupled)
011-0129-00	Feed-through termination	50	±0.05	NA	NA	NA	100 kHz	–	–	–
011-0102-00	Coax termination	75	±0.5	NA	NA	NA	–	0.5	–	–
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.*

SMA (3mm) 50 Ω (see photo on previous page)

	Type	Impedance (Ω)	Z-Tol. (Ω)	Atten.	Atten. (dB)	Tol. (dB)	Freq. (DC to) (Watts)	Avg. Power (Watts)	Peak Power	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	±10	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	NA	NA	NA	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	–	NA	NA	NA	18 GHz	NA	NA	–
015-1021-00	Short-circuit termination (female)	0	–	NA	NA	NA	18 GHz	NA	NA	–
015-1022-00	Termination (male)	50	±0.5	NA	NA	NA	18 GHz	0.5	100	–

Printers/Plotter

HC100 • HC220 • HC411

Features

PRODUCT COMPATIBILITY

HC100

- Compatible with TDS Series, 11000 Series, and Most PC Systems
- Direct Plots from Most Tektronix Digitally-based Instruments Without Using a Controller
- Four Color
- Standard Interfaces
  – Centronics Parallel
  – GPIB
- A4 and US Letter Sizes
- Four Plotting Modes, Including HPGL

HC220

- Compatible with TDS Series, 11000 Series, and Most PC Systems
- Economical
- Bubble Jet
- Direct Plots in About 90 Seconds
- Compact Size
- Accurate and Fast
- Laser Quality Printouts

HC411

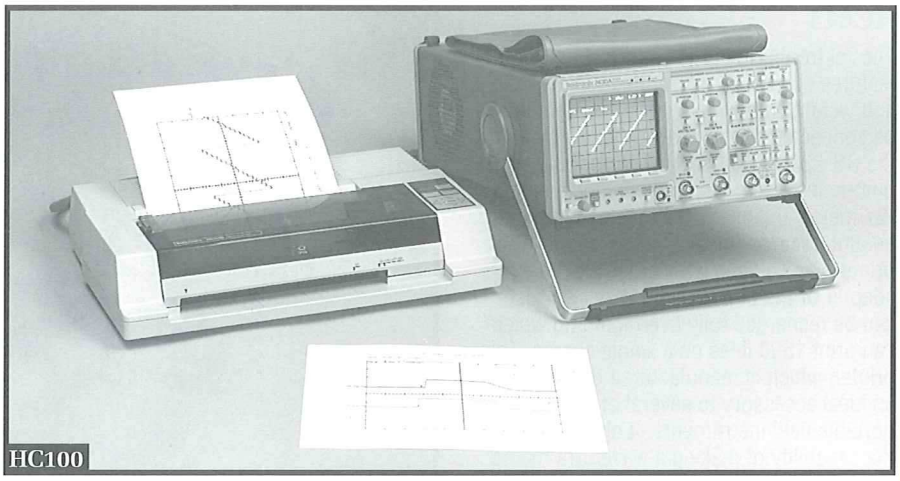
- Compatible with THS 700 Series, TV110, TS100, TFS3031, CTS 710, and CTS 750
- Quiet Thermal Printer
- Built-in NiCd Battery
- AC Adapter and Charger
- RS-232C Serial and Centronics Parallel Interfaces
- Lightweight
- Enclosed Paper Supply
- Designed for Portability

Applications

- Business Reports
- Presentations
- Archives
- Documentation

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com



HC100 Direct Waveform Plotting

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 requiring an external controller. Under program control from the attached instrument's front panel or keyboard, the HC100 provides plots of digitally stored waveforms and printouts of instrument setup information.

FUNCTIONS

Drawing Modes: Plotter (HPGL, Epson® HI 80, Graphtec® command sets), printer (Epson® RX-80 compatible), self-tests (HPGL) and standard plotter.

Plotter operation is supported by HPGL (Hewlett-Packard Graphics Language). Tektronix codes and formats are also supported on the GPIB Interface. Other modes in the HC100 include Graphtec® emulation and Epson® RX-80 printer mode.

Printer operation is Epson® RX-80 compatible and is supported by a full ASCII 96-character set. International character sets for 11 countries can be selected as well. HC100 handles printer functions to format and print text, but it does not support dot graphics.

The HC100 cannot be used in a multi-controller environment, such as with a GPIB instrument and controller, unless attached to the controller (IBM® PC or equivalent). Multiple GPIB controllers on one bus do not conform to IEEE 488 standards.

HC100 Characteristics

Effective Drawing Size – 267 mm (X-axis) x 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 mm x 210 mm; B5: 257 mm x 182 mm; US letter size: 279 mm x 216 mm.

Paper Types – Ordinary paper, OHJ film.

POWER REQUIREMENTS

Line Voltage – Standard 117 V AC ±10%; Options A1-A5: 220 V/240 V AC ±10%.

Line Frequency – 49.5 Hz to 60.5 Hz.

Power Consumption – 30 W.

PHYSICAL CHARACTERISTICS

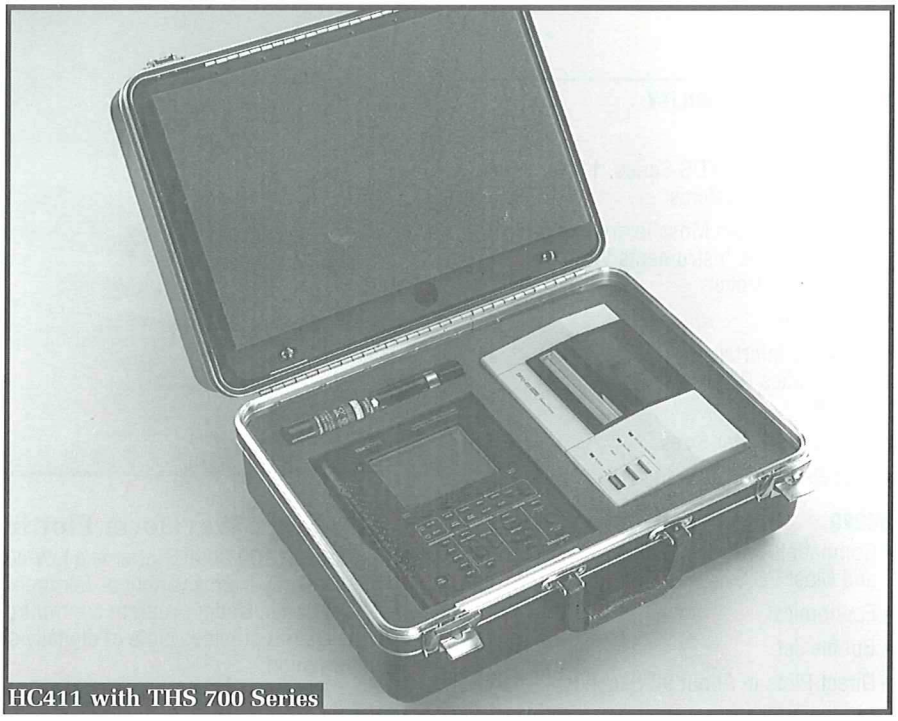
Outside Dimensions	in.	mm
Width	16.5	415
Height	3.2	81
Depth	10.8	272
Weight	**lb.**	**kg**
Net	13.2	6

Printers/Plotter

HC100 • HC220 • HC411

HC411

The Tektronix HC411 is a thermal printer that features quiet and clear printing in a portable, lightweight, battery-powered package. It can be connected to instruments through either the RS-232C serial or the Centronics parallel built-in interface. The printer's 90-foot (27 meter) roll of paper provides more than enough records for most applications. The printer can be used with either the AC adapter or the built-in NiCd battery, which can be recharged fully overnight and which can print 1500 lines on a single charge. This printer, which is manufactured by Seiko®, is an ideal accessory to several of Tektronix' portable field instruments. It gives the user the capability of making a waveform record in the field and the confidence that the record is correct for the field report.



HC411 with THS 700 Series

HC411 Characteristics

HC411

Character Set – 256 characters.

Character Font – 9 x 7 dot matrix.

Character Size – 0.074" W x 0.097" H; 1.88 mm W x 2.47 mm H.

Number of Columns – 40 (regular); 80 (condensed).

Line Space – 6 dots programmable.

Printing Speed – 37.5 cps (regular); 50 cps (condensed).

Graphics Mode

Dot Composition – 320 dots/line (regular); 640 dots/line (condensed).

Interfaces – Serial: RS-232C; Parallel: Centronics.

Weight – 2.1 lb.(0.95 kg) without paper or adapter.

ADAPTER POWER REQUIREMENTS

Line Voltage – 120 V AC or 220 V AC (Opt. A1).

Line Frequency – 60 Hz or 50 Hz (Opt. A1).

Power Consumption – 9 W.

PHYSICAL CHARACTERISTICS

Outside Dimensions	in.	mm
Width	9.45	240
Height	2.3	58.5
Depth	6.38	162
Weight	**lbs.**	**g**
Net	2.1	950

Printers/Plotter

HC100 • HC220 • HC411

HC220

The Tektronix HC220 Bubble Jet Printer offers high quality printing in a small package at an economical price. We are proud to offer this Tektronix-compatible Canon printer to satisfy your documentation needs.

Because it is an ink-jet printer, the HC220 has darker, denser, more consistent printing than most other printers. At 360 dots per inch, it is considered a laser quality printer. In addition, the printer uses plain paper, not the hard-to-manage and expensive continuous-feed paper. No fuzzy ends and no time-consuming tractor feed edges to tear off. The more traditional dot-matrix printers make a lot of noise, while the whisper-quiet HC220 does not require bulky and ineffective noise suppression boxes.

HC220 Characteristics

Print Method – Bubble jet ink on demand.

Print Speed – 83 characters per second.

Print Resolution – 360 dpi (64 nozzle head).

Standard Emulations – CanonBJ®: 10e mode; Epson® LQ-510; IBM® X24E.

Fonts – X24E: Prestige and Courier; BJ-10e: Courier; LQ-510: Roman, Sans Serif and Draft.

Pitch – X24E: 10, 12, 17 cpi and Proportional; LQ-510: 10, 12, 17, 20 cpi and Proportional.

Paper Sizes – US letter size, Legal and #10 Envelopes.

Paper Types – Ordinary paper, Card stock (17-28 lb.), Transparencies, Envelopes.

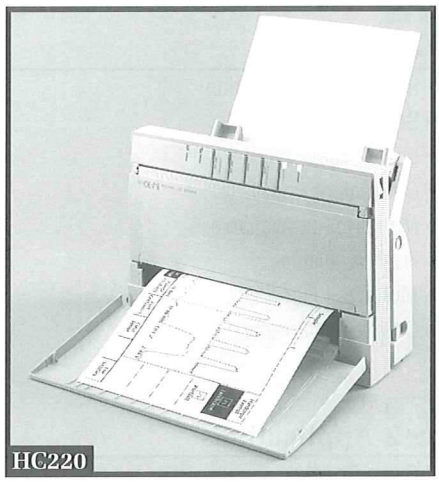
Standard Interface – Centronics (Parallel).

ADAPTER POWER REQUIREMENTS

Line Voltage – Standard 120 V AC adapter.

Line Frequency – 60 Hz.

Power Consumption – 30 W.



PHYSICAL CHARACTERISTICS

Outside Dimensions	in.	mm
Width	12.2	309.8
Height	1.8	45.7
Depth	8.5	215.9
Weight	**lbs.**	**kg**
Net	4	1.81

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

HC100
Color Plotter.
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 (070-6441-01); One Pen Cartridge (016-0876-00).

Opt. 01 – 1M GPIB Cable. Order 012-0991-01.

Opt. 02 – DB-25 M to Centronics M Cable for PCs. Order 012-1214-00 (Both Opt. 01 and 02 may be ordered).

Opt. 04 – Parallel Cable for Use with Oscilloscopes (012-1284-00).

For a 220 V/240 V, 50 Hz version order one of following options:

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V, 50 Hz.

Opt. A2 – United Kingdom 240 V, 50 Hz.

Opt. A3 – Australian 240 V, 50 Hz.

Opt. A4 – North American 240 V, 60 Hz.

Opt. A5 – Switzerland 220 V, 50 Hz.

See General Customer Information Section for additional description.

ADDITIONAL ACCESSORIES FOR HC100

Extra Pen Cartridge – Order 016-0876-00.

Pens – Four colors (black, red, green, blue) in each package:
Fiber-tip, aqueous ink. Order 016-0879-00.
Fiber-tip, oil-based ink. Order 016-0878-00.
Ball-point, aqueous ink. Order 016-0877-00.

Interface Board Kits – Has all the parts necessary to install the board in the HC100. It includes the interface board, mounting hardware, and installation instructions.
GPIB Interface Board Kit.
Order 021-0457-00.
RS-232C Interface Board Kit.
Order 021-0458-01.

Cable – Data Cable. 10 ft., Male-to-Male with 9-Pin DB Connectors.
Order 174-0537-01.

HC220
Bubble Jet Printer.

ADDITIONAL ACCESSORIES FOR HC220

36-Pin Male-to-Male Centronics 9 ft. Cable – Order 012-1284-00.

DB-25 Male to 36-Pin Male Centronics 9 ft. Cable – Order 012-1214-00.

HC411
Thermal Printer.
Includes: 1 Roll of Thermal Paper, Operations Manual, AC Adapter.

Opt. 01 – Interface Cable for THS 700 Series.

Opt. 02 – Interface Cable for TS100, TV110.

Opt. 03 – Interface Cable for TFS3031.

Opt. 04 – Interface Cable for CTS 710, CTS 750.

INTERNATIONAL POWER OPTION

Opt. A1 – Universal Euro 220 V, 50 Hz.

ADDITIONAL ACCESSORIES FOR HC411

1 Roll of Thermal Paper – Order 006-7840-00.

5 Rolls of Thermal Paper – Order 006-7580-00.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

Film-based Camera

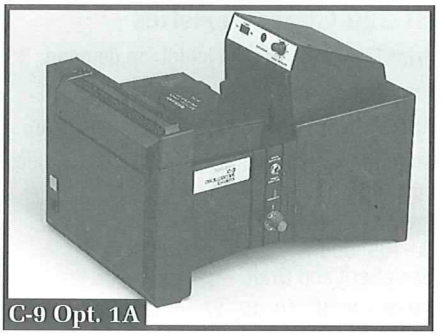
C-9

Features

- Instant Documentation
- Small, Easily Shared
- Legal Proof
- Convenient Print Size
- Many Hoods Available
- Flash Available
- Motorized Film Back Available
- One Year Warranty

Applications

- Clean Rooms
- Scope Data Archival
- Patient Areas



C-9 Opt. 1A

C-9 Oscilloscope Camera

The C-9 CRT camera uses Polaroid film packs to document most CRT displays. A 3.25 inch x 4.25 inch pack film back is standard.

An optional motorized film back is available to reduce handling. It automatically ejects a clean, dry, self-developed print.

An optional pistol grip is available for use when only one hand is free. A flash unit is also available for scopes without graticule lighting. The variable xenon flash makes the CRT phosphor glow, which evenly backlights the graticule.

Characteristics

Aperture – Fixed at f/11.

Lens – Fixed-focus, three element.

Magnification – .55 or .73.

Geometric Distortion – Less than 0.5%.

Relative Light-gathering Ability – .035.

Shutter – Electronic; timed mode from 0.1 to 5 seconds and manual exposure.

Power – Eight AA alkaline batteries (not included).

Resolving Power – At least 6 lines/mm at center, 3 lines/mm at the corners.

Safety – UL Listed 1244.

PHYSICAL DIMENSIONS OF C-9 SCOPE HOODS

Option	Supported	Inside Height	Outside Height	Inside Width	Outside Width	Mag.Ratio
C9-04	TDS400	10.40 cm/4.09 in.	10.60 cm/4.17 in.	13.80 cm/5.43 in.	14.00 cm/5.51 in.	0.71
C9-05	TDS5/6/800	10.80 cm/4.25 in.	11.20 cm/4.41 in.	14.10 cm/5.55 in.	14.50 cm/5.71 in.	0.71
C9-06	TAS400	/5.28 in.	/5.61 in.	/6.38 in.	/6.64 in.	
C9-07	7 K	13.03 cm/5.13 in.	13.67 cm/5.38 in.	14.22 cm/5.60 in.	14.86 cm/5.85 in.	0.70
C9-11	11 K, CSA, DSA	12.29 cm/4.84 in.	12.80 cm/5.04 in.	15.75 cm/6.20 in.	16.26 cm/6.40 in.	0.73
C9-20	Portable	10.49 cm/4.13 in.	11.18 cm/4.40 in.	11.94 cm/4.70 in.	12.67 cm/4.99 in.	0.51

RECOMMENDED POLAROID FILM PACKS

Back Type	Film Type	ISO Speed	Color	Wide Gray Scale	Contrast	Special	Prints	Order #
AutoFilm™ *2	337	3200		√	Medium	Clean room	200 60	006-7350-00 006-7349-00
Manual	612	20,000			High	Panachromatic	24	006-6822-00
Manual	667	3000			Medium	Coaterless	500 60	006-6825-00 006-6824-00
Manual	669	80	√	√	Medium	Extended dynamic range	48	006-6826-00

**2 AutoFilm™ is a trademark of the Polaroid Corporation.*

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

C-9
Camera.
Includes: Camera Body without Hood (a Hood is required), Instruction Manual. Order 070-8105-02.

Opt. 1A – AutoFilm™ Motorized Film Back.

Opt. 1F – Graticule Flash Unit for Use with Opt. 07 and/or Opt. 20.

Opt. 1P – Pistol Grip Handle with Trigger.

Opt. 04 – TDS 400 Series Scope Hood.

Opt. 05 – TDS 500/600/800 Series Scope Hood.

Opt. 06 – TAS 400 Series Hood.

Opt. 07 – 7 K Series Scope Hood.

Opt. 11 – 11 K, CSA, DSA Series Scope Hood.

Opt. 20 – Portables (2000) Series Scope Hood.

ADDITIONAL ACCESSORIES

Graticule Flash – Use with 7000 Series and 2000 Series Scope Hoods. Order 016-0642-02.

Pistol Grip – Pistol Grip Hand with Trigger. Order 122-0186-01.

Scope Hoods –
TAS 400. Order 016-1181-00.
TDS 400 Series. Order 016-1154-01.
TDS 500, TDS 600, TDS 800 Series. Order 016-1145-00.
7000 Series. Order 016-0357-03.
11000, CSA, DSA Series. Order 016-1099-01.
2000 Series. Order 016-0359-03.

Battery – Order 016-0799-03.

AC Power – 110 V. Order 119-1847-02.

Recommended Camera Adapters

RECOMMENDED CAMERA ADAPTERS

Instruments	C-9 Hood	C-30BP Bezel Adapter
300 Series*1	None Available	Opt. 01 016-0327-01
308*1	Not Recommended	Not Recommended
370, 371	Opt. 07, 016-0357-03	Not Recommended
400 Series*1	Opt. 20, 016-0359-03	Opt. 01, 016-0269-03
400 Series with 0.8 cm graticule: 422, 453, 454, 485, 491*1	None Available	016-0306-01
All 49X Series Except 491	Opt. 07, 016-0357-03	016-0248-01
500 Series Round*1	None Available	None Available
500 Series Rectangular*1	None Available	None Available
500 Series TV Vectorscopes*1	None Available	None Available
528A*1	Opt. 07, 016-0357-03	016-0248-01
529, 576	None Available	None Available
600 Series	Opt. 07 016-0357-03	Opt. 01, 016-0248-01 (NR for 10 x 12 cm size)
1240	Not Recommended	Not Recommended
1400 Series (not 1480C)	Opt. 07, 016-0357-03	016-0248-01
1500 Series	None Available	Opt. 01, 016-0327-01
1700 Series	Opt. 20, 016-0359-03	Opt. 01, 016-0269-03 (NOT 1740 or 1750 Series)
2200 Series	Opt. 20*2, 016-0359-03	Opt. 01, 016-0269-03
2300 Series	Opt. 1P, 20*2, 016-0359-03	None Available
2400 Series	Opt. 20, 016-0359-03	Opt. 01, 016-0269-03
271X Series	Opt. 20, 016-0359-03	Opt. 01, 016-0269-03
275X Series	Opt. 07, 016-0357-03	016-0248-01
5000 Series*1	Opt. 07, 016-0357-03	Not Recommended
5030, 5031*1	None Available	None Available
5400 Storage 5403/D41, 5441, D41	Opt. 07 016-0357-03	016-0248-01
7000 Series*1	Opt. 07, 016-0357-03	Opt. 010, 016-0248-01
7000 Large-screen 7403, 7603, 7603N	Opt. 07 016-0357-03	Not Recommended
11300 Series	Opt. 07, 016-0357-03	Not Recommended
11400 Series	Opt. 11, 016-1099-01	Not Recommended
CSA Series	Opt. 11, 016-1099-01	Not Recommended
DSA 600 Series	Opt. 11, 016-1099-01	Not Recommended
OF100, OF200 TDR	Opt. 07, 016-0357-03	Not Recommended
R7103	Opt. 07, 016-0357-03	016-0248-01
T900 Series*1	Not Recommended	None Available
T922R	Opt. 07, 016-0357-03	016-0248-01
TAS 400	Opt. 06, 016-1181-00	None Available
TDS 300, TDS 400/A	Opt. 04, 016-1154-00	None Available
TDS 500/A, TDS 600/A, TDS 700/A, TDS 800/A	Opt. 05, 016-1145-00	None Available
TLS 216	Opt. 05, 016-1145-00	None Available
TM 500 SC502, SC503, SC504	None Available	Opt. 01 016-0327-01
WFM 300	Opt. 20, 016-0359-03	None Available

*1 *See next entry.*

*2 *Opt. 1F recommended for scopes with no graticule lighting. The first and last small graticules may be cut off the picture image on some oscilloscopes.*

Instrument Carts/Workstations

CONTENTS

TDS SERIES OSCILLOSCOPES

K420 Bench-Height Cart.....521
K465 Storage Tower.....521
K415 Transport Cart.....522
K475 Workstation Tower.....522
K212 Portable Instrument Cart.....523
Test Station (016-1239-00).....523

Instrument Carts/Workstations

Tektronix can free up your valuable work space, make sharing and moving equipment easy, and get you closer to the device under test.

Our ergonomically designed instrument carts and workstations bring a higher level of functionality to the end user, while safeguarding your instrument investment.

All new instrument carts and workstations can be customized to meet your specific requirements. The carts are shipped ready to assemble, allowing maximum configuration flexibility. The shelf height of the carts can be quickly and easily adjusted.

INSTRUMENT COMPATIBILITY CHART

	K212	K415	K420	K465	K475	TEST STATION (016-1239-00)
Oscilloscopes/Digitizers						
11000 Series CSA 803A 404		•		√	•	
DSA 600 Series					√	•
2200/2400 Series	√	•	•			
305/314/336	√	•				
5000/7000 Cabinet			√			
5000/7000 Rackmount		•	√	•	•	
TDS 300/400 Series	√		•	•		
TDS 500,600,700,800 Series		•	√	•	•	
TAS Series	√	•				
2500/2600		•	√	•		
TLS 216		•	√	•		
Television/Spectrum Analyzers						
1480 Series Cabinet	√		•			
1480 Rackmount		√	•		•	
17XX Cabinet	√					
17XX Rackmount		•		•		
1910		√	•		•	
2710 Series	√					
2750 Series		•		•	•	
2780/2790 Series	√		•			
490 Series	√	•				
Logic Analyzers						
1230		•	√	•		
DAS® 9200		•		•	√	•
LV500				•	√	•
Prism 3000		•	•	•	√	•
TLA500		•	√			
DAS® NT		•	√			
DAS® XP		•	√			
Curve Tracers						
370A/371, 372					√	•
577		•				

√ – *Recommended*
• – *Compatible*

Instrument Carts/Workstations

K465 • K420

Features

K465

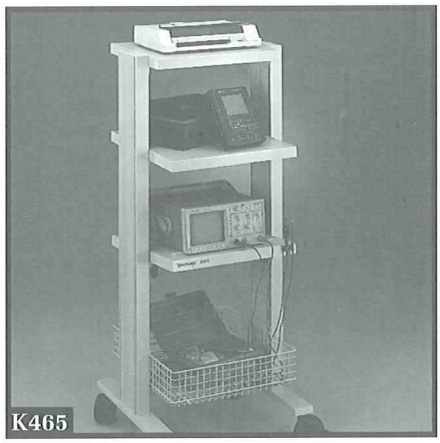
- Three Rack-width Shelves
- Designed for Use with 11K Series and CSA Series Oscilloscopes
- Tiltable Shelf with Positive Locking
- Three-quarter Shelf for Printer
- Tough Steel and Aluminum Construction Means a Secure Platform for All Your Instruments
- Shipped Ready to Assemble to Give Maximum Configurability

K420

- Stable/Mobile Platform
- Tiltable Shelf for Optimum Viewing
- Work-bench Height
- Heavy-duty Nylon Instrument Straps
- Surge and Noise Suppression
- Surge-protected Four Outlet Power Strip Accessory
- Shipped Ready to Assemble

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com





Rack-width Portability

The K465 Instrument Tower is specifically designed for Tektronix' larger oscilloscopes like the 11K Series and the CSA Series. These sturdy carts provide stable and safe instrument mobility with large smooth-rolling four-inch dual durometer twin wheel casters. The tiltable shelf has infinite positive locking positions between horizontal and 26 degrees. The three-quarter shelf is intended to hold a printer or other small device.

Characteristics (K465)

Shelf Tilt – 0° to 26°.

Shelf Loading – Top Shelf: 35 lb. (16 kg). Middle Shelves: 82 lb. (37 kg). Basket: 50 lb. (23 kg).

Durable Work Bench

These sturdy, portable carts are specifically designed for the Tektronix TDS Series Oscilloscopes used in digital design, telecommunications service and installation, and manufacturing environments. The tiltable shelf is rack-width to accommodate your instruments. The cart handle can serve double duty as a probe drape.

In addition, the spacious accessory drawer provides convenient storage for power cords, probes, manuals, and small parts.

Characteristics (K420)

Shelf Tilt – 0° to 26°.

Shelf Loading – 82 lb. (37 kg) per shelf.

Drawer Dimensions – 18 in. x 19.5 in. x 4 in. (645 x 495 x 102 mm).

PHYSICAL CHARACTERISTICS

		K465			K420	
Dimensions		**mm**	**in.**		**mm**	**in.**
Width	Overall Cart	635	25		635	25
	Tilt Shelf	502	19.75	Top Shelf	502	19.75
	All Other Shelves and Basket	508	20	Bottom Shelf	508	20
Height	Overall Cart	1415	55.7		780	30.7
Depth	Overall Cart	533.4	21		620	24.4
	Top Shelf	419	16.5		533	21
	Middle and Bottom Shelves	533.4	21	Bottom Shelf	533	21
Weight		**kg**	**lb.**		**kg**	**lb.**
Net		35	78		26	57

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

K420
Work Bench Cart.
Includes: Probe Holders, Two Heavy Duty Nylon Instrument Straps, Instrument Manual, Retainer Bar, Hex Wrench, Level.

K465
Instrument Tower.
Includes: Two Probe Holders, Four Nylon Instrument Straps, Instrument Manual, Level, Hex Wrench, Retainer Bar.

RECOMMENDED ACCESSORIES

U.S. Power Strip – Four Outlet, 6 ft., Noise/Surge Suppression. Order 131-5342-01.

Skyhook – Order 384-1800-00.

Mouse Pad – Order 436-0317-00.

Instrument Carts/Workstations

K415 • K475

Features

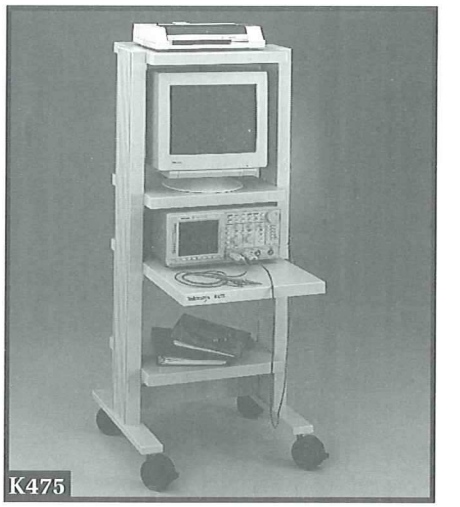
K415

- Constructed of Extruded Aircraft Aluminum
- Tactile Fit and Hold Soft Form Handle
- Stable/Sturdy Platform
- Easy Assembly
- Height Adjustable Shelves

K475

- Rugged Workstation Tower Offering Sturdy, Mobile Instrument Platform
- Oversized Shelf for Larger Oscilloscopes or Fixed Keyboard Platform
- 4 Instrument Restraining Straps
- Steel and Aluminum Design Ensures Solid Support
- Shipped Ready to Assemble to Give Maximum Configurability





Unmatched Value in Portability

The K415 Transport Cart, one of two mid-height carts, is constructed of nearly indestructible high-strength aluminum. These sturdy carts are ideal general purpose utility carts for holding Tektronix portable oscilloscopes, 1230 Logic Analyzers, and other general purpose service instrumentation like the Tektronix TM 5000 and 7000 Series. The K415 consists of two rack-width shelves, plus a wire basket for storage.

Portability For Larger Oscilloscopes

The rugged K475 Workstation Tower is designed for rackmount applications required in digital design, research and development and manufacturing environments. This cart holds Tektronix' larger oscilloscopes, like the DSA Series, providing stable transportation. It includes an extra long shelf (26.6 inches) with ample work space in front of the scope and three three-quarter shelves with loading capacity of 75 lb. per shelf.

PHYSICAL CHARACTERISTICS

		K415			K475	
Dimensions		**mm**	**in.**		**mm**	**in.**
Width	Overall Cart	635	25		635	25
	Top Shelf	508	20	All Shelves	508	20
	Bottom Shelf	508	20			
Height	Overall Cart	907	35.7		1418	55.7
Depth	Overall Cart	533	21		676	26.6
	Shelves	533	21	Middle Shelf	676	26.6
				All Other Shelves	370	16.5
Weight		**kg**	**lb.**		**kg**	**lb.**
Net		30	65		38	83

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

K415
Transport Cart.
Includes: Two Probe Holders, Two Heavy Duty Nylon Safety Straps, Hex Wrench, Instruction Manual, Level.

K475
Workstation Tower.
Includes: Two Probe Holders, Four Nylon Instrument Straps, Hex Wrench, Level, Instrument Manual.

RECOMMENDED ACCESSORIES
U.S. Power Strip – Four Outlet, 6 ft., Noise/Surge Suppression. Order 131-5342-01.
Skyhook – Order 384-1800-00.
Mouse Pad – Order 436-0317-00.

Instrument Carts/Workstations

TEST STATION • K212

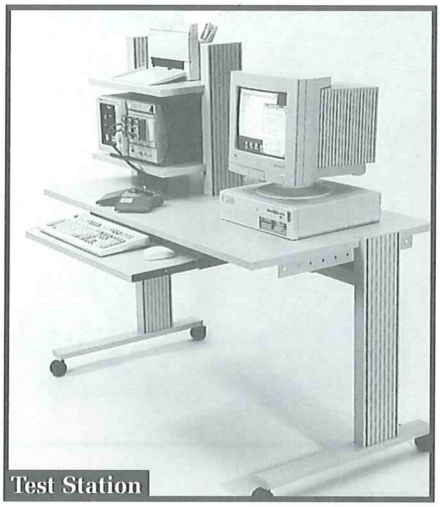
Features

TEST STATION (016-1239-00)

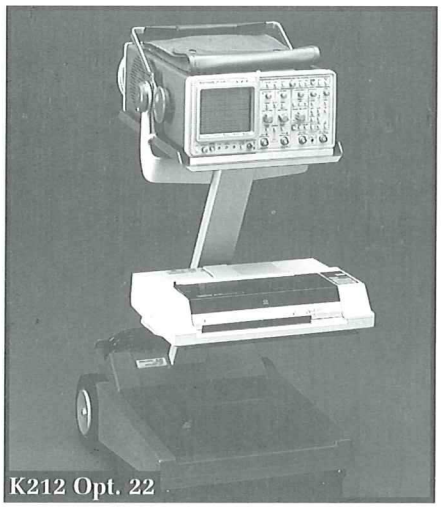
- Organizes System Hardware
- Provides Additional Work Area
- Slide Out Keyboard
- Height Adjustability
- Practical and Sturdy
- Shipped Ready to Assemble

K212

- For All Portable Instruments
- Sturdy and Mobile Platform
- Enhances Sharing and Work Space
- Tiltable Top Tray
- Locking Front Casters
- Four Outlet Power Strip Option



Test Station



K212 Opt. 22

System Mobility and Work Space Functionality

The Test Station is inspired by the Tektronix IPA 310 Interconnect Parameter Analyzer System. It is perfect for use with systems requiring multiple pieces of equipment. It can be used as a standalone work space with enough room for a scope and accessories, as well as an additional work area. The Test Station consists of the main desk top, two shelves, a slide out keyboard, manual holders and power cord channel. Both the shelves and base are height adjustable.

Characteristics

Shelf Loading – 75 lb. per shelf; 100 lb. on main desktop.

Low Cost Portability

The K212 column and trays are made from high strength aluminum; the base is thermo-set polyester.

PHYSICAL CHARACTERISTICS

		Test Station (016-1239-00)		K212	
Dimensions		**mm**	**in.**	**mm**	**in.**
Width	Overall Cart	1442	56	435	17.0
	Shelf	559	22	407	16.0
Height	Overall Cart	1295	51	840	33.0
Depth	Overall Cart	762	30	550	21.6
	Shelf	533	21	352	14.0
Weight		**kg**	**lb.**	**kg**	**lb.**
Net		*1	*1	9	20

*1 *Contact your local Tektronix representative.*

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TEST STATION
Order 016-1239-00.
Includes: Slide Out Keyboard Tray, Cable Management Channel, Manual Holders.

K212
Portable Instrument Cart.
Includes: Two 1 in. x 5 ft. Securing Straps, Retaining Bar, Instruction Sheet, and Probe Holders.
Opt. 10 – Add Four Outlet Power Strip.
Opt. 12 – Add Second Tray.
Opt. 22 – Combines Opt. 10/12.

RECOMMENDED ACCESSORIES
U.S. Power Strip – Four Outlet, 6 ft., Noise/Surge Suppression.
Order 131-5342-01.
Skyhook – Order 384-1800-00.
Mouse Pad – Order 436-0317-00.

Additional Accessories

Features

TRAVEL LINE PACKAGE

- Impact-resistant Packaging
- Pouch and Cover
- Carrying Strap
- Rubber Shock-absorbing Bumpers

PORTABLE INSTRUMENT TRANSIT/CARRYING CASES

- High Strength
- Foam Padding
- Custom Fit

PORTABLE INSTRUMENT PROTECTIVE COVERS

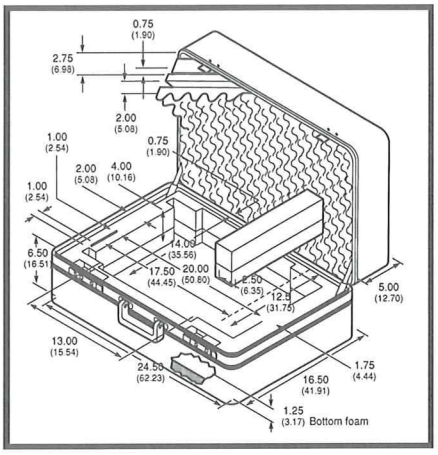
- Custom Fit
- Waterproof Vinyl for Complete Enclosure of High-impact Plastic for Front Panel Enclosure

FRONT COVERS

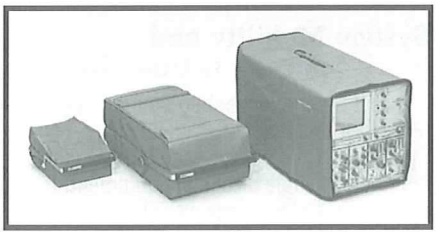
- Snap-on Front Cover
- High-impact Plastic



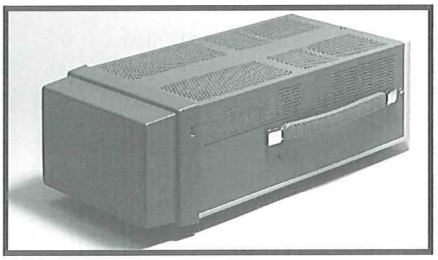
Portable Oscilloscope



016-0792-01 (Shown)



Complete Covers



Front Covers Only

Travel Line Package

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. Plus it has a handy cord wrap.

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 are also included, plus a convenient carrying strap for hands-free operation and transport.

The Travel Line Package can be ordered at the time of purchase or as a field retrofit kit (available on 2235A, 2236A, 2221, 2224, and 2232).

Portable Instrument Transit/Carrying Cases

Rugged transit cases molded of high strength glass-epoxy protect your instruments from hostile environments, shock, vibration, moisture, and impact. Recommended for shipping or transporting your instruments.

Adjustments can be made to the internal padding of the 016-0792-01 to accommodate a wide variety of portable instruments and accessories.

Portable Instrument Protective Covers

The covers provide protection for the instrument during transport or storage. Made of waterproof vinyl, the covers are available for both laboratory and portable instruments. The covers for 5000/7000 Series have clear vinyl frontal areas.

Front Covers

Front covers are available for most portable oscilloscopes, spectrum analyzers, and TM 500/5000 mainframes.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

Additional Accessories

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

TRAVEL LINE PACKAGE
Order Opt. 33 for specific instrument.

2235A, 2236A – Opt. 33.
Includes: Rubber Molding, Accessory Pouch, Front-panel Cover, Carrying Strap.

2221, 2224, 2232 – Opt. 33.
Includes: Rubber Molding, Carrying Strap.

TRAVEL LINE PACKAGE CONVERSION KIT
2235A – Order 040-1188-03.
Includes: Replacement cabinet and rear cover with the rubber moldings installed.

2236A, 2221, 2224, 2232 –
Order 040-1187-03.
Includes: Replacement cabinet and rear cover with the rubber moldings installed.

PORTABLE INSTRUMENT TRANSIT/CARRYING CASES
Hard Sided Case
271X Family. Order 016-0792-02.
2400 Series, 2200 Series. Order 016-0792-01.
278X, 279X Family, OF150, OF235. Order 016-0658-00.
TM 504. Order 016-0608-00.
TM 515. Order 016-0643-00.

Soft Sided Case
271X Family. Order 016-1158-00.
278X, 279X Family, OF150, OF235 Order 016-0659-00.

Carrying Strap
2200/2300 Series, 271X Family. Order 346-0199-00.

Accessory Pouch
271X Family. Order 016-0677-02.

PORTABLE INSTRUMENT PROTECTIVE COVERS
7300/7400/7600 Series. Order 016-0192-01.
5000 Series. Order 016-0544-00.
2400 Series. Order 016-0720-00.
2200 Series. Order 016-0848-00.
200 Series. Order 016-0512-00.
434/464/466. Order 016-0365-00.
314/335. Order 016-0612-00.
TM 504. Order 016-0621-00.
TM 503. Order 016-0620-00.

FRONT COVERS
2400 Series. Order 200-3199-01.
2245A, 2246A, 2247A. Order 200-3232-01.
2235A, 2236A/271X Family. Order 200-2520-00.
2201, 2205, 2211, 2225. Order 200-3397-00.
TM 506. Order 200-1728-00.
TM 504. Order 200-1727-00.
TM 503A. Order 200-3554-00.
1700 Series. Order 200-3897-01.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

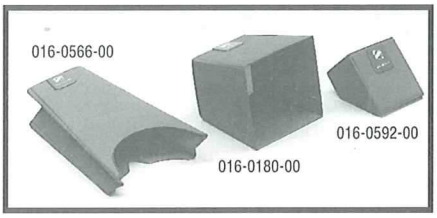


See Tektronix on the World Wide Web: http://www.tek.com

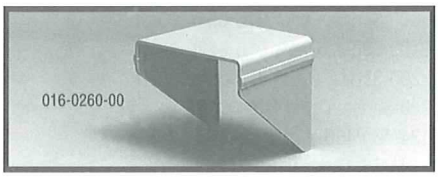
Additional Accessories

Features

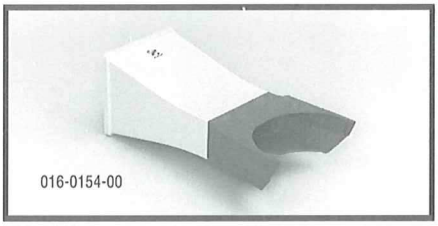
- Viewing Hoods
- Blank Plug-in Chassis
- Blank Panel
- Plug-in Storage Compartment



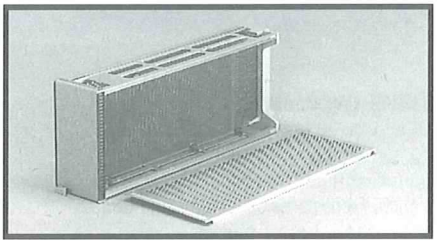
The viewing accessories normally mount on the instrument graticule cover. Some may fit camera-mounted bezels. If you intend to use a camera on your instrument, check with your Tektronix Sales Engineer for bezel-viewer compatibility.



Folding Viewing Hoods



Non-collapsible Viewing Hoods



BLANK PLUG-IN CHASSIS
Available for all Tektronix mainframes. The 11000 Series provides a blank plug-in only. The 7000 Series includes a bare printed circuit board.

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.

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 x 51 mm wide x 106 mm high (9-7/8 x 2 x 4-1/4 inches).

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

FOLDING BINOCULAR
For 2200 Series, 2445A/B, 2465A/B, 2467B, 271X/A Family, 434, 455, 464, 466, 465B, 475, 475A. Order 016-0566-00.

COLLAPSIBLE
To reduce reflections and glare under high ambient light. Blue vinyl, folds flat for storage. For 2200 Series, 2445A/B, 2455A, 2465A/B, 2467B, 271X/A Family, 432, 434, 455, 465/B, 475, 464, 466 (Polarized). Order 016-0180-00.

For 2200 Series, 2445A/B, 2465A/B, 2467B, 271X Family, 464, 466, 455, 465, 465B, 475 (Non-polarized). Order 016-0592-00.

FOLDING
For 576. Order 016-0259-00.

For 577, 5000, 7000, 11000 Series. Order 016-0260-00.

NON-COLLAPSIBLE
For Older Tektronix 5-in. Oscilloscopes. Order 016-0001-01.

MOLDED
Gray Polystyrene with Polyurethane Eyepiece. For 5000 and 7000 Series, 528, 577. Order 016-0154-00.

For 576. Order 016-0153-00.

BLANK PLUG-IN CHASSIS
11000 Series. Order 016-0829-00.

7000 Series. Order 040-0553-04.

5000 Series. Order 040-0818-04.

TM 500 Series. Order 040-0652-06.

BLANK PANEL
7000 Series. Order 016-0155-00.

5000 Series. Order 016-0452-01.

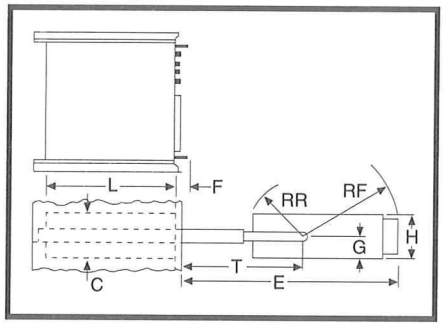
TM 500/TM 5000 Series. Order 016-0195-05.

PLUG-IN STORAGE COMPARTMENT
Order 016-0362-02.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

Additional Accessories



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
E	Maximum forward clearance with instrument out and horizontal
D Min	Minimum mounting depth from front mounting rail to rear mounting rail
D Max	Maximum mounting depth from front mounting rail to rear mounting rail

RACKMOUNT KIT SELECTION GUIDE

		H		L		F		E		D Min.		D Max.	
Instrument	**Part Number**	**in.**	**cm**	**in.**	**cm.**	**in.**	**cm**	**in.**	**cm**	**in.**	**cm**	**in.**	**cm**
DSA 601, DSA 602, 1201/A, 11301/A, 11302/A, 11401, 11402/A, 11403/A	040-1279-02 040-1214-03	12.25	31.1	24.3	61.7	2.4	6.1	31.7	80.5	14.63	37.2	27.75	70.49
11801, 11802, CSA 803A, SM11	040-1214-03	8.75	22.3	21.6	55.0	–	–	–	–	14.63	37.2	27.75	70.49
7704A, 7104, 7934, 7854, 7904A	040-0611-01	15.75	40.0	21.63	54.9	1.25	3.18	30.48	77.4	–	–	–	–
7704A, 7104, 7934, 7854, 7904A	040-0560-00*1	22.0	55.9	21.9	55.6	1.98	5.0	–	–	–	–	–	–
5100, 5400 Series	040-0583-03	5.25	13.3	19.0	48.3	1.1	2.8	24.6	62.5	–	–	–	–
279X Family	016-0844-02	8.75	22.3	17.8	45.2	–	–	–	–	–	–	–	–
278X Family	016-1019-01	8.75	22.3	17.8	45.2	–	–	–	–	–	–	–	–
271X Family	016-0901-00	5.25	13.3	16.3	41.4	1.84	4.67	–	–	–	–	–	–
271X Family	016-0897-00*1	7.0	17.8	18.4	46.7	4.67	11.9	–	–	–	–	–	–
2400 Series (with DV or DMM Opt.)	016-0805-00	8.75	22.3	18.3	46.5	1.8	4.5	24.8	62.9	12.8	32.5	26.8	68.1
2400 Series (w/o DV or DMM Opt.)	016-0825-01	7.0	17.8	18.3	46.5	1.8	4.5	24.8	62.9	12.8	32.5	26.8	68.1
2402 TekMate™	016-0971-00	3.5	8.9	18.0	45.7	1.8	4.5	24.5	62.2	11.0	27.9	23.0	58.4
2335	016-0468-00	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2236, 2236A	016-0015-03	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2235 Opt. 01	016-0833-02	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2235A	016-0833-02	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2220, 2221, 2224, 2230, 2232	016-0833-02	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2213A, 2215A	016-0466-00	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2211, 2214, 2216	016-0819-03*2	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2201, 2205, 2225, 2815	016-0819-03*2	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
1240, 1241	016-0789-00	8.75	22.3	17.75	45.1	1.13	2.9	–	–	–	–	–	–
490 Series	016-0844-02*1	8.75	22.3	17.75	45.1	4.7	11.9	–	–	–	–	–	–
TAS 200/400 TDS 300/400	016-1166-00	7.0	17.8	18.3	46.5	2.2	5.6	24.8	62.9	12.8	32.5	24.5	62.2
DAS9200	016-0845-00	10.5	26.7	23.5	59.7	0.63	1.6	26.5	67.3	23.38	59.4	27.3	69.5
TDS 500/600/700	016-1236-00	7.0	17.8	22	55.9	16.3	41.4	–	–	–	–	–	–
TM 5006, TM 506A	040-0982-04	7.0	17.8	18.0	45.7	–	–	–	–	–	–	–	–
TM 5003	040-1257-02	7.0	17.8	18.0	45.7	–	–	–	–	–	–	–	–
Two TM 503s side by side	040-0616-02	5.3	13.5	16.5	41.9	1.1	2.8	24.6	62.5	–	–	–	–
TM 503 with 1/2 Rackwidth Adapter	040-0617-02	5.3	13.5	16.5	41.9	1.1	2.8	24.6	62.5	–	–	–	–

**1 Cradle mount to rackmount a cabinetized instrument.*

**2 For the 2211, 2201, 2225, 2205 oscilloscopes, and the 2815 Opto-Electronics scope when ordered with a rackmount kit (Option 1R) from the factory, the front feet of the instrument are removed. This reduces instrument height by one-half inch and cannot be reversed. When a field retrofit rackmount kit is installed, the instrument feet will remain integral to the instrument.*

Additional Accessories

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

CATHODE-RAY TUBE LIGHT FILTERS

Instrument*1	Color	Part Number
200 Series	Blue	378-0691-00
324/335	Blue	378-2016-01
490	Amber	378-0115-01
	Gray	378-0115-02
	Blue	378-0115-00
434	Blue	378-0678-01
455/465M	Blue	337-2122-00
465/465B	Blue	337-1674-00
475	Clear	337-1674-01
464/466	Smoke-gray Filter	337-1674-07
576	Blue*2	378-0616-00
603/604	Clear (603*2)	337-1440-00
	Green	337-1440-01
	Amber	337-1440-02
	Blue	337-1440-03
	Gray	337-1440-04
	Graticule (8 x 10 div)	331-0303-00
605/606/607	Blue	337-1674-00
	Graticule (Clear)	337-1674-10
	Clear Shield	337-1674-13
	Gray*2	337-1674-06
608	Amber	378-0704-00
	Graticule*2	337-2126-02
2200 Series	Blue*2	337-2775-00
	Clear	337-2775-01
	Gray w/TV Graticule	035-0175-00
2300 Series	Blue Implosion Shield*2	337-2760-00
2400 Series	Blue*2	378-0199-03
	Clear Implosion Shield*2	378-0208-00
271X Series	Smoke Gray	337-2775-02

CATHODE-RAY TUBE LIGHT FILTERS

Instrument*1	Color	Part Number
5100 & 5400 Series (except 5441)	Clear	337-1440-00
	Green	337-1440-01
	Amber	337-1440-02
	Blue	337-1440-03
	Gray	337-1440-04
5441	Clear*2	337-1674-01
	Gray	337-1674-07
7603	Blue	378-0684-00
	Amber	378-0684-01
	Gray	378-0684-02
	Green	378-0684-03
	Spectrum Analyzer Graticule	337-1439-01
	Blue Implosion Shield*2	337-1700-01
	Clear Implosion Shield	337-1700-04
7613/7623/7623A/7633	Spectrum Analyzer Graticule	378-0625-07
	Green (UV)	378-0625-08
7844/7313	Blue*2	378-0625-00
7700 Series/7613/7623/7100 Series/7900	Amber	378-0625-01
	Gray	378-0625-02
	Green	378-0625-03
	Gray TV Graticule NTSC	378-0625-06
	Clear Shield	
	Spectrum Analyzer Graticule	337-1159-02

CRT MESH/EMC FILTERS

Instrument*1	Color	Part Number
314/326/335	N/A	378-0063-00
432/434	N/A	378-0682-00
422/491/453A/454A/485	N/A	378-0648-00
465/465B/475/464/466/434	N/A	378-0726-01
7400/7603	N/A	378-0696-00
7100/7500/7700/7800/7900 Series/7613/7623/A/7633	N/A	378-0603-00

The mesh filter improves display contrast for instrument 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.

**1 For cabinet and rackmount instruments unless otherwise noted.*

**2 Standard filter supplied with instrument.*

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

Television Products

Building on its success in the video marketplace, Tektronix' Television Division has broken competitive strongholds in the **audio** marketplace with its introduction of the AM700. This advanced mixed signal measurement set brings the power of digital signal processing to analog and digital audio measurement tasks. An advanced user interface relies upon proven CRT-touchscreen, hardkey and keystroke programming elements to control the internal applications and utilities. Conventional measurement capabilities include FFT-based spectral analysis featuring zoom and cursors, plotting analysis, audio waveform display and multitone analysis, etc. The digital interface analyzer measures digital audio time-domain, frequency-domain, and data-domain parameters such as jitter, synchronization and delay, bit activity, and data content.

Addressing **digital** implementation and expansion in video environments, Tektronix introduced several products, among them the WFM601i Serial Component Monitor for operational environments. It provides component displays, including Tektronix-patented Lightning and error detection capability for thorough testing of digital signals. A full line of digital products, including the SDA601 Handheld Analyzer, TSG601 Handheld Generator and the SPG422 Sync Generator, has been designed specifically for digital video environments.

Several new introductions for **cable** customers currently provide the broadest product offerings for CATV test and measurement equipment. Our most notable additions include the RFM150 SignalScout™ Signal Level Meter and TV110 CableScout TDR Cable Tester. Tektronix has the products, service, and education conveniently packaged to help customers maximize their time and potential. A full range of equipment is available for baseband and RF measurements, in manual or automated applications.

A comprehensive line of handheld waveform/vector/picture/audio monitors and low-cost generators has also been added to the list of new products. These application-specific products break significant price/performance barriers while maintaining Tektronix quality. Look for the world's first handheld WFM 90 Series monitors on page 536.

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MPEG TEST SYSTEM

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VM 100 533
1780R/1781R 533

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MPEG Test System

New MTS 100

Features

MPEG TRANSPORT STREAM SIGNAL SOURCE

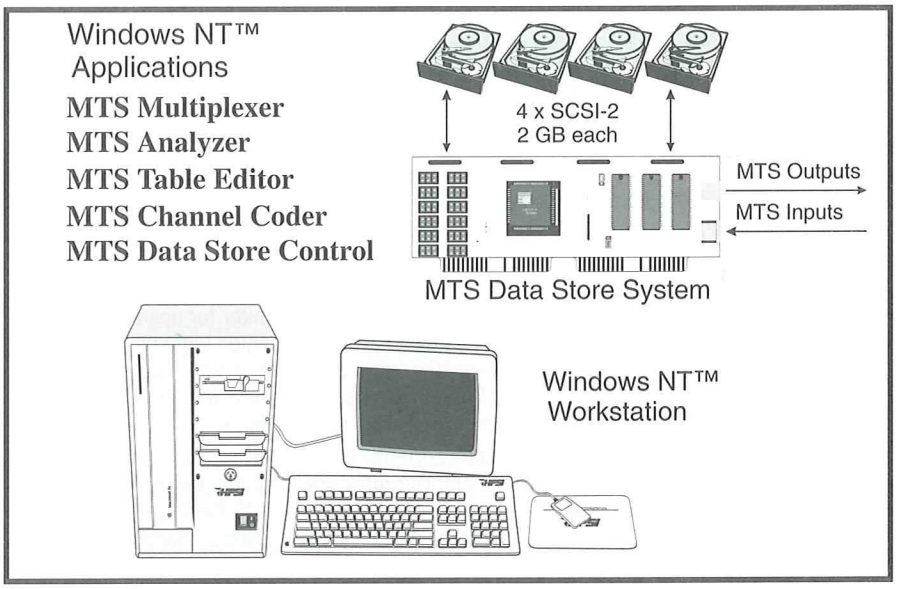
- Bit Rates up to 45 MB/s
- Multiplex Video/Audio/Data
- Up to 20 Programs/Stream
- Up to 10 Elements/Program
- Suite of Elementary Data
- Parameters for Stressing
- Channel Coding

MPEG TRANSPORT STREAM ANALYZER

- Acquire at up to 45 MB/s
- 5 Minutes at Highest Speed
- 8 GB of Active Data Storage
- Hierarchical Data Display
- Program Association Table
- Program Map Tables
- Point-and-click Analysis of Transport & PES Packets, Field Syntax & Semantics
- Graph System Time Stamps
- Identify I, P, B Frames

MULTIPLE DATA I/O PORTS

- TTL Serial Data and Clock
- CCIT G.703
- ECL Parallel and Serial
- Control Port
- RS422 Serial Data and Clock
- Others Under Development



The MTS 100 MPEG Test System generates, acquires and analyzes MPEG 1 and 2 digitized and compressed video, MPEG 2 audio and data transport streams. From a single program with one audio or video elementary stream, to multiple elementary streams in multiple programs, the MTS 100 provides an extensive variety of streams.

Output and acquisition of transport stream data is at rates from 50 KB/s to 45 MB/s. Based on the available 8 GB of hard disk capacity (20 min at 45 MB/s), output and acquisition may be either of limited length, determined by a single file, or continuous using end-to-start looping.

A Windows NT™ workstation is the platform for the MTS 100. Fully configured by Tektronix, the MTS 100 includes the Data Store System and five application programs. Transport stream I/O is provided on a variety of hardware interconnections, including TTL serial and ECL parallel.

Pre-formed transport stream files are provided with the MTS 100, including useful test signals and motion sequences. Using the MTS Multiplexer application, an immense variety of transport streams may be formed based on Tektronix supplied or user supplied elementary data files. Sarnoff MPEG Compliance Bitstreams (525-line system only), which provide an independent certification of MPEG interoperability, are available as an option.

Analysis of transport stream data (in files acquired by the Data Store system) is accomplished with the Windows-based MTS Analyzer. In addition to being a very intuitive analysis program, the MTS Analyzer provides a tutorial view of the MPEG transport stream, including definitions of each field in the transport stream and PES packets, as well as the program association table and map tables.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

ISO 9001 ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

For product detail, request a TV catalog by completing the business reply card in the back of this catalog.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

Initial delivery dates for the MTS 100 will begin in November. Please contact your local Tektronix sales office.

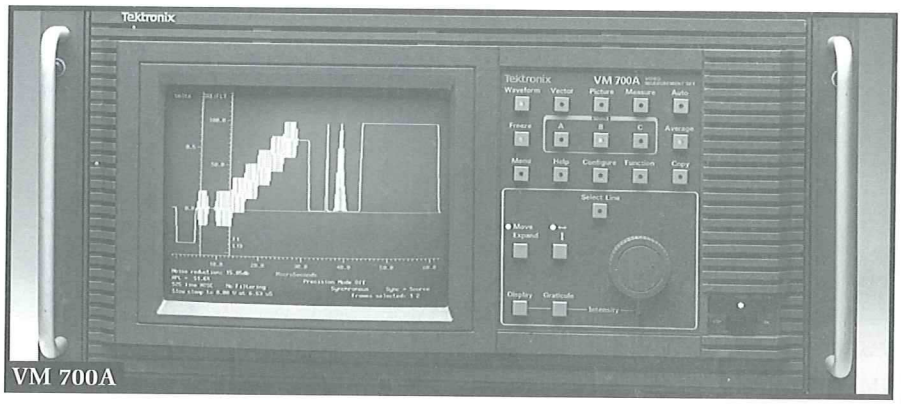
Measurement Sets

VM 700A • Automatic Video and Audio Measurements

Features

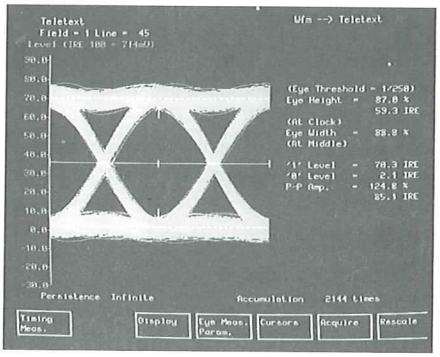
VM 700A

- Video Measurement Set
  - Opt. 01 – NTSC Measurements
  - Opt. 11 – PAL Measurements
  - Opt. 20 – Teletext Measurements
  - Opt. 21 – Camera Measurements
  - Opt. 30 – Component Measurements
  - Opt. 40 – Audio Measurements
  - Opt. 41 – Three Stereo Audio Inputs
  - Opt. 42 – Audio to Video Delay Measurement
  - Opt. 48 – GPIB Interface
  - Opt. 74 – White Phosphor CRT
  - Opt. 1C – Cabinet Version
  - Opt. 1P – Printer (110 V only)
  - Opt. 1Z – Probe Adapter



VM 700A Video Measurement Set

- Many capabilities in one instrument
  - Digital waveform monitor
  - Digital vectorscope
  - Group delay and frequency response
  - Noise measurement set
  - Automatic measurement set
- Auto Mode
  - Unattended monitoring of NTSC or PAL video signals from studios, STLs, earth stations, and transmitters
  - User-specified limits
- Remote control operation
- Automatic measurement of short duration audio test sequence
- Measure frequency response, distortion, phase, crosstalk, and other important audio parameters
- Measure mode provides graphic display of measurements
  - K factor
  - Differential gain and phase
  - Chrominance to luminance delay
  - Noise spectrum
  - Group delay with (Sin x)/x
  - Color bars
  - Relative-to-reference on most measurements
- Three input channels
- Averaging on most measurement modes
- Picture mode for source ID
- Hardcopy for analysis and documentation



VM 700A Option 20 Teletext Measurements

- Provides numerical results
  - Eye height
  - Start of data code
  - Eye width
  - Number of run-in bits
  - Data levels (logical "0" and logical "1" levels)
- Provides graphical displays
  - Eye height with variable persistence
  - Eye height with grading
  - Amplitude histogram
  - Teletext timing
- Multiple clock frequencies
  5.727272 MHz for System M (NTSC)
  6.9375 MHz for System B/G/I (PAL)
- Cursors for manual measurements

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

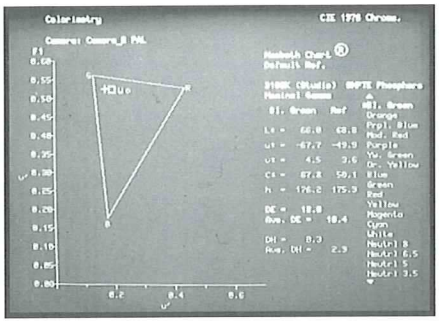
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Video Measurement Sets

Component Measurements • AVTIME



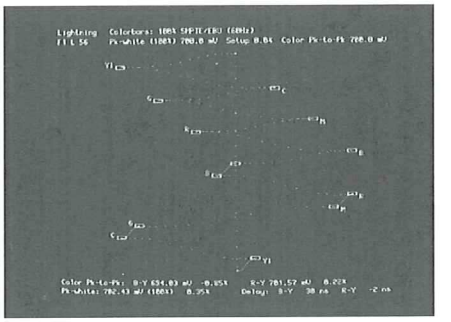
VM 700A Option 21.

VM 700A Option 21 Camera Measurements

- Significantly simplifies key measurements of camera performance
- Compatible with NTSC or PAL cameras
- Automates pre-purchase evaluation and comparison of cameras
- Reduces time spent on acceptance testing, routine maintenance and operational adjustments
- Uses industry standard charts
- Camera matching simplified with relative-to-reference mode
- Ten key measurements:
  - Colorimetry
  - Vertical Smear
  - Gamma
  - Fixed Pattern Noise
  - Frequency Response
  - CDD Defects
  - Shading
  - Detail
  - Geometry/ Registration
  - Frequency Response with Aliasing

VM 700A Option 30 Component Measurements

- Provides numerical results for:
  - Relative timing of B-Y and R-Y
  - Relative amplitude of B-Y and R-Y
  - Peak to peak amplitude for B-Y and R-Y
  - Peak white amplitude
- Compatible with SMPTE/EBU, Sony Betacam®, and MII Formats
- Numerical results in all measurements
- Level meter displays amplitude of all three channels simultaneously
- Configurable for Y/R-Y/B-Y or GBR formats
- Full complement of component analog video measurements and displays



VM 700A Option 30.

VM 700A Option 40/41

- Automatic measurement of short duration audio test sequence
- Combined video and audio performance reports
- Real-time spectral response
- Real-time multitone analyzer
- Stereo audio input
  - Single (Option 40)
  - Three (Option 41)
- Measure frequency response, distortion, phase, crosstalk, and other audio parameters

VM 700A Option 42 Audio to Video Delay Measurement

Option 42 provides the VM 700A with the capability to measure the timing difference between the audio and video portions of a program. The measurement is designed to operate with a Tektronix VITS 200 NTSC VITS Inserter or VITS 201 PAL VITS Inserter, and a Tektronix ASG 140 Audio Signal Generator.

- Measures audio to video delay of transmission paths
- Operates in both NTSC and PAL video standards
- Measures audio to video delay of up to 120 video frames
- Easy to read graphic display

AVTIME Audio to Video Delay Measurement Package

Complete audio to video time delay measurement package including VM 700A with Option 40 audio measurement hardware, audio to video delay measurement Option 42, a VITS 200 Series Inserter, and an ASG 140 Audio Signal Generator.

VM 700A Software

VMBKUP Backup and Remote Control Software

- Backup or restore sets of measurement configuration files, reference measurement files and function key definitions
- Perform individual file and directory operations on both the connected personal computer and VM 700A
- Use to restore backed up files to VM 700A after upgrade
- Control the VM 700A from a PC
- Use Serial Line Internet Protocol (SLIP) for data transfer over RS-232C connection

VMT Remote Control Software

- Controls the VM 700 or VM 700A
- Pull down/pop up menus simplify operation
- Conditional testing of incoming data
- PC based functions
- Text and graphics capture
- Adapts to VM 700A and its options

VMREMGR Remote Graphics Software

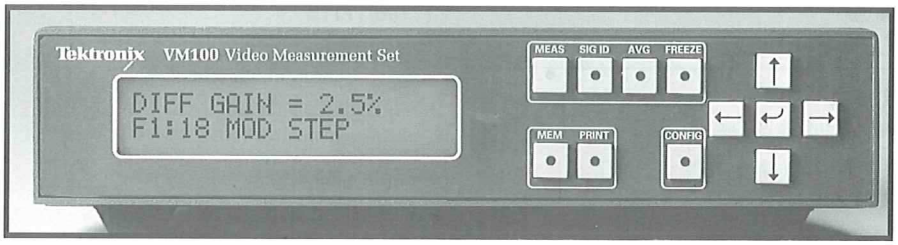
- Display VM 700A graphics on a remote PC
- Perform front panel operations via mouse
- Issue remote commands
- Terminal operations

Automatic & Analog Video Measurement Sets

1780R/1781R • New VM100

VM100

- Automatically Measures 12 Key NTSC Video Parameters:
  - Differential Gain
  - Differential Phase
  - Chrominance to Luminance Gain
  - Chrominance to Luminance Phase
  - Frequency Response
  - 2T K-Factor
  - Hum
  - Signal to Noise
  - Group Delay
  - Bar Amplitude
  - Sync Amplitude
  - Burst Amplitude

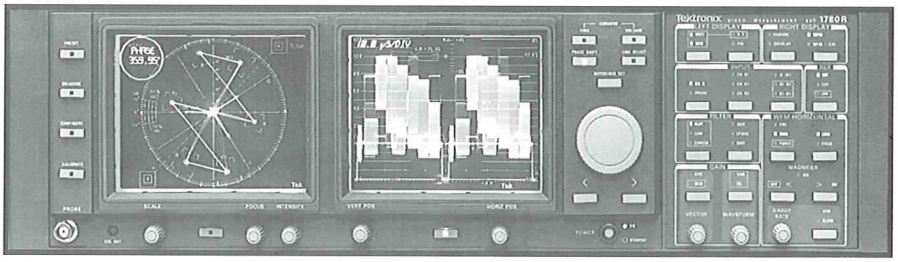


VM100 Low Cost Automatic Video Measurement Set

- Verifies compliance with new FCC cable TV regulations
- Automatic "Signal ID"
- Fast, accurate measurements at a touch of a button
- Average Mode for accurate results in low signal to noise
- Freeze Mode suspends testing to view intermediate results
- RS-232C port for remote access or local printer output
- Simple and intuitive interface
- Internal memory for storage of measurement results
- Internal time clock for dating measurement results

1780R/1781R

- Analog Waveform and Vector Displays
- Touch Screen Control
- 20 MHz Signal Bandwidth
- Bright Line Select
- On-screen Prompts Guide User Through Key Video Performance Measurements



1780R/1781R Video Measurement Sets

- Full bandwidth analog processing
- Precision waveform/vector measurements
- Polar SCH presentation with calibration mode
- Four loop-through video input channels
- Component or composite waveform evaluation
- Measurement-grade time/voltage cursors
- Precision differential phase/differential gain measurements even with noisy signals
- Stereo audio phase and amplitude display
- User definable semi-automatic setups
- Available for either NTSC or PAL standards

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

VM 700A
Video Measurement Set.

Opt. 01 – NTSC Measurements.
Opt. 11 – PAL Measurements.
Opt. 20 – Teletext Measurements.
Opt. 21 – Camera Measurements.
Opt. 30 – Component Measurements.
Opt. 40 – Audio Measurements.
Opt. 41 – Three Stereo Audio Inputs.
Opt. 42 – Audio to Video Delay Measurement.
Opt. 48 – GPIB Interface.
Opt. 74 – White Phosphor CRT.
Opt. 1C – Cabinet Version.
Opt. 1P – Printer Version (110 V only).
Opt. 1Z – Probe Adapter (067-1429-00).

AVTIME – Audio to Video Delay Measurement Package
Opt. 01 – NTSC System with an ASG 140.
Opt. 02 – NTSC System with an ASG 100 in place of an ASG 140.
Opt. 11 – PAL System with an ASG 140.
Opt. 12 – PAL System with an ASG 100 in place of an ASG 140.
VMBKUP – VM 700A Backup and Remote Control Software.
VMREMGR – VM 700A Remote Graphics Software.
VMT – VM 700A Remote Control Software.
VM 100 – Automatic Video Measurement Set.
1780R (NTSC)/1781R (PAL) – Video Measurement Sets.
1780F02 – Portable Carrying Case for 1780R/1781R.
1780F05 – Rackmount Shelf.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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Tektronix Measurement products are manufactured in ISO registered facilities.

For product detail, request a TV catalog by completing the business reply card in the back of this catalog.

Waveform Monitors/Vectorscopes

1710B/1711B • 1720/1730/1740A/1750A/1760 Series

Features

1710B/1711B
- Waveform Monitors

1720/1721/1725
- Vectorscopes

1720 SCH/1721 SCH
- Vectorscopes with SCH

1730/1731/1735
- Waveform Monitors with Line Select

1730 D/1731 D
- Composite Digital Waveform Monitors

1735 HD
- HDTV Waveform Monitors

1740A SERIES
- Combination Waveform Vector Monitors

1750A SERIES
- Combination Monitors with SCH

1760 SERIES
- Combinations Component/Composite Monitors

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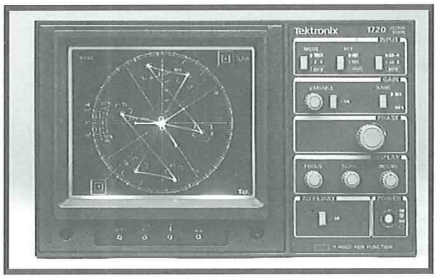
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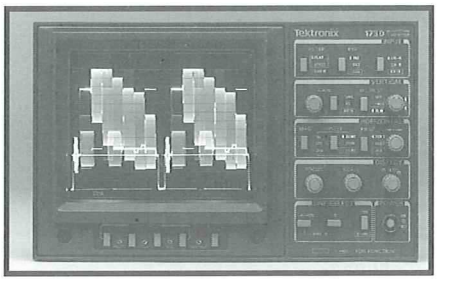
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1710B/1711B
Waveform Monitors
- Easy operation/cost effective
- Burst phase indicator
- Dual filter display
- Bright CRT display
- Available in NTSC or PAL standards

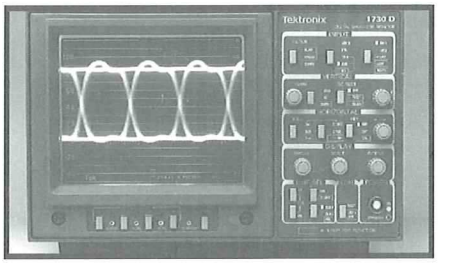


1720/1721/1725
Vectorscopes
- Performance and economy
- Simultaneous channel A and B display
- Stereo audio phase measurement
- R-Y output for differential phase measurement
- Available in NTSC, PAL or dual standard

1720 SCH/1721 SCH
Vectorscopes with Polar SCH Phase Display
- Polar display of relative and absolute SCH phase
- Full line select capabilities when used with 1730 Series Waveform Monitors
- White CRT phosphor available for neutral color display applications
- Stereo audio phase and amplitude display
- Especially useful in editing suites for matched frame editing
- Digital phase shifter
- Available in NTSC (1720 SCH) and PAL (1721 SCH) standards



1730/1731/1735
Waveform Monitors
- Performance and economy
- Complete line select
- Simultaneous channel A and B display
- Differential gain measurement
- One button front-panel recall
- Dual filter display
- VTR servo rates
- Available in NTSC, PAL or dual standard



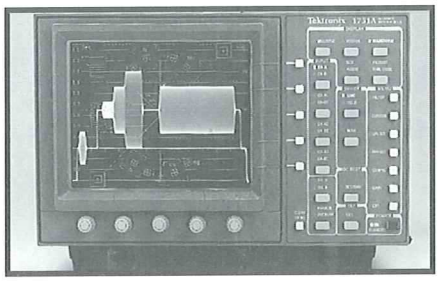
1730 D/1731 D
Serial Digital Waveform Monitors
- Two analog composite inputs
- Two serial digital composite inputs
- One parallel digital composite input
- Passive loop-through for serial inputs
- Precision analog display of digital input
- Full time DAC output
- Serial digital bit stream EYE Pattern display
- Error Detection and Handling display mode (EDH)
- Displays D-2 servo waveforms
- Available in NTSC (1730 D) and PAL (1731 D) versions

Waveform Monitors/Vectorscopes

1710B/1711B • 1720/1730/1740A/1750A/1760 Series

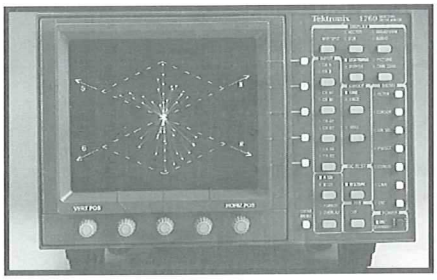
1735 HD
Multiformat Waveform Monitor

- Six video inputs
- 30 MHz video bandwidth
- Excellent performance in high magnifications
- High DC stability with front-panel ground reference
- HDTV and standard video formats
- Full line select in each format
- Subtract mode for intersignal timing



1740A/1750A Series
Analog Composite
Waveform/Vector Monitors

- Easy to use operating system
- Eight video inputs
- Waveform and vector displays
- Picture display for signal identification
- Stereo audio phase/amplitude display
- Time code waveform display
- Waveform and vector cursors
- Front panel presets
- 1750A includes Polar SCH and color framing



1760 Series
Composite/Component
Waveform/Vector Monitor

- Two composite plus two component inputs
- All composite features of the 1740A
- Component vector, Lightning and Diamond displays
- Component picture monitor output
- Optional SCH and color framing

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

1710B (NTSC)/1711B (PAL)
Waveform/Burst Phase Monitor.

1720 (NTSC)/1721 (PAL)
Vectorscope.

1725
NTSC/PAL Vectorscope.

1720 SCH (NTSC)/1721 SCH (PAL)
Vectorscope.

1730 (NTSC)/1731 (PAL)
Waveform Monitor.

1735
NTSC/PAL Waveform Monitor.

1730 D (NTSC)/1731 D (PAL)
Serial Digital Composite Waveform Monitor.

1735 HD
HDTV Waveform Monitor.

1740A (NTSC)/1741A (PAL)
Waveform/Vector Monitor.

1745A
NTSC/PAL Waveform/Vector Monitor.

1750A (NTSC)/1751A (PAL)
Waveform/Vector/SCH Monitor.

1755A
NTSC/PAL Waveform/Vector/SCH Monitor.

1760 (NTSC)/1761 (PAL)
Composite/Component Waveform/Vector Monitor.

1765 NTSC/PAL
Composite/Component Waveform/Vector Monitor.

Opt. SC – (1760/1761/1765)
Adds SCH/Color Framing Display.

Opt. 74 – P4 White Phosphor.
Available on all half-rack 1700 Series products.

ACCESSORIES

1700F00 – Plain Case.
1700F02 – Portable Case.
1700F05 – Dual Rack Adapter.
1700F06 – Blank Panel.
1700F07 – Utility Drawer.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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Waveform Monitor/Vectorscope

WFM 90 • WFM 91 • WFM 300A • WFM 601 • WFM 601i

Features

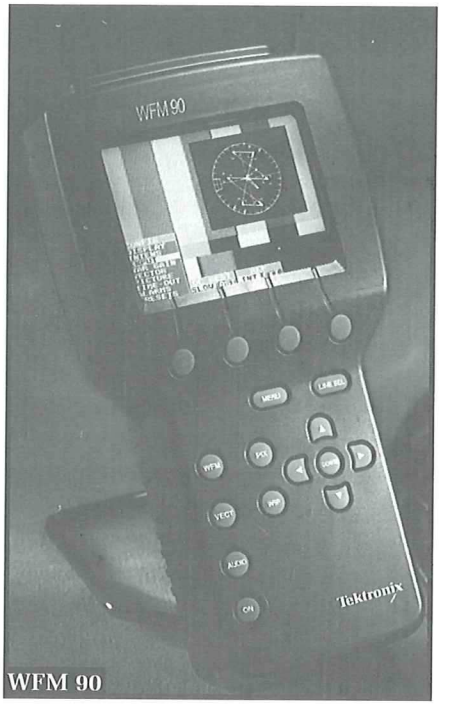
WFM 90
- Handheld NTSC Monitor

WFM 91
- Handheld PAL Monitor

WFM 300A
- Analog Component Monitor

WFM 601
- Serial Component Monitor

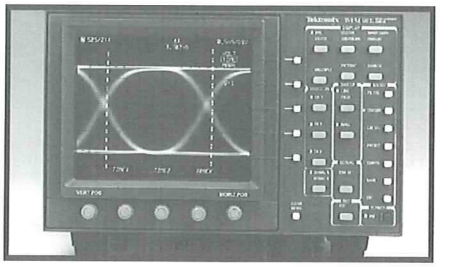
WFM 601i
- Serial Component/Data Monitor



WFM 90

WFM 90 and WFM 91 Handheld Waveform/Vector/Audio/Picture Monitors
- Video waveform, with 1H, 2H, 2F, and magnified displays
- Composite vector display, with x5 magnification
- Audio waveform voltage/time display
- High quality color picture display
- Waveform or vector displays cut into picture
- Output to external picture monitor
- Battery or AC operation with adapter
- Headphone output for audio identification and microphone checks
- Rugged package for field operation
- Available for NTSC (WFM 90) or PAL (WFM 91) operation

WFM 300A
Component/Composite Waveform Monitor
- Component and composite waveform display
- Lightning display for equipment setup and monitoring
- Bowtie display for system timing
- Menu selectable component format options
- Menu selected 625/50 or 525/60 configuration
- Separate GBR and composite picture monitor outputs
- Front-panel user recalls for fast operation



WFM 601/WFM 601i
Serial Component Monitors

WFM601 Series Features:
- Two serial digital component video inputs
- Waveform parade and overlay displays
- Component vector display
- Tektronix Diamond color gamut display
- Tektronix Lightning and bowtie displays
- Waveform time and amplitude cursors
- EDH and date error reporting
- Picture display of Y channel
- RGB picture monitor outputs
- Eight user presets

Features Unique to WFM 601i Series:
- Eye Pattern of 270 MB/s data signal
- Format Checking
- ANC data identification
- Expanded data error reporting
- Active picture CRC readout

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

WFM 90 (NTSC)/WFM 91 (PAL)
Handheld Waveform/Vector/Audio/Picture Monitor.
Opt. 01 – Include NiCad Battery.
Opt. 33 – Travel Package.
Includes: Carrying Case, NiCad Battery, Desk Stand and Viewing Hood.

WFM 300A
Component/Composite Monitor
Opt. 05 – Delete Color Shutter.
Opt. 10 – NTSC/BETACAM Transcoder.
Opt. 14 – NTSC/MII Transcoder.

WFM 601
Serial Component Monitor.

WFM 601i
Serial Component Monitor with Eye Pattern.

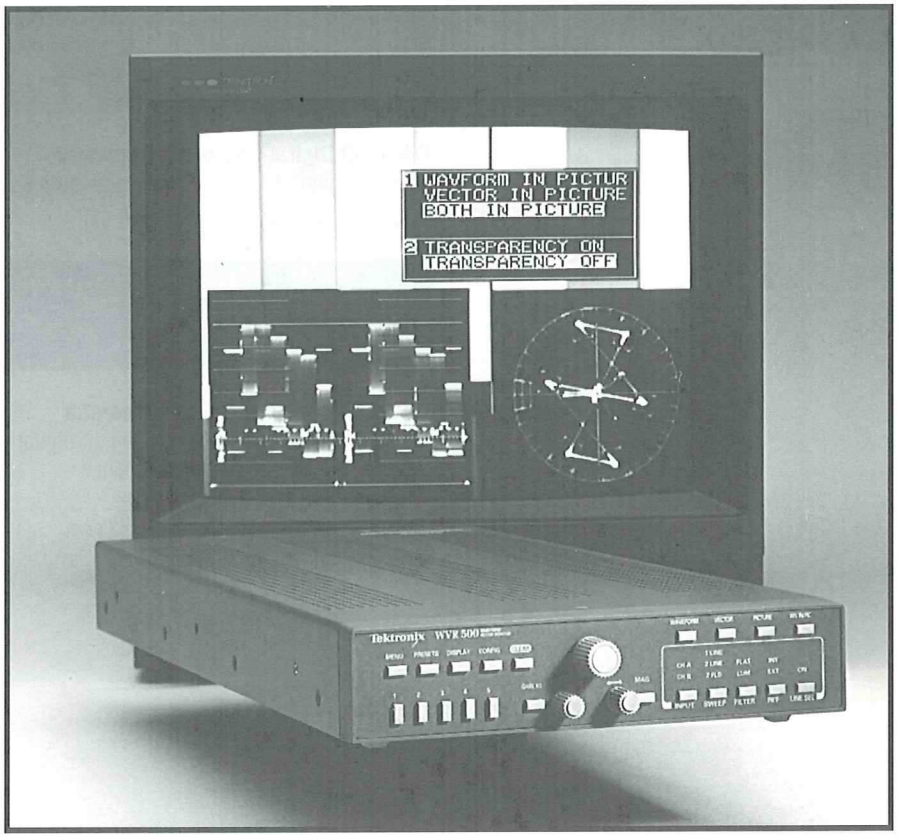
Waveform Monitor/Vectorscope

WVR 500

Features

WVR 500

- NTSC/PAL Waveform/Vector Rasterizer



(Monitor not included)

WVR 500 Waveform/Vector Rasterizer

- Rasterizes NTSC or PAL video signal for picture monitor display
- High quality display of live or test waveforms
- Full field or cut-in waveform and vector displays
- Safe title/safe action area indication
- No processing of picture, even in cut-in modes
- Line select for VITS observation
- Local or RS-232 control
- Small, single unit package
- Compatible with Tektronix mounting system
- Ideal for dual-standard applications
- Safety certified to UL, CSA, and VDE standards

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ORDERING INFORMATION

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WVR 500
Waveform/Vector Rasterizer.

Generators/Inserters

TSG 170D • TSG 422

Features

- TSG 170D
- TSG 422



TSG 170D Digital Composite Generator

- NTSC digital and analog test signal outputs
- Optional serial digital video outputs
- Digital and analog audio tone outputs
- SMPTE RP 154 black burst output for master SPG application



TSG 422 Digital Component Generator

- D1 VTR and other 4:2:2 component digital equipment testing and maintenance
- Conforms to ITU-R BT.601/656, SMPTE 125M, and EBU Tech. 3267-E
- 10- or 8-Bit signal generation
- Digital video test signal outputs
- Serial digital video output (Opt. 1S)
- Separate Y, B-Y, R-Y clock outputs
- 525/60 and 625/50 operation
- NTSC or PAL black burst outputs
- Sync lock to 525/60 or 625/50

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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ORDERING INFORMATION

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TSG 170D
NTSC Digital Composite Generator.

Opt. 1V – VM 700A Signal Set.
Opt. 1S – Adds Serial Digital Video Outputs.

TSG 422
Digital Component Generator.
Opt. 1S – Adds Serial Digital Video Outputs.

Generators/Inserters

SPG 422 • ECO 422

Features

- SPG 422
- ECO 422



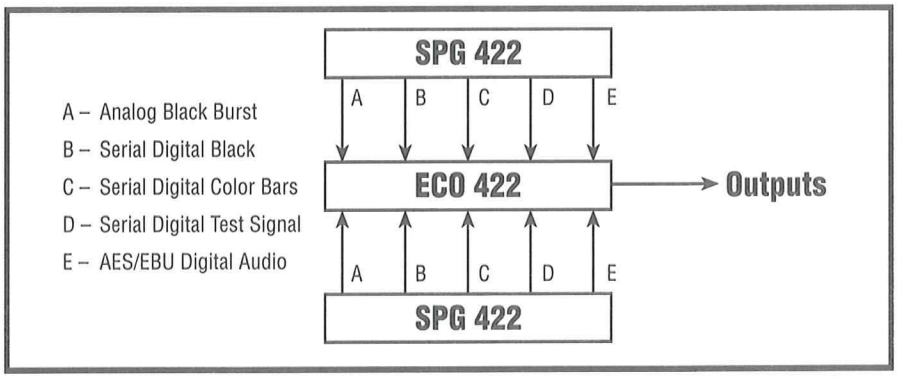
SPG 422 Component Digital Master Sync Generator

- PAL/NTSC, 525/625, or dual standard operation
- Multiple, independently timeable black burst outputs
- High stability internal reference with genlock
- Full time serial digital bars and black outputs
- AES/EBU digital audio outputs
- Optional serial digital test signal output
- RS-232 or ground closure remote control



ECO 422 Changeover Unit

- Switches analog black and serial digital video and audio
- Eleven user configurable signal channels
- Amplitude detection on all channels
- Automatic or manual operation
- Fault and operating mode indicators



Component digital master sync system. The ECO 422 provides eleven user configurable signal channels, each consisting of primary and backup inputs and an output.

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ORDERING INFORMATION

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SPG 422
Component Digital Master Sync Generator.

Opt. 01 – Adds Four Additional Analog Black Burst Output.

Opt. 02 – Adds a Serial Digital Test Signal Generator.

ECO 422
Changeover Unit.

Generators/Inserters

TSG 95 • TSG 100 • TSG 111 • TSG 120

Features

- TSG 95
- TSG 100
- TSG 111
- TSG 120



TSG 95 Handheld PAL/NTSC Signal Generator

PAL:
- 75%, 100% Bars
- 75% Bars over Red
- 100% Bars over Red
- Green, Blue, Red Field
- 100%, 50%, 0% Flat Field
- Multiburst
- 60% Reduced Line Sweep
- Bounce
- 5 Step (Gray Scale)
- Modulated 5 Step
- Convergence
- Plug
- Matrix
- Field Square Wave
- Safe Area

NTSC:
- SMPTE Bars
- 75% Bars
- Multiburst
- Cable Multiburst
- Cable Sweep
- NTC7 Composite
- NTC7 Combination
- FCC Composite
- 5 Step (Gray Scale)
- Red Field
- Field Square Wave
- 30 IRE Flat Field
- 50 IRE Flat Field
- 0 IRE No Burst
- Black Burst
- Sin (x)/x
- Convergence
- Matrix
- Safe Area/Safe Title

AUDIO:
- Stereo with Click ID
- Programmable Frequencies and Levels

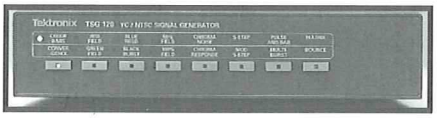
CHARACTER ID:
- 2 16 Character Lines
- 4 Memories



TSG 100 NTSC Signal Generator
- Studio and transmission test signal sets
- 8-Bit digital generation
- Conforms to SMPTE RP 154 timing specifications
- 1 kHz audio tone
- H or V rate scope trigger signal
- DC power option
- Compact and lightweight



TSG 111 PAL Signal Generator
- Low cost test signal generator
- Tailored for service applications
- High accuracy (12-Bit) signal generation
- Two channels of audio tone with channel one identification
- Compact and lightweight



TSG 120 YC/NTSC Signal Generator
- Low cost test signal generator
- NTSC; Y, C and Y/C outputs
- Stereo audio outputs
- Ideal for equipment maintenance

Cable Option for TSG 120 (Option 02)
- Special signals to test cable systems to FCC requirements

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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TSG 95
Handheld Generator.
Opt. 01 – NiCad Battery Pack.

TSG 100
NTSC Test Signal Generator.

TVGF10 – Single Half-rack Mount (for TSG 100 only) To Mount to 1700F02.
Opt. 01 – Transmission Test Signal Set.

TSG 111
PAL Signal Generator.
Opt. 10 – ±5 Hz Internal Reference.

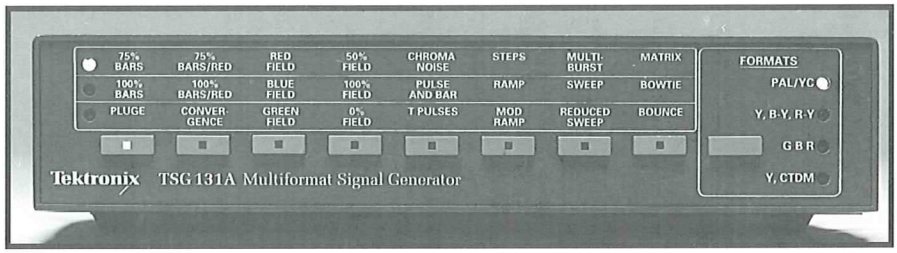
TSG 120
YC/NTSC Generator.
Opt. 01 – Adds Black Burst Output.
Opt. 02 – Cable Signal Set.

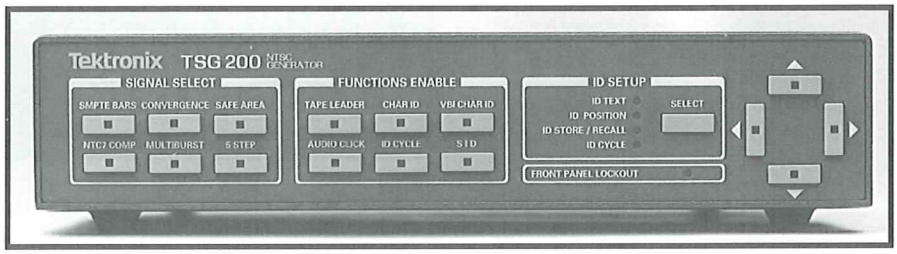
Generators/Inserters

TSG 130A • TSG 131A • TSG 200

Features

- TSG 130A
- TSG 131A
- TSG 200





TSG 130A/TSG 131A Multiformat Generators

- Low cost test signal generator
- NTSC or PAL; Y,C; Y/C; Y, B-Y, R-Y; GBR and CTDM outputs
- Betacam® or MII levels
- Optional black burst output
- Stereo audio outputs
- Ideal for equipment maintenance

TSG 200 NTSC Signal Generator

- NTSC test signals
- Multiple black burst outputs
- Character identification positionable within the active field
- Tape leader countdown with visual and audio cues
- Stereo audio tone with CH 1 identification
- 12 V DC input
- Remote control
- Applications:
  - Compact production system SPG
  - Bars/ID source for microwave links

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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ORDERING INFORMATION

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TSG 130A
Multiformat Generator (NTSC).

Note: Only Opt. 01 and 02 may be combined.

Opt. 01 – MII Test Signals (replaces Betacam® signals).

Opt. 02 – Adds a Dedicated Black Burst Output.

Opt. 2J – 0 IRE Setup and Black Burst.

Opt. 03 – Sony PVW Series Service. Includes: Special test signal set, black burst output, and TTL level color frame pulse output.

Opt. 04 – Panasonic MII Service. **Includes:** Special test signal set and TTL level comp sync and frame pulse outputs.

TVGF11A – Single Rack Mount Adapter.

TVGF13 – Dual Rack Adapter.

TVGF14 – Dual Half-rack Adapter.

TSG 131A
Multiformat Generator (PAL).

Note: Only Opt. 01 and 02 may be combined.

Opt. 01 – MII CTCM Signals.

Opt. 02 – Adds a Dedicated Black Burst Output.

Opt. 03 – Sony PVW Series Service. Includes: Special test signal set, black burst output, and TTL level color frame pulse output.

Opt. 04 – Panasonic MII Service. Includes: Special test signal set and TTL level comp sync and frame pulse outputs.

Opt. 10 – ±5 Hz Internal Reference.

TSG 200
NTSC Signal Generator.

Generators/Analyzer

TSG 601 • SDA 601

Features

- TSG 601 Serial Digital Generator
- SDA 601 Serial Digital Analyzer



TSG 601/SDA 601 Serial Digital Component Data Analysis Set

The TSG601 Serial Component Generator provides Serial Digital Interface (SDI) check field test signals that stress receiver clock recovery and phase lock loop circuitry. Data signal launch amplitude may be varied over the SMPTE specification range to check equalizer performance, and a built in 50 meter cable simulator may be used to quickly check available signal strength margin.

The SDA 601 Serial Digital Analyzer provides analysis of the incoming digital television signal with the push of a button, quickly identifying data errors and indicating the presence and status of SMPTE RP165 and other ancillary (ANC) data signals. The analysis results may be displayed on the built-in LCD screen, on a picture monitor, or transferred directly to a printer or PC for further analysis.

SDA 601 Handheld Serial Digital Analyzer

- Video Format Analysis
- Data Format Analysis
- Transport Layer Analysis
- Video Content Analysis
- Picture ID Output
- Cursor with Data Word Value Display

TSG 601 Handheld Serial Component Generator

- 75% color bars
- 100% color bars
- Pluge, BBC version 1
- Pluge, BBC version 2
- 5 Step staircase
- Limit ramp
- Convergence
- PLL SDI checkfield
- Equalizer SDI checkfield
- SDI checkfield matrix
- Valid (encodes to PAL or NTSC) 5 step modulated staircase
- Valid modulated pulse and bar
- 60% line sweep with markers at 0.5, 1.0, 3.0, 4.0 and 5.0 MHz
- 500 kHz reduced amplitude bowtie
- Shallow ramp, settable levels
- Active picture markers
- Programmable Embedded Audio
- Return Loss Alarm
- Passive Cable Simulator
- Character ID
- User Presets

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SDA 601
Handheld Serial Digital Analyzer.
Opt 01 – NiCad Battery Pack.

TSG 601
Handheld Serial Component Generator.
Opt 01 – NiCad Battery Pack.

Generators/Inserters

TSG 170A • TSG 271 • TSG 371

Features

- TSG 170A
- TSG 271
- TSG 371



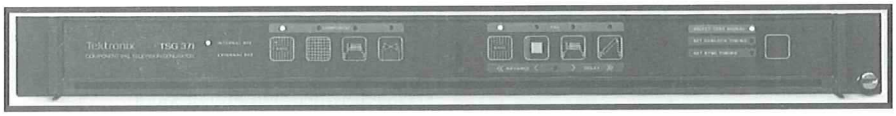
TSG 170A NTSC Television Generator

- Simple, effective test signal complement
- Correctly SCH phased sync pulse generator with digital genlock
- Separate SMPTE bars with programmable ID (Opt. 01)



TSG 271 PAL Television Generator

- Precise 12-Bit digitally derived test signals
- SCH phase accuracy, guaranteed by use of a single D AC
- Conforms to EBU Statements D23 and D25
- Stable internal reference, ideal for master sync operation



TSG 371 Component/Composite Television Generator

- Analog component and composite test signals
- Simultaneous and independent component and composite test signal outputs
- High stability, correctly SCH phased internal sync generator

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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TSG 170A
NTSC Television Generator.

Opt. 01 – Adds separate SMPTE Bars Output with 12-character ID, Audio Tone Output and Tape Leader Countdown.

Opt. 1V – VM 700A Signal Set.

TSG 271
PAL Television Generator.

Opt. 01 – Character ID and Audio Tone Output.

Opt. 05 – PAL-D Signals.

TSG 371
Component/PAL Television Generator.

Generators/Inserters

SPG 1000 • TSG 1001 • TPG 20 • VITS 100 • VITS 200 • VITS 201 • 1910

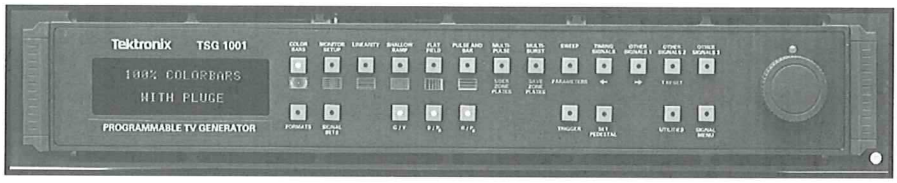
Features

- SPG 1000
- TSG 1001
- TPG 20
- VITS 100
- VITS 200
- VITS 201
- 1910



SPG 1000 MULTIFORMAT HDTV Sync Generator

- Master sync generator for high definition television systems
- Sync locks to HDTV, NTSC, and PAL
- Color bars and monitor setup test signals
- Provides genlock function for TSG 1000 Series Generators



TSG 1001 Programmable TV Generator

- Multiformat, programmable test signal generator
- Programmable zone plate generator
- SDP 1000 Signal Development Package
- PC based software program
- Waveform editing and creation
- PC to generator test signal downloads
- Internal or external clock operation
- SMPTE/EBU, Betacam®, MII, NTSC analog, NTSC composite digital, CCIR 601 component digital, and HDTV test signal libraries
- 10-Bit signal generation
- 30 MHz bandwidth
- Analog and parallel digital test signal outputs
- Battery backup for RAM signal memory
- Programmable trigger function for waveform analysis



TPG 20 Test Pattern Generator

- Multiformat test signal pattern and image generator
- Serial and parallel composite and component digital outputs
- Analog composite, Y/C, Y and Color Difference and GBR and Sync output
- 10-Bit resolution on three independent channels
- Instant switching between any two patterns
- Controllable moving patterns
- Fully genlockable
- Supports VM 700A measurement routines
- Conforms to digital standards CCIR 601, 656: EBU Tech 3267, SMPTE 125M, 244M, 259M, 267M
- Compatible with 16:9 EDTV standards

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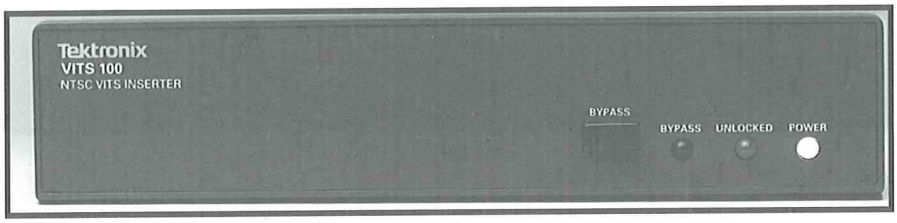
Generators/Inserters

SPG 1000 • TSG 1001 • TPG 20 • VITS 100 • VITS 200 • VITS 201 • 1910



VITS 201 PAL Insertion Generator

- CCIR, EBU, UK National ITS
- Operates in the presence of sound in syncs
- Four external ITS inputs
- Comp Sync output
- Source identification
- All user program settings saved in non-volatile storage
- User programs for:
  - Insertion of internal, external, and source identification signals
  - Loss of program input modes



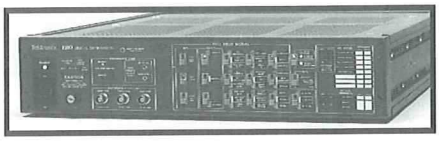
VITS 100 NTSC Generator/Inserter

- Low price generator/inserter
- NTC7, FCC, and VIR signals
- VM 700A recognizable vertical interval source identification
- Cable signal set (Opt. 02)
- Special features for PAL-M systems (Opt. 1M)



VITS 200 NTSC Generator/Inserter

- Full capability generator/inserter for use at the facility output point
- NTC7, FCC, VIRS, and GCR signals
- Four external VITS inputs
- VM 700A compatible vertical interval source identification
- Text generator for full field and vertical interval messages
- Sync and burst regeneration
- Full field test signal output
- RS-232C and ground closure remote control
- Loss of program continuity mode (standby mode)



1910 NTSC Digital Generator/Inserter

- Studio, transmitter, and transmission test signals
- 10-Bit signal generation
- RS-232C control port
- Four external VITS inputs
- Non-volatile memory to maintain selected VITS and full field signal configuration after power interruption
- Ghost Canceller Reference (GCR) signals available in standard product

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

SPG 1000
HDTV Sync Generator.

TSG 1001
Programmable TV Generator.

TPG 20
Test Pattern Generator.

VITS 100
NTSC Generator/Inserter.
Opt. 02 – Cable signal set.
Opt. 1M – Special features for PAL-M systems.

VITS 200
NTSC Generator/Inserter.

VITS 201
PAL Insertion Generator.

1910
NTSC Digital Generator/Inserter.
Opt. 01 – GCR signal and 0% setup test signals.
Opt. 03 – CBC test signals.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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Digital Audio Monitor
New 764

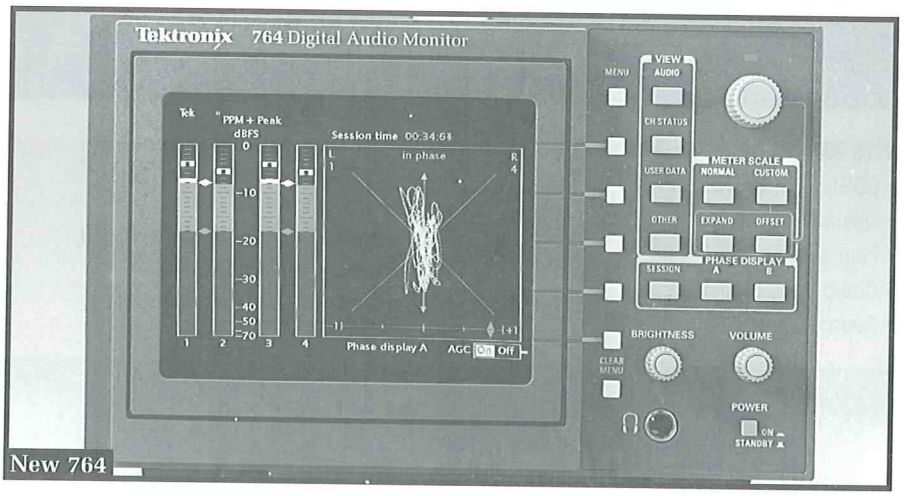
Features

NEW 764

- Two AES/EBU Input Channels with Loop-through Capabilities
- Four-channel Level Metering
- Phase Display With Correlation Meter
- Session Statistics
- Channel Status Decoding

Applications

- Consoles and Workstations
- DAT, D1, D2, D3, etc.
- Digital STL for Radio
- A/D Testing and Alignment
- Digital Audio Routers
- Signal Processing
- Duplication and Mastering



764 Digital Audio Monitor

The Tektronix 764 is an advanced monitoring tool for production and quality assessment in modern digital audio facilities. It combines the features of a phase and level meter with those of a digital audio data monitor. The 764 provides technical personnel with a setup and calibration tool and production personnel with an operational monitor capable of conventional and advanced audio assessment tasks.

The 764 is well equipped for these tasks. Easy-to-read display screens can be viewed from across a room. An auxiliary VGA output supports larger color display units. Its two AES/EBU input channels have loop-through capability permitting the 764 to be assigned to any signal path. Operation follows an easy-to-use, menu-driven scheme.

AUDIO LEVEL

Audio amplitude measurement results are displayed on up to four bar graphs. Most characteristics can be configured to user preferences. This includes the amplitude scale and ballistics, peak-hold characteristics and the value of test and peak levels. Other features include detection of digital clipping and muting and detection of system errors.

SESSION STATISTICS

The 764 records critical level parameters and several types of data and format errors for each session. These events/errors are time stamped with either Vertical Interval or Longitudinal Time Code to simplify their location on a digital audio workstation.

AUDIO PHASE

A Lissajous display is augmented with a mathematical phase correlation meter. In addition, selectable Sum and Difference bars provide an additional phase assessment tool.

SYSTEM TIMING

A Digital Audio Reference input, conforming to AES recommendations, permits 764 users to assess timing relationships between digital audio signals. Common problems due to sample slipping and non-locked signals can easily be detected.

CHANNEL STATUS AND USER DATA

Channel status and user data are recovered and displayed in contiguous 24-byte blocks. This allows the content and format of these auxiliary data channels to be monitored.

Channel status data is decoded into English, simplifying data analysis.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

See Tektronix on the World Wide Web: http://www.tek.com

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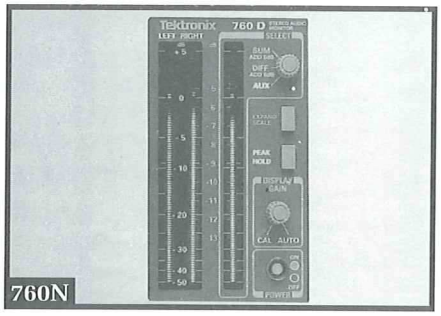
764
Digital Audio Monitor.

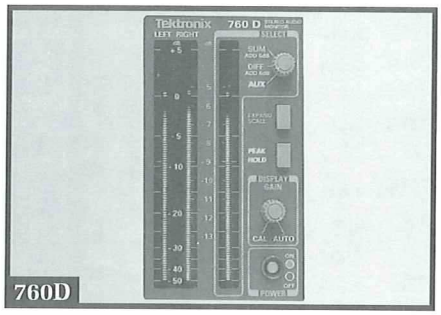
ACCESSORIES

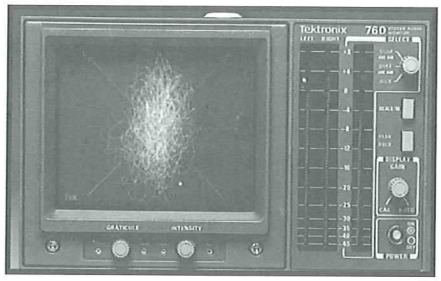
1700F00 – Plain Case.
1700F02 – Portable Case.
1700F05 – Dual Rack Adapter.
1700F06 – Blank Panel.
1700F07 – Utility Drawer.

Audio Monitors/Generators

760N • 760D • 760A • ASG 100 • ASG 140







With Tektronix' 760 Series Stereo Audio Monitors, 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. Three product versions are available with various scales: 760A (standard), 760N (Nordic), or 760D (DIN) (see photos).



760 Series 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 mono compatibility when set to L+R
- Suitable for phase and amplitude measurements
- Optional Nordic or DIN Scale
- Scale and dynamics conform to proposed IEEE ppm standard
- EXPAND SCALE feature increases resolution at –8 dB (760A) level for accurate line-ups
- White phosphor CRT option available

ASG100

- Dual channel for stereo applications
- Balanced inputs and outputs
- Connects in-line for easy test signal insertion
- Quick identification of insertion point with voice ID

ASG 140

- Four output channels
- 10 Ω output impedance
- Ideal for VTR maintenance

ASG 100/ASG 140 Common Features

- Short duration audio test sequence for rapid automatic checkout of audio lines
- Single button selection of line-up tone
- Tone, multitone, polarity and sweep signals
- Manual mode allows selection of frequency and amplitude
- Quick identification of insertion point with voice ID
- RS-232 for remote control

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

760N
Stereo Audio Monitor.

Opt. 74 – White Phosphor CRT (760 Series).

760D
Stereo Audio Monitor.

760A
Stereo Audio Monitor.

ASG 100
Audio Signal Generator.

ASG 140
Four Channel Audio Generator.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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Audio Analyzer

UPD04 • UPD05

Features

UPD04 • UPD05

- Compact Unit with Integrated PC
- Two-channel Measurement for Fast and Effective Stereo Measurements
- Comprehensive Range of Analysis Modes Through Built-in FFT Analyzer
- Quick and Easy Implementation of New Measuring Functions via 3.5 inch Diskette
- All Measurements with any Combination of Input and Output (AA, AD, DA, and DD)
- Flexible Application Through Almost Unlimited Range of Filters
- Extremely High Dynamic Range for Measurements on High-end Equipment
- High Measuring Accuracy and Speed
- Fast and Simple Operation

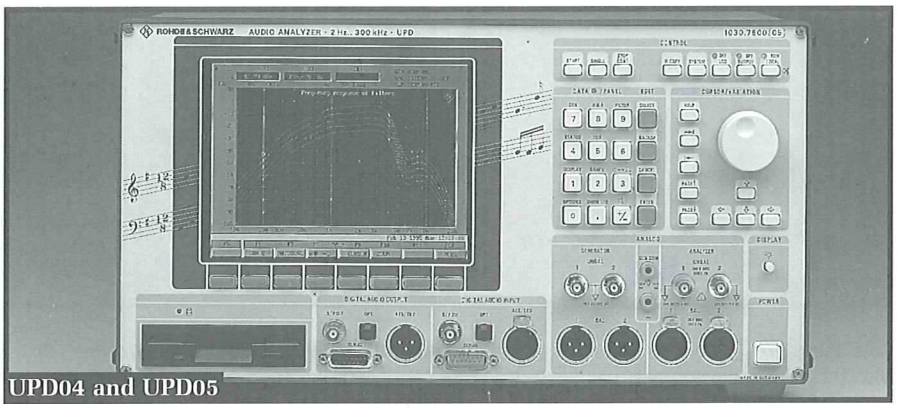
Applications

- Entertainment Electronics: DCC, Mini-discs, CD Players, Cassette Decks, Amplifiers, Tape Decks, Car Hi-fi
- Professional Studio Technology: Audio Mixers, Tape Machines, DAT Recorders, Sampling Rate Converter, Sound Processors
- Transmission Links
- Modules and Components: ADC, DAC, Equalizers.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

ROHDE&SCHWARZ

Rohde & Schwarz' quality system complies with the DIN ISO 9001 standard and has been certified by DQS (German Association for the Certification of Quality Systems).



UPD04 and UPD05

UPD Audio Analyzer

The market for audio products gets more and more sophisticated by the day. And the demands made on measurements – from development to production and monitoring – get tougher and tougher. Analog technology has reached the limits of the physically possible, but digital technology opens a totally new dimension. What's needed is a first-class audio analyzer with digital technology, equipped to meet the full range of current analog and digital measuring tasks – open and programmable for the future. The UPD Audio Analyzer is truly a versatile state-of-the-art analyzer that can measure the best that audio technology has to offer with unbeatable accuracy.

A COMPLETE SOLUTION

The UPD Audio Analyzer is a compact, universal measuring instrument with built-in generators for measuring the full range of audio parameters at analog and digital interfaces. The UPD provides fast measurements and is equipped with all commonly used interfaces. Windowing and user prompting make the UPD easy to use despite the large number of measurement and signal generation possibilities.

The latest digital signal processing capabilities, an extensive range of analysis modes, and Fast Fourier Transform (FFT) give you peace of mind, now and for the future – the technology used in the UPD allows the implementation of new measuring functions simply by loading new or updated software.

MEASURE ANYTHING AT ANY INTERFACE

Equipped with all common interfaces, the UPD can measure just about anything. In the future, you won't need three measuring instruments – just one, the UPD. No matter what interface you have, we'll make the connection.

PROGRAMMED FOR THE FUTURE

Digital filters and signal processing mean superb accuracy and great flexibility. Since filters and signal processing are software-implemented, new features can be added easily. With other instruments, changes in testing requirements call for the purchase of new test equipment. Not with the UPD! A software update is all that's needed.

EASY TO OPERATE

Despite the wide range of functions offered, intelligent user prompting and context-sensitive help keep the UPD remarkably simple to operate. Routine measurements become truly routine – just call up settings, carry out the measurement, and generate the protocol at the press of a key. Because familiarization is so fast and easy, you save both time and costs.

ORDERING INFORMATION

For price information: Outside the U.S. contact your local Tektronix representative, inside the U.S. see the price list in the back of this catalog.

UPD04
Audio Analyzer with monochrome display.
Opt. B1 – Low Distortion Generator.
Opt. B2 – AES/EBU Interface.
Opt. B3 – High Speed Extension.
Opt. B4 – IEC-625/IEEE-488 Bus.

UPD05
Audio Analyzer with color LCD display.
Opt. B1 – Low Distortion Generator.
Opt. B2 – AES/EBU Interface.
Opt. B3 – High Speed Extension.
Opt. B4 – IEC-625/IEEE-488 Bus.

UPDK1
Universal Sequencer Controller Software.

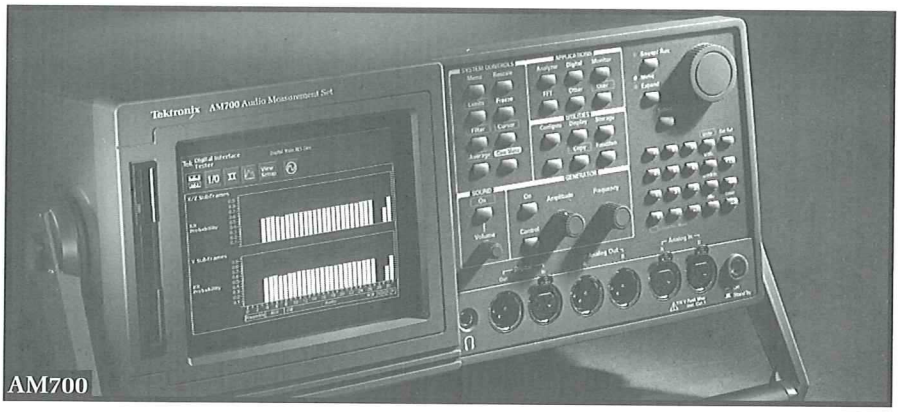
RECOMMENDED ACCESSORIES
19 Inch Rack Adapter. Includes Front Handles. Order ZZA-95.
Service Manual – Order 1030.7551.24.

Audio Measurement Set
AM700

Features

AM700

- Programmable Audio Analyzer
- Programmable Audio Generator
- Analog Audio Inputs/Outputs
  - Balanced
- Digital Audio Inputs/Outputs
  - AES/EBU
  - SPDIF
  - Optical
- Manual and Automatic Measurements
- GPIB Remote Control
- Benchtop or Portable Operation



AM700

AM700 Audio Measurement Set

The Tektronix AM700 provides audio professionals operating in a mixed-signal environment a powerful tool set for design, manufacturing, quality control, installation and service applications. An intuitive user interface allows first-time users to immediately perform common tasks with accuracy and repeatability.

A totally self-contained instrument, the AM700 requires no personal computer, external display monitor or separate signal generator to stimulate and analyze audio equipment and display measurement results. This level of integration makes the AM700 a truly portable measurement system.

FFT ANALYZER
Two-channel, wideband FFT analysis has never been easier. Selecting windowing schemes, averaging and cursors is accomplished through touch-screen menus. The zoom mode provides variable frequency resolution. The AM700 can record maximums and minimums to track signal deviation over time.

PLOTTING ANALYZER
The AM700's plotting analyzer is exceptionally flexible. It provides plots of dependent parameters like level, phase and distortion against independent parameters like level and frequency. Cursors, filters, zoom and relative-to-reference add to the functionality of this two-channel analyzer.

MULTITONE ANALYZER
Real-time analysis of both user-defined multitones and standard multitones simplifies many analysis, adjustment and measurement operations. The AM700 multitone analyzer is compatible with multitone signals from the Tektronix ASG 100/140 Audio Signal Generators, the portable AM70 Digital Audio Analyzer/Generator, and generates multitones compatible with the VM 700A Video Measurement Set, as well as other popular test equipment.

MONITOR MODE
The "Waveform" provides oscilloscope displays of input, output, and residual signals like harmonic distortion. Headphone jack permits users to listen to these signals as well.

DIGITAL INTERFACE ANALYZER
Measurement and analysis of the digital signal in the analog domain is critical for ensuring that the signal conforms to technical standards. Whether troubleshooting equipment interface problems or designing interface circuitry, this analyzer provides an eye pattern display, jitter, and time-domain measurements.

AUDIO GENERATOR
For every function listed above, the internal programmable generator can produce a complimentary signal in digital or analog form (as appropriate).

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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ORDERING INFORMATION

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AM700
Audio Measurement Set.
Opt. 1F – Adds ASW100F Switch.
Opt. 1M – Adds ASW100M Switch.
Opt. 1P – Adds Epson Serial Printer.

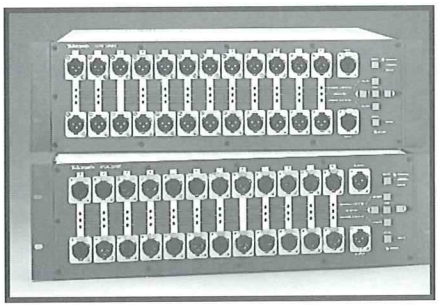
ACCESSORIES
AM7FR1 – Rack Mount Kit.

Audio Switchers, Digital Audio Analyzer

ASW100M • ASW100F • AM70

Features

- ASW100M
- ASW100F
- AM70



ASW100M Output Switcher
ASW100F Input Switcher

The Tektronix ASW100 Measurement Grade Audio Switchers permit the inputs and outputs of analog audio test equipment to be switched between multiple signal sources and destinations. ASW100 instructions contribute no measurable degradation to signals under test.

- Balanced signal paths
- Manual controls
- RS-232 and GPIB operation
- Cascadable
- Cable shield lifts
- Universal power supply
- Rackmount

Calibration and Testing of Audio Equipment

- Multitrack tape decks
- Mixing consoles
- Surround sound gear

Monitoring Multiple Devices Under Test

- Burn-in test chamber
- Powered life testing

Routing Ultrasonic Signals

- BTSC baseband signals
- RDS-modulated signals
- SCA-modulated signals



AM70 Handheld Digital Audio Analyzer/Generator

- Balanced analog outputs
- Balanced/unbalanced digital inputs and outputs
- Optical inputs and outputs
- Internal speaker/headphone jack
- Battery powered

Installation and Troubleshooting

- Signal tracing in analog and digital domains
- Confidence monitoring of digital audio signals

Digital Compatibility Debug

- Resolving data compatibility problems
- Digital audio format conversion

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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ASW100M
Output Switcher.

ASW100F
Input Switcher.

AM70
Handheld Digital Audio Analyzer/Generator.

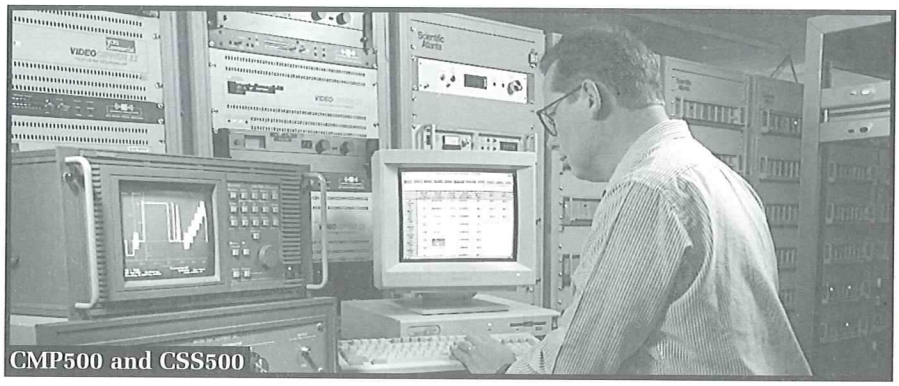
Opt. 01 – NiCad Battery Pack.

RF/Cable Measurement Packages

CMP500 • CSS500 • CMP100 • CMP200 • CMP400

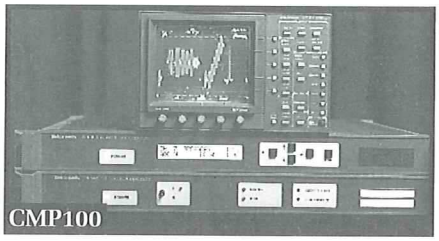
Features

- CMP500
- CSS500
- CMP100
- CMP200
- CMP400


CMP500 and CSS500

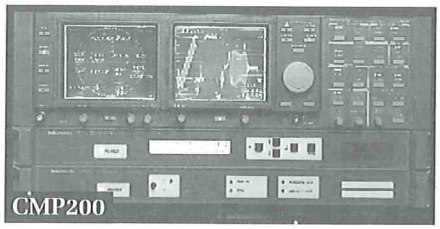
CMP500 Cable Television Measurement Package/CSS500 Cable Television System Software

- Delivers baseband video and RF measurement performance unmatched in the industry
- Performs all recommended baseband and RF measurements including the FCC requirements
- Includes easy-to-use Windows-based control software
- Automatically monitors results and displays alarm when out-of-service measurement limits are reached
- Sequences can be defined on the computer, downloaded to the 2714, which can be removed from the system to make automatic field RF measurements
- Displays the picture of the channel being measured on the computer screen when equipped with video display board
- Compatible with standard, HCR or IRC systems up to 1 GHz
- Export data to Windows-based programs such as Lotus 1-2-3 or Microsoft Excel for more detailed analysis
- Supports many different types of printers


CMP100

CMP100 Cable Measurement Package

- Low cost
- Ideal for all FCC baseband measurements


CMP200

CMP200 Cable Measurement Package

- Low cost
- Ideal for all FCC baseband measurements
- Measures signal-to-noise ratio and K Factor

CMP400 Automatic Cable Measurement Package

- Low cost
- Automatically measures FCC baseband measurements

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CMP500 Cable Measurement Package.

CSS500 Cable Measurement Package Software.

CMP100 Cable Measurement Package.
Includes: DS1200 Demodulator System and 1740 Waveform/Vector Monitor.

CMP200 Cable Measurement Package.
Includes: DS1200 Demodulator System and 1780R Video Measurement Set.

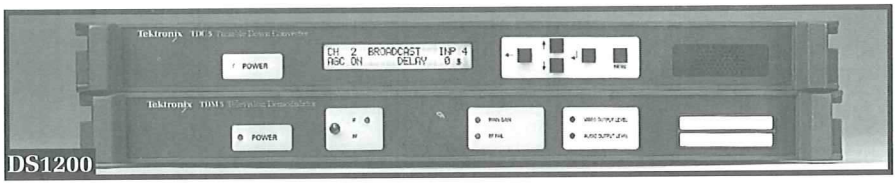
CMP400 Automatic Cable Measurement Package.
Includes: DS1200 Demodulator System and VM100 Video Measurement Set.

Signal Level Meter/Demodulators

DS1200 • TV1350 • RFM150

Features

- DS1200
- TV1350
- RFM150



DS1200 Low Cost Television Demodulator System

- Low cost
- Measurement quality performance
- 47 MHz to 860 MHz frequency range
- Cable TV standard, HRC and VHF/UHF channel tables
- RS-232C or RS-485 control of TDC5 Tunable Down Converter
- Synchronous detection
- Gain control system optimizes signal-to-noise ratio and intermodulation distortion
- Zero carrier pulse for depth of modulation measurement
- Wide dynamic range
- Four RF inputs on TDC5
- Quadrature out for ICPM measurements
- Aural intercarrier out for interface to a BTSC decoder



RFM150 SignalScout™ Signal Level Meter

- 5 MHz to 1GHz frequency range
- ±1 dB accuracy over wide temperature range
- In-service hum at subscriber tap levels (0 dBmV/60 dBµV)
- In-service hum
- NICAM and dual aural carrier compatible
- Channel spectrum mode
- Multi-format compatible – NTSC, PAL, SECAM, digital carriers
- Interface port for uploading test results to a PC and downloading test sequences and configuration to SignalScout™
- Three year parts and labor warranty

TV1350 Series Television Demodulators

- Continuously tunable over all TV bands and CATV channels (HRC and IRC) to 880 MHz (channels 2-99) with synthesizer precision for HRC and IRC
- Channel selection by digital entry of channel number, manual or remote modes, plus search
- Automatic compensation for carrier offsets to ±100 kHz
- Switch selectable sound trap
- Switchable IF gain for improved S/N ratio
- Selectable envelope or synchronous detection
- Synchronous detector quadrature output for convenient adjustment of modulation balance and ICPM measurements
- Stable zero carrier reference for video level adjustments and residual carrier measurements
- Built-in loudspeaker, headphone jack, and deviation meter
- Parallel remote control standard; IEEE 488 bus interface optional
- User-friendly operation
- Available in standards M, D/K, B/G, I, and K1
- Worldwide audio standards available: dual sound, NICAM prepared, or BTSC output

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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For complete ordering information for your country, please contact your local Tektronix representative.

DS1200
Demodulator System.

TV1350
Demodulator.

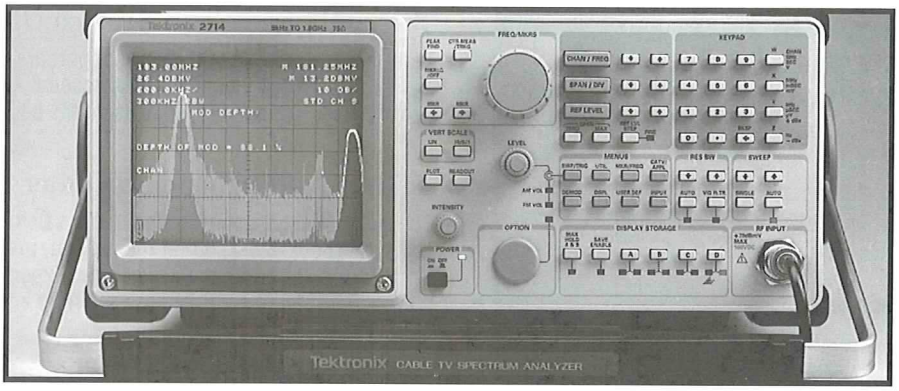
RFM150
SignalScout™ Level Meter.

Spectrum Analyzer/Monitor/Sweep System

2714 • 1705A • 2721A • 2722A

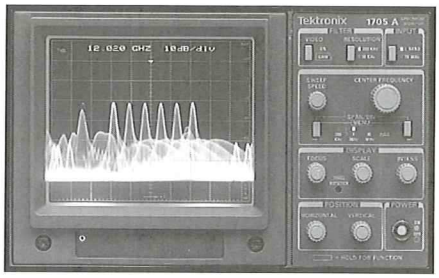
Features

- 2714
- 2721A/2722A
- 1705A



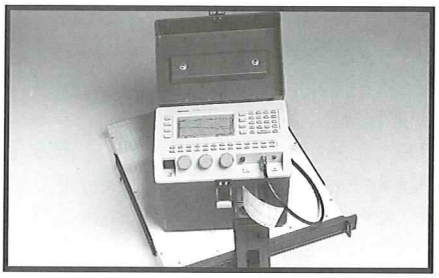
2714 Cable TV Spectrum Analyzer

- Automatic positioning of visual and aural carriers
- Visual and aural carrier levels and frequencies for selected channels
- Survey of system visual and aural carrier levels and frequencies
- Depth of modulation
- Aural carrier deviation measurement
- Visual carrier-to-noise measurement
- Visual to carrier amplitude and frequency difference measurements
- Automatic measurement of CSO, CTB, and cross modulation



1705A Spectrum Monitor

- Full 850 MHz span for international satellites
- L-Band and 70 MHz IF inputs
- Designed for satellite uplink & downlink monitoring
- On-screen Ku- or C-Band frequency readout
- Selectable 2 dB/div or 10 dB/div sensitivity
- Resolution bandwidth switchable to 10 kHz or 300 kHz
- Span range and video filter selection



2721A/2722A Cable TV Sweep System

- Non-interfering; full 5-600 MHz range
- Full alpha keyboard for data entry
- LCD Display visible even in bright sunlight
- Lightweight, compact receiver
- User programmable sweep frequency and telemetry frequency
- 63 archive records
- RS-232C downloads stored waveforms to Serial Printer or PC
- PC download software included
- Three year parts and labor limited warranty
- Worldwide compatibility

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

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ORDERING INFORMATION

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2714
Cable TV Spectrum Analyzer.

2721A
Sweep Transmitter.

2722A
Sweep Receiver.

Opt. 01 – Chart Recorder.

1705A
Spectrum Monitor.

General Customer Information

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Tektronix Sales and Service Offices

Tektronix products and technical support are available through a worldwide network of sales and service offices. Your Tektronix Account Manager is available to answer your questions. See the sales and service office list in the back of this catalog.

Tektronix TeleBusiness Center (TBC)

The same quality support found in our sales and service offices is available toll free. In the U.S., call (800) 426-2200 (at the prompt, press 3), Monday through Friday, from 8:00 am Eastern Time to 5:00 pm Pacific Time. Expert sales engineers are available to provide technical support to help you choose the right equipment and answer questions.

Authorized Tektronix Distributors and Manufacturers Representatives

Authorized Tektronix Distributors and Manufacturers Representatives offer selected products in geographic areas. They will provide you with fast, convenient service and support. Ask your electronics distributor or representative if they carry Tektronix. Take advantage of their support and purchase Tektronix products from them.

As you use this catalog, note these products that are available through our distributors and representatives. To find the distributor or representative nearest you, see the list in the back of this catalog. Questions? Call (800) 479-4490 in the U.S.

Lease and Rental Programs

Tektronix measurement products are available under a variety of lease and rental programs offered by Tektronix and Tektronix Authorized Rental Companies. For lease and rental program details and a list of our Authorized Rental Companies, see page 555.

Warranty

Products offered by Tektronix are manufactured to provide the highest level of reliability and performance. Tektronix warrants these products against defects in materials and workmanship in accordance with the warranty statement applicable to each product. If any product fails during the warranty period, Tektronix will provide the remedy set forth in the applicable warranty. A copy of the warranty applicable to a particular product offered by Tektronix may be obtained from your nearest Tektronix office.

General Terms

PRICES
Prices in this catalog are U.S. list prices in effect at the time of printing. Export pricing information is available from your nearest Tektronix Office. Tektronix reserves the right to change prices without notice.

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Net 30 from date of invoice, subject to approved credit. Other terms are available.

CREDIT CARDS
Tektronix currently accepts the following credit cards: VISA, MasterCharge, Discover, American Express.

SHIPMENT
FOB Tektronix plant.

ELECTRONIC DATA INTERCHANGE
Tektronix encourages the use of EDI/EC to communicate quotations, orders, invoices and payment. If you are capable of this medium, please contact your Tektronix office and let us know.

General Business Information

Features

U.S. GOVERNMENT CUSTOMERS
- Federal Order Management Office
- GSA Contract Information
- Logistics Data Book

MEASUREMENT PRODUCTS LEASING PROGRAM

AUTHORIZED RENTAL/LEASING COMPANIES

U.S. Government Customers

FEDERAL ORDER MANAGEMENT OFFICE

U.S. Government agencies should obtain price, delivery and place orders directly with Tektronix Federal Order Management at (800) 682-1210. Federal Agency RFQs, RFPs, IFBs, Purchase Orders and Contracts should be sent directly to:

Tektronix, Inc.
Federal Order Management M/S 50-290
P.O. Box 4600
Beaverton, OR 97076

FAX: (503) 629-5388
Phone: (800) 682-1210

GSA CONTRACT INFORMATION

Tektronix, Inc. has General Service Administration Multiple Award Schedule Contracts for many products listed in this catalog. These contracts are:

- Instruments and Laboratory Equipment; FSC Group 66, Class 6625, Part II, *Section H*
- Instruments and Laboratory Equipment; FSC Group 66, Class 6625, Part II, *Section J*

An Authorized GSA Price List for any of the above contracts is available from your nearest Tektronix office or by calling (800) 682-1210.

Selected Tektronix products are available through GSA MAS contracts held by Tektronix Authorized Distributors. **For information on MBD products available through this channel, call (800) 682-1210.** For information on Tektronix Color Printing and Imaging Division products available under GSA MAS contracts, call (800) 835-6100 and request Product Information. For information on Tektronix Video and Networking Division products on GSA MAS contracts, call (800) 824-5127, extension 3170.

Tektronix' subsidiary, Grass Valley Group, also has GSA contracts. Contact GVG at (916) 478-4055.

LOGISTICS DATA BOOK

A Logistics Data Book of products and accessories sold by Tektronix, containing information on National and NATO Stock Numbers, U.S. military nomenclature, products, provisioned by the U.S. military, replacement product information, test and calibration systems, and calibration fixtures for servicing Tektronix products is available by contacting your nearest Tektronix sales office or calling (800) 682-1210.

Tektronix Measurement Products Leasing Program

Although Tektronix will continue to offer leasing opportunities through our well established leasing company partners, customers now have the option to lease new measurement products directly from Tektronix. You can make arrangements to lease at the time product selections are made. Tektronix leasing terms include a variety of 12-, 24-, and 36-month programs with a minimum order of $3,000. In addition, our FlexLease™ program offers a very competitive monthly rate for 39 months with many attractive features. Contact your Tektronix Account Manager, or call the Tektronix TeleBusiness Center at 1-800-426-2200 (at the prompt, press 3).

Authorized Rental/Leasing Companies

Tektronix' Authorized Rental Companies provide the widest selection of well-maintained Tektronix instruments, with flexible and attractive terms. For short term rentals, leases and lease purchase options, Tektronix' Authorized Rental Companies provide the right terms, the right instruments, the right options so you can make the right choice.

Our Authorized Rental Companies can provide you a solution when you want to try out new equipment before you purchase or when you need equipment for short-term projects or for an immediate requirement. They will provide you the best answers for managing your test equipment inventory, whether you rent it for a month or lease it for a year.

When you need to rent or lease Tektronix products, look to our Authorized Rental Companies. Call:

AT&T Capital Corporation Instrument Services	**1-800-874-7123**
Continental Resources, Inc.	**1-800-937-4688**
Electro Rent Corporation	**1-800-688-1111**
G.E. Capital Test Equipment Management Services	**1-800-GE-RENTS (1-800-437-3687)**
McGrath RentCorp	**1-800-352-2900**
McGrath RenTelco	**1-800-233-5807**
Telogy, Inc.	**1-800-TELOGY-I (1-800-835-6494)**

GSA Price List and/or Logistics Data Book available. Call 1-800-682-1210, or contact your nearest Tektronix office (listed in the back of this catalog).

See Tektronix on the World Wide Web: http://www.tek.com

Customer Support

Features

CUSTOMER SUPPORT PROGRAMS

- Service Offerings
- Customer-site Installations
- Long-term Product Support
- Training and Assistance
- Product and Technical Seminars
- Operational and Applications Workshops
- Service Training Workshops
- Module Exchange Services
- Replacement Parts
- Technical Support

NOTE: Customer support programs vary according to country. For information on programs available in your location, contact your Tektronix representative (listed in the back of this catalog).

APPLICATIONS SUPPORT

- For Applications Support call:
  1-800-835-9433, Ext. 2400

  Outside the U.S., call:
  1-503-627-2400

  E-mail Address:
  "tm_app_supp@tek.com"

  Hours: 6:00 AM to 5:00 PM Pacific Time

SOFTWARE BULLETIN BOARD

- Software Bulletin Board 24 hrs., 7 days a week. 2400/9600 baud, dial 503-627-5658

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

Request a copy of our Measurement Service Brochure detailing service options available to you.

See Tektronix on the World Wide Web: http://www.tek.com

Total Solutions for Your Success

There is more in the box than a quality product when you purchase your product from Tektronix. You'll find an array of services that provides total-solution coverage – coverage that begins with your first call to Tektronix and continues after the sale through long-term product support. Our sales and service personnel work together to help you make the best selections for your applications. Then we help you maximize your investment by ensuring optimum product performance. All this is accomplished through customer support programs ranging from training to product installations and a variety of maintenance plans.

Contact your nearest Tektronix office. Our U.S. and international office locations are listed at the back of this catalog. We will give you information on products and the names of Account Managers assigned to serve your product interests.

SERVICE OFFERINGS
What do you need? There is a good chance that we have already developed a service solution you will like. If not, we will gladly create a service package to complement your current goals and will partner with you to anticipate your future requirements. See pages 557-559 for specific service offerings.

CUSTOMER-SITE INSTALLATIONS
Tektronix provides on-site installations for most Tektronix-configured systems, setting up your product to meet all operating specifications. Contact your nearest Tektronix office for more information.

LONG TERM PRODUCT SUPPORT
Tektronix has a long-standing policy to provide service coverage after a product has been removed from the catalog, subject to parts availability. Contact your Tektronix service center for service quotes and information.

TRAINING AND ASSISTANCE
Your product is most useful to you when you are thoroughly familiar with it. Formal training classes and self-study aids can help you get up to speed faster. Contact your Tektronix office for details about customer training.



SEMINARS
To receive information about our free Tektronix product and technical seminars, contact your Tektronix sales office and ask to be added to the seminar mail list. See page 562.

OPERATION, APPLICATIONS, AND SERVICE WORKSHOPS
Achieve optimum utilization of your equipment. Let Tektronix provide fast-paced courses with classroom lectures and supervised hands-on laboratory sessions. Participants receive manuals and workbooks containing detailed course notes and lab exercises. For added convenience, Tektronix also offers private workshops conducted at your company. See page 562.

MODULE EXCHANGE SERVICES
Easily exchangeable modular components facilitate rapid troubleshooting and repair of many products offered by Tektronix. You may choose to diagnose a problem and specify the module to exchange, or a Tektronix customer service technician can provide assistance. Typically your module order will ship from our plant within 24 hours, and overnight delivery can be arranged for most U.S. locations. To place an order, call Tektronix at (800) 835-9433, Ext. 6630.

REPLACEMENT PARTS
Replacement parts and supplies can be ordered by calling toll free between 5AM and 5PM, Pacific Time. Call Tektronix at (800) 835-3553.

TECHNICAL SUPPORT
Tektronix provides high quality Technical Support on applications, operation, measurement specifications, hardware, and software by expert application engineers. See contact information at left.

Service Assurance

Features

SERVICE ASSURANCE

- Calibration Services
- Repair Protection
- ISO 9001 Certified
- Our Unconditional Service Guarantee: "If, for any reason, our services fail to fully meet your requirements as promised, we will resolve the problem at our expense."

NOTE: Service Assurance programs vary according to country. For information on programs available at your location, contact your Tektronix representative (listed in the back of this catalog).

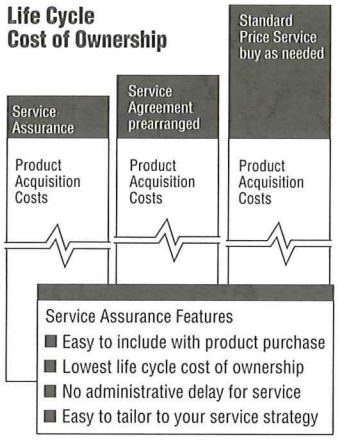
For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

Request a copy of our Measurement Service Brochure detailing service options available to you.

See Tektronix on the World Wide Web: http://www.tek.com

Service Assurance

You can prearrange reliable, convenient, long-term instrument support that suits your needs. Service Assurance expands your own instrument calibration and repair capabilities with Tektronix resources at Service Centers nationwide. Avoid authorization delays when routine calibration or unplanned repairs are needed, and eliminate unplanned support expenses by including Service Assurance in your instrument purchase.



FLEXIBLE, EASY ALTERNATIVES

When you buy Service Assurance with your new Tektronix instrument as a Product Option, Tektronix-recommended protection begins for you automatically.

If you prefer, you may buy Service Assurance any time during your instrument's warranty period.

Purchase one or several years of **Repair Protection, Customer-Site Repair Protection**, or **Calibration Services** to meet your needs, and we will send you a registration card. Once registered, your Service Assurance will be honored at any Service Center in your country with no further proof of coverage. Calibration Services begin upon registration. Repair Protection begins at the end of your product warranty.

Repair Protection extends priority repair services for up to three years beyond your instrument's warranty period (in one year intervals). Order up to three each, REP4XXX, or ask for Option R2 with your instrument purchase.

Customer-Site Repair Protection provides extended priority customer-site repair services and software subscription services, as appropriate. Coverage begins when the instrument warranty ends. Order in one year increments, up to three each, REP5XXX, or ask for Option K1, K2, or K3 with your instrument purchase.

Calibration Services include adjustment or verification to assure instrument accuracy. We are compliant with ANSI/NCSL Z540-1, ISO Guide 25, and MIL-STD-45662A. As appropriate, we provide our Certificate of NIST Traceability, calibration stickers, forward and reverse traceability records maintenance, calibration recall assurance, and scheduled recalibration notification. Along with our ISO 9001 Certification, these services will significantly help you meet your internal quality audit requirements. Order up to five years of support by requesting 5 each, CALXXXX, or ask for Option C5 with your instrument purchase.

TAILORED SUPPORT

Additional, customized plans can be arranged for large blocks of instruments, customer-site protection, telephone hotline support, extended software support, and a variety of other services. Contact a Tektronix Service Account Manager for help meeting your needs, from one calibration to managing your entire metrology support function.

Comprehensive Systems Services

Features

COMPREHENSIVE SYSTEMS SERVICES

- Customer-site Services
- Depot Services
- Custom Service Agreements
- Telephone Support Hotline
- Our Unconditional Service Guarantee: "If, for any reason, our services fail to fully meet your requirements as promised, we will resolve the problem at our expense."

NOTE: Systems services vary according to country. For information on services available at your location, contact your Tektronix representative (listed in the back of this catalog).

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

Request a copy of our Measurement Service Brochure detailing service options available to you.

See Tektronix on the World Wide Web: http://www.tek.com

Comprehensive Systems Services are available for many Tektronix measurement systems. They combine the features of Calibration Services, Repair Protection, and Customer-site Support, as well as access to our Telephone Support Center and extended software support.

Customer-site Services

The following services are provided at your site:

SHARED SERVICE AGREEMENTS
You provide the first line of response; Tektronix provides spares support and telephone assistance. If we can't help you over the phone to have your system fully functional within 24 hours, we provide back-up support at your site from one of our systems technical support specialists.

CUSTOMER-SITE SUPPORT AGREEMENTS
You call us, we do the rest. We provide rapid response at your site by our highly-trained technical support specialists, with the right spares to get your system up and running right away. Where applicable, Tektronix also provides preventive maintenance and calibration services at your site as part of the agreement.

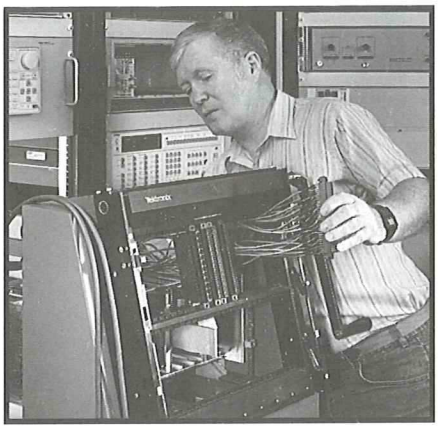
TOTAL-SITE HARDWARE AND SOFTWARE SUPPORT AGREEMENTS
If you have multiple qualifying systems, Total-site Support may be just what you're looking for. At a very substantial discount from our single-system pricing, we cover all the systems at your site, providing software update services, hardware maintenance and repair, as well as any required preventive maintenance. Since we know every system at your site is covered, there's no hassle with serial numbers to check coverage – we come when you call.

CUSTOMER-SITE SYSTEM ENGINEERING/APPLICATION SUPPORT
For qualifying systems, we provide system engineering support right at your site, helping you with system integration and/or helping you develop application software to maximize the utility of your Tektronix system.

Depot Services

The following services are provided at the nearest designated Tektronix Service Center:

EXCHANGE SERVICE AGREEMENTS
For a nominal fee, we provide access to our exchange system, giving you next-day receipt of a replacement for your failed module when you call. Later we take your failed module, refurbish it to like-new condition, and place it in our exchange inventory.



REPAIR
We provide three-day turnaround (exclusive of shipping time) on your failed module when you return it to us for repair.

STANDARD PRICE CALIBRATION OR PERFORMANCE VERIFICATION
On a per-incident basis, Tektronix provides ANSI/NCSL Z540-1, ISO Guide 25, and MIL-STD-45662A calibrations and full performance verifications to manufacturers' specifications, as applicable.

CALIBRATION OR PERFORMANCE VERIFICATION AGREEMENTS
At a discount from our per incident rates, Tektronix offers agreements providing ANSI/NCSL Z540-1, ISO Guide 25, and MIL-STD-45662A calibrations and full performance verifications to manufacturers' specifications, as applicable. Recall notification is included.

Custom Service Agreements

There are times when our standard offerings may not give you exactly what you need. We are happy to discuss your needs and tailor a custom Service Agreement to fit them exactly.

Telephone Support Hotline

Tektronix provides telephone support via nationwide toll-free service to resolve hardware and software operability, system integration, and fault-isolation issues.

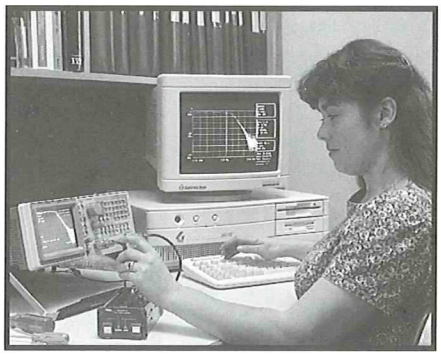
Service Agreements

Features

SERVICE AGREEMENTS

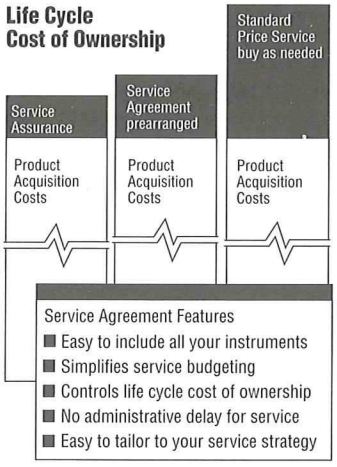
- Low Cost Protection
- A Variety of Offerings
- Discounts May Apply
- ISO 9001 Certified
- Our Unconditional Service Guarantee: "If, for any reason, our services fail to fully meet your requirements as promised, we will resolve the problem at our expense."

NOTE: Service Agreements vary according to country. For information and availability of agreements in your location, contact your Tektronix representative (listed in the back of this catalog).



Prearranged Instrument Protection

When your product warranty or Service Assurance coverage expires, consider the cost effectiveness of purchasing a Service Agreement. Service Agreements provide a substantial cost advantage over per-incident Standard Price service costs. Multi-year coverage minimizes your paperwork and affords you tighter control over your ownership costs. Most important, Service Agreement protection helps you maximize your instrument uptime and performance.



CALIBRATION, REPAIR, AND SYSTEMS AGREEMENTS

Repair Protection, Calibration Services, or both, may be prearranged by a Service Agreement. Comprehensive Systems Service Agreements are available for many Tektronix measurement systems and feature calibration, repair protection, and extended software support, along with access to our Telephone Support Center.

REDUCED COST OF OWNERSHIP WITH NO SPECIAL CONDITIONS

Tektronix Service Agreements foster a disciplined approach to providing superior quality, performance and value by assuring in advance that any care your Tektronix product needs will be provided. Instruments maintained in this manner perform faithfully and experience an extended useful life, which translates into a lower cost of ownership.

ADDITIONAL COST SAVINGS

Aggressive discounts can be added together to reduce support costs below the already favorable basic agreement prices.

MULTI-YEAR DISCOUNT

Multi-year discounts are available on Service Agreements of two or more years.

QUANTITY DISCOUNT

Significant discounts may be applied to Service Agreements covering a number of instruments.

DOLLAR VOLUME DISCOUNT

If you expect to make a substantial investment in repair and calibration services during the year, you may qualify for discounted pricing based on the value of the services you have already purchased from us. Ask a Tektronix Service Account Manager for information about our Dollar Volume Discount Program.

ELIGIBILITY

Products covered by a new product or service warranty, Service Assurance, or an existing Tektronix Service Agreement are automatically eligible for Tektronix Service Agreement coverage. Other products may be eligible subject to a qualifying inspection. To avoid inconvenience, we can waive inspection in many cases – ask about our inspection waiver fee.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

Request a copy of our Measurement Service Brochure detailing service options available to you.

See Tektronix on the World Wide Web: http://www.tek.com

Standard Price Service

Features

STANDARD PRICE SERVICE

Services Available:

- Product Calibration
- Product Repair
- Dimensional Tools
- Obsolete Products
- ISO 9001 Certified
- Calibration Scheduling and Recall
- Metrology Audit Records
- Instrument Upgrades
- Technical Support

NOTE: Standard Price service varies according to country. For information on services available in your location, contact your Tektronix representative (listed in the back of this catalog).

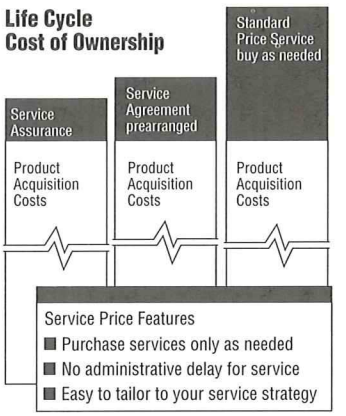
For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200.

Request a copy of our Measurement Service Brochure detailing service options available to you.

See Tektronix on the World Wide Web: http://www.tek.com

Standard Price Service

Tektronix offers calibration and repair services for most products on a Standard Price basis. This lets you make a service decision without waiting for a quote, allowing us to go to work for you right away.

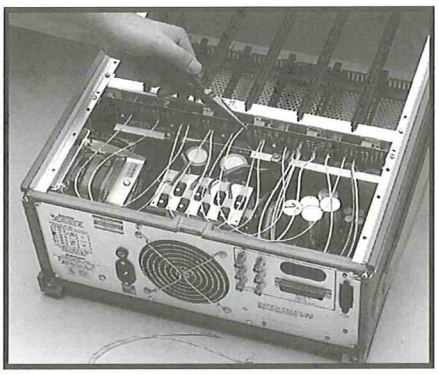


STANDARD PRICE CALIBRATION

Our calibration program is designed to ensure the continued accuracy and precision of your instruments. It provides NIST traceability and ANSI/NCSL Z540-1, ISO Guide 25, and MIL-STD-45662A standards compliance at no additional charge on all eligible products. This includes a Certificate of Traceable Calibration and a calibration label showing our certification date and the due date for the next calibration. The Certificate of Traceable Calibration describes your instrument's condition, the measurement standards we used, and the environmental conditions at the time of calibration. Your product is entered into our calibration records and recall system. We notify you when it is time to schedule recalibration to maintain your instrument's certification. In compliance with ANSI/NCSL Z540-1, ISO Guide 25, and MIL-STD-45662A, we maintain documentation of your instrument's performance.

STANDARD PRICE REPAIR

Tektronix will repair your instrument as you request, installing any component modifications needed to make the repair, and then conduct a front panel check, verifying externally accessible adjustments, to enable your instrument to be calibrated to perform within its specifications. To ensure optimum performance, we encourage you to have us calibrate your instrument when we repair it.



A FEW EXCLUSIONS KEEP OUR STANDARD PRICES LOW

Standard Prices generally cover all labor and parts. Some major, high reliability components are billed separately on the few occasions they are needed. Products that have been damaged through accident or improper use may be ineligible for Standard Price.

ADDITIONAL SERVICES ASSURE YOU OF PREMIUM VALUE AT NO EXTRA CHARGE

We treat every instrument service as an opportunity to deliver the extra care that sets Tektronix apart from other service providers. We install up-to-the-minute safety modifications in accordance with the latest Tektronix engineering change orders. We alert you to any performance problems you may want to consider correcting, and if there appears to be an application or operator error, we may phone with technical suggestions to improve your success. Finally, we verify the appearance of your instrument and correct minor cosmetic flaws before packaging it with the appropriate certifications and returning it to you.

DIMENSIONAL STANDARDS SERVICES

Calibration and repair of your dimensional tools are available at selected Tektronix Service Centers. Tektronix Dimensional Service offers superior quality, convenience, and value. Contact your local Tektronix service representative for detailed information.

TIME AND MATERIAL

Products that are obsolete or that have been damaged or abused are serviced under Time and Material charges with hourly labor rates and parts usage prices applied.

INCIDENTAL SERVICES

Other services offered are Before and After Test Data Recording, Instrument Wash, Shuttle Services, Pick Up and Delivery, and Next Day Calibrations.

Reconditioned Products

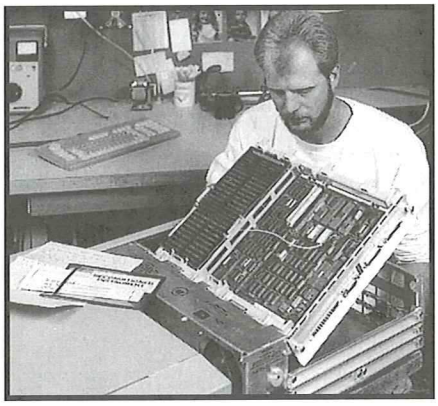
Features

- Reduced Prices
- Quick Delivery
  – Many products are in stock and are immediately available
- Quality
  – Products meet Tektronix' high standards for aesthetics and performance. Accordingly, all Tektronix Reconditioned Products come with a new-product warranty.

Reconditioned Products

If budget restrictions prevent getting the Tektronix product that you would like to have – Tektronix Reconditioned Products may be your solution.

Tektronix Reconditioned Products meet Tektronix standards for quality and performance, both technically and aesthetically.



Reconditioned Products meet Tektronix standards for quality and performance.

PERFORMANCE
Tektronix Reconditioned Products are serviced, calibrated and tested to meet the same high quality standards as new products. All essential upgrades are installed and all products are functionally equivalent to new products and meet full product specifications. All reconditioned products are provided with standard manuals and accessories.

PRICES
Tektronix Reconditioned Products often are available below new product prices.

WARRANTY
All Tektronix Reconditioned Products are warranted to the same warranty as if the products were new. Extended service options are also available on most products.

APPEARANCE
We like our products to look as good as they run. Instruments are inspected and cleaned prior to delivery.



Reconditioned Products are calibrated and tested to meet the same high standards as new products.

AVAILABILITY/DELIVERY
Reconditioned Products are offered on an "as-available" basis. Many products are in stock and are immediately available.

Your Tektronix Account Manager or local Tektronix sales office will be glad to see if there is a Reconditioned Product available and to provide you with a current price quote.

For your local Tektronix representative see the list in the back of this catalog or outside the U.S. call: 1-503-627-1933, inside the U.S. call: 1-800-426-2200 (at the prompt, press 3).

See Tektronix on the World Wide Web: http://www.tek.com

Training and Seminars

For Users and Service Technicians

Features

MEASUREMENT CUSTOMER TRAINING OFFERINGS:

- Measurement Product Service Training
- Measurement User and Measurement Techniques Workshops
- Measurement Self-study Material
  - Self-study Packages
  - Videotapes
  - Audiotapes
- Measurement Training Documentation
  - Instructor/Training Guides
  - Service Manuals
- Measurement Product and Technology Seminars

NOTE: Training and Seminar programs vary according to country. For information on programs in your location, contact your Tektronix representative (listed in the back of this catalog).

To register for formal training classes or for information on other training services, contact: Tektronix, Measurement Training, Walker Road Industrial Park. Attention: Measurement Training Registrar, P.O. Box 4600, M/S 94-925, Beaverton, OR 97076. Inside the U.S. phone: (800) 426-2200; at the prompt, press 3 and inquire about code 429.

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; Santa Clara, CA; and Washington, D.C. On-site classes and workshops are also available upon request.

See Tektronix on the World Wide Web: http://www.tek.com

Measurement Product Service Training Classes

Professional training provides your technicians the opportunity to learn the latest maintenance techniques in the same 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 product service training instructors sharpen your skills in troubleshooting, isolating faults, and repairing Tektronix products. You learn factory-approved maintenance procedures for long product life and maximum uptime.

Customized on-site product service 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.

INSTRUMENT USER AND MEASUREMENT TECHNIQUES WORKSHOPS

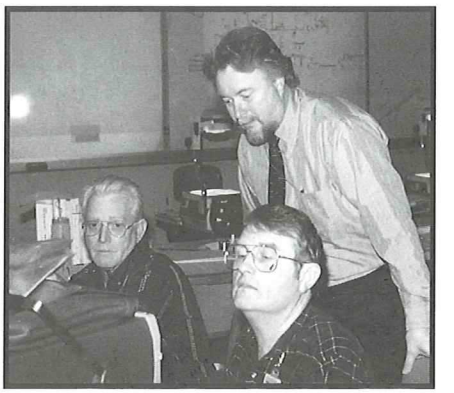
Maximize the efficient utilization of your Tektronix products by subscribing to one of the many Instrument User and Measurement Techniques Workshops offered by Tektronix Measurement Training. These workshops combine classroom lectures with plenty of hands-on labs that emphasize the "Make Measurements" philosophy.

These workshops may be conducted at your U.S. location and customized to satisfy your needs. This high quality training increases your productivity and provides you with the instrument familiarity necessary to excel in your profession. Tell us what you need and see what we can do for you. Call today: 1-800-835-9433 x WR1407.

SELF-STUDY MATERIALS

Study on the job or at home. We offer self-study video-/audiotapes and training packages which include exercises to help you quickly develop product familiarity and skills in fault diagnosis and repair.

Tektronix Measurement product user self-study training packages provide interactive, hands-on instruction for comprehension of product operation and applications. Measurement product service packages cover troubleshooting and repair techniques at your own bench. Our tapes are quality products that progress from basic



concept packages for novice technicians to advanced concept 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. Refer to pages 424-426 for self-study package content and ordering information.

TRAINING DOCUMENTATION

Tektronix Measurement Training develops the complete program for your training needs. In addition to formal training, we can create for your use a complete instructor package consisting of class outline, lesson plan, instructor guide, student workbook, lab exercises, and visual projections. Service manuals, created by the Measurement 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 U.S. Armed Services with high acclaim. Join the team of professionals using training offered by Tektronix Measurement Training.

MEASUREMENT PRODUCT AND TECHNOLOGY SEMINARS

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Power Sources

Power Sources

Many products offered by Tektronix*1 provide wide-range regulated supplies, or quick change line-voltage selectors for convenient selection of line-voltage operating ranges. In a few instruments transformer taps can be changed to accommodate specific line-voltage operating ranges or, if specified on the purchase order, can be factory wired for a specific range.

Most 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.

For power cord/plug options not specified in this catalog, contact your local Tektronix representative for information. When ordering Opt. A1, Opt. A3, Opt. A5, Opt. A6, ask for export pricing.

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's chassis to protect operating personnel.

Power cord coding follows one of the two following schemes:

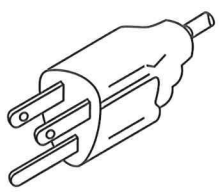
	Scheme 1	Scheme 2
Line	Black	Brown
Neutral	White	Light blue
Ground (safety earth)	Green-yellow	Green-yellow

POWER SOURCES

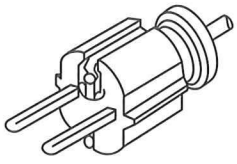
Many Tektronix instruments can be fitted with one of the power cord/plug options listed and wired for the voltage as indicated, if specified on the purchase order.

Standard	North American	120 V
Opt. A1	Universal Euro	220 V
Opt. A2	United Kingdom	240 V
Opt. A3	Australian	240 V
Opt. A4	North American	240 V
Opt. A5	Switzerland	220 V
Opt. A6	Japan	100 V

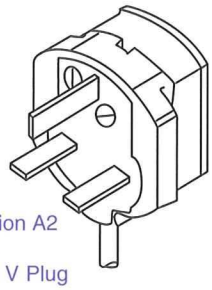
**1 These options are not available for Rohde & Schwarz or ADVANTEST products.*



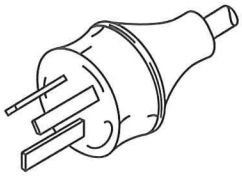
Standard
North American
120 V Plug



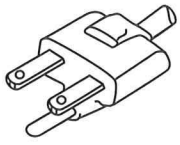
Option A1
Universal Euro
220 V Plug



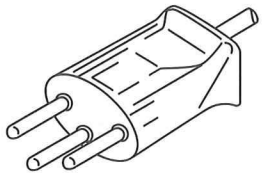
Option A2
UK
240 V Plug



Option A3
Australian
240 V Plug



Option A4
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240 V Plug



Option A5
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220 V Plug

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FAX: * 358 (0) 4783 4200

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Brownell Electro, Inc.
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Allied Electronics
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(800) 433-5700
Innovative Measurement Products
(205) 883-6699
Marshall Industries, Inc.
(205) 881-9235
RS Electronics
(205) 721-9999 or
(800) 859-5859

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Brownell Electro, Inc.
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(800) 345-2233
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(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
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(800) 472-7373
Transcat
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ALASKA

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Kent-Moore, SPX
(800) 345-2233
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
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TESSCO
(800) 472-7373
Transcat
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Techni-Tool
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Phoenix
Allied Electronics
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Grainger
(602) 273-9143
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(602) 496-0290
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(800) 528-4512

Springdale
Carlton-Bates Co.
(800) 632-7633

Tempe
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(800) 251-4443

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(800) 345-2233
RAG Electronics, Inc.
(800) 732-3457
TESSCO
(800) 472-7373
Transcat
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(800) 632-7633

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Brownell Electro, Inc.
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Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

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Anaheim
Grainger
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Calabasas
Marshall Industries, Inc.
(818) 878-7000

Chatsworth
ITC Electronics
(818) 700-0940

Danville
Westcon, Inc.
(510) 736-1304

El Monte
Marshall Industries, Inc.
(800) 432-2223

Fremont
Allied Electronics
(510) 505-0220 or
(800) 433-5700

Irvine
Allied Electronics
(714) 727-3010 or
(800) 433-5700
Marshall Industries, Inc.
(714) 458-5333

Los Angeles
Allied Electronics
(800) 433-5700
ITC Electronics
(213) 388-0621
Zack Electronics
(818) 303-1183

Milpitas
Marshall Industries, Inc.
(408) 942-4700

Mountain View
Metermaster
(800) 251-4443

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RAG Electronics, Inc.
(800) 732-3457

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(800) 845-3427

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(805) 983-4115

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(800) 251-4443

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(916) 635-9700

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Allied Electronics
(909) 980-6522 or
(800) 433-5700

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(916) 632-3104 or
(800) 433-5700

Sacramento
Zack Electronics
(916) 369-1786

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Allied Electronics
(619) 279-2550 or
(800) 433-5700
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(619) 278-5120
Instrument Engineers
(619) 673-3644
Marshall Industries, Inc.
(619) 627-4140
Metermaster
(800) 251-4443

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Grainger
(415) 285-7200

San Jose
Allied Electronics
(408) 383-0366 or
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Grainger
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(408) 998-5355
Techni-Tool, Inc.
(408) 224-5032
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(408) 324-0551

South San Francisco
Allied Electronics
(415) 952-9599 or
(800) 433-5700

Torrance
ITC Electronics
(310) 370-6211
Techni-Tool, Inc.
(714) 731-7733
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Woodland Hills
Allied Electronics
(818) 594-8280 or
(800) 433-5700

Yorba Linda
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Also in this state:
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(503) 777-3272
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(800) 225-5382
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(Only San Diego, Imperial, Orange, LA, Riverside, & San Bernardo Counties.)
Jensen Tools, Inc.
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(800) 345-2233
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

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Aurora
R & R Instrumentation, Inc.
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(800) 452-1463

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Techni-Tool, Inc.
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Colorado Springs
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(719) 598-9500
Marshall Industries, Inc.
(719) 573-0904

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Brownell Electro, Inc.
(303) 333-3541
Grainger
(303) 733-8777 or
(303) 366-6939

Englewood
Allied Electronics
(303) 790-1664 or
(800) 433-5700

Fort Collins
Grainger
(303) 223-2100

Thornton
Marshall Industries, Inc.
(303) 451-8383

Wheatridge
Zeus Electronics, Inc.
(303) 420-5100

Also in this state:
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(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

CONNECTICUT

Cheshire
Allied Electronics
(203) 272-7730 or
(800) 433-5700

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Grainger
(203) 525-1967

Newtown
Beta Lambda Instruments
(800) 282-5632

Wallingford
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(800) 225-5382
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(203) 265-3822

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Kent-Moore, SPX
(800) 345-2233
Metermaster
(800) 251-4443
RAG Electronics, Inc.
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(800) 472-7373
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Transcat
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(800) 638-7616
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RAG Electronics, Inc.
(800) 732-3457
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(800) 225-5382
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(800) 345-2233
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RAG Electronics, Inc.
(800) 732-3457
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(800) 472-7373
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Grainger
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(800) 492-6767

Decatur
Tycom Industries, Inc.
(404) 378-6160

Duluth
Allied Electronics
(800) 433-5700

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Forest Park
Brownell Electro, Inc.
(800) 332-3423

Lilburn
Metermaster
(800) 251-4443

Norcross
Dow Electronics
(800) 627-2910
EMSCO
(404) 925-8366
Marshall Industries, Inc.
(404) 923-5750
RS Electronics
(404) 242-0520 or
(800) 776-5284

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Dow Electronics
(800) 627-2890

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Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
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Honolulu
Grainger
(808) 432-0028

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Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
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RAG Electronics, Inc.
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Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

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Boise
Allied Electronics
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Grainger
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Radar Electric Co.
(208) 336-2227

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Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
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(800) 251-4443
NW Test and Measurement
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Techni-Tool, Inc.
(602) 345-2700
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TESSCO
(800) 472-7373
Transcat
(800) 828-1470
Westcon, Inc.
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Zeus Electronics, Inc.
(800) 528-4512

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Bensenville
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(708) 965-7600
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(800) 323-5925

Oak Forest
Allied Electronics
(708) 535-0038 or
(800) 433-5700

Peoria
Klaus Companies
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(800) 475-5287
Industrial Parts

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Klaus Companies
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Schaumburg
Marshall Industries, Inc.
(708) 490-0155

Also in this state:
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Jensen Tools, Inc.
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RS Electronics
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RAG Electronics, Inc.
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TESSCO
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Great Lakes Electronics
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Marshall Industries, Inc.
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(800) 488-9065

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Barkhurst and Associates, Inc.
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Klaus Companies
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RAG Electronics, Inc.
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(800) 433-5700
Grainger
(319) 366-7174

W. Des Moines
Allied Electronics
(515) 223-6488 or
(800) 433-5700

Also in this state:
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Jensen Tools, Inc.
(800) 426-1194
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Marshall Industries, Inc.
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RAG Electronics, Inc.
(800) 732-3457
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(800) 472-7373
Transcat
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Marshall Industries, Inc.
(913) 492-3121

Overland Park
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(800) 251-0067

Wichita
Grainger
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Kent-Moore, SPX
(800) 345-2233
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(800) 472-7373
Transcat
(800) 828-1470

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Grainger
(502) 499-0001

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Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
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(800) 828-1470

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(800) 324-4517

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Inotek
(504) 924-9046 or
(800) 492-6767
Ralph's Industrial Electronic Supplies
(318) 443-4517 or
(800) 324-4517
Transcat
(504) 272-9156 or
(800) 828-1470

Lafayette
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(318) 443-4517 or
(800) 324-4517

Lake Charles
Ralph's Industrial Electronic Supplies
(318) 443-4517 or
(800) 324-4517

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(318) 443-4517 or
(800) 324-4517

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Ralph's Industrial Electronic Supplies
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(800) 324-4517

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Carlton-Bates
(318) 636-9975

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Allied Electronics
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(800) 433-5700

Also in this state:
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(800) 332-3423
Contact East, Inc.
(800) 225-5382
EnTest
(800) 955-0077
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

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Portland
Grainger
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Beta Lambda Instruments
(800) 282-5632
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(913) 432-2223
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

MARYLAND

Aberdeen
Harco Electronics, Inc.
(410) 838-7990

Baltimore
Beta Lambda Instruments
(800) 282-5632
Harco Electronics, Inc.
(410) 575-6885

Baltimore East
Grainger
(410) 391-9000

Columbia
Allied Electronics
(410) 312-0810 or
(800) 433-5700
Marshall Industries, Inc.
(301) 470-2800 (VA) or
(410) 880-3030 (MD)

Gaithersburg
Beta Lambda Instruments
(800) 282-5632

Gambrills
Techni-Tool, Inc.
(610) 941-2400

Salisbury
Harco Electronics, Inc.
(800) 634-2589

Sparks
TESSCO
(410) 472-7000

Also in this state:
Contact East, Inc.
(800) 225-5382
Harco Electronics, Inc.
(800) 638-7616
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
Transcat
(800) 828-1470

MASSACHUSETTS

Boston
Beta Lambda Instruments
(800) 282-5632

North Andover
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(800) 225-5382

Northboro
Techni-Tool, Inc.
(508) 393-3399

Norwood
Allied Electronics
(617) 255-0361 or
(800) 433-5700
Grainger
(617) 935-8808

Peabody
Allied Electronics
(800) 433-5700

Wilmington
Marshall Industries, Inc.
(508) 658-0810

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(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
RAG Electronics, Inc.
(800) 732-3457
TESSCO
(800) 472-7373
Transcat
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(800) 962-3144

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Flint
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(810) 742-5000 or
(800) 726-4556

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(616) 365-9960 or
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RS Electronics
(616) 241-3483 or
(800) 776-1155

Livonia
Marshall Industries, Inc.
(313) 525-5850
RS Electronics
(313) 525-1155 or
(800) 366-7750

Plymouth
Allied Electronics
(313) 416-9300 or
(800) 433-5700

Saginaw
Allied Electronics
(517) 792-2400 or
(800) 433-5700

Warren
Kent Moore - SPX
(800) 345-2233

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Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
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(800) 472-7373
Transcat
(800) 828-1470

MINNESOTA

Minneapolis
Marshall Industries, Inc.
(612) 559-2211
Stark Electronics, Inc.
(612) 332-1325

Minnetonka
Allied Electronics
(612) 938-5633 or
(800) 433-5700

Plymouth
Grainger
(612) 352-0891

St. Paul
Allied Electronics
(612) 482-9904 or
(800) 433-5700

Also in this state:
Contact East, Inc.
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Kent-Moore, SPX
(800) 345-2233
RAG Electronics, Inc.
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TESSCO
(800) 472-7373
Transcat
(800) 828-1470

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Brownell Electro, Inc.
(800) 332-3423
Carlton-Bates
(901) 365-3539
Contact East, Inc.
(800) 225-5382
EnTest
(800) 955-0077
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

MISSOURI

Earth City
Allied Electronics
(314) 291-7031 or
(800) 433-5700
Marshall Industries, Inc.
(314) 770-1749

Kansas City
Electronics Supply Co., Inc.
(816) 931-0250

Maryland Heights
RS Electronics
(314) 997-7709 or
(800) 325-4806

Springfield
Carlton-Bates
(417) 862-1699 or
(800) 356-9275

St. Louis
Carlton-Bates
(314) 343-6060
Grainger
(314) 231-5031

Also in this state:
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

MONTANA

Billings
Grainger
(406) 252-6311

Also in this state:
Allied Electronics
(800) 433-5700
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
Platt Electric Supply
(800) 25-PLATT or
(503) 641-6121
Radar Electric Co.
(208) 336-2227
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(602) 345-2700
Technology Sales, Inc.
(801) 572-1588
TESSCO
(800) 472-7373
Transcat
(800) 828-1470
Zeus Electronics, Inc.
(800) 528-4512

NEBRASKA

Lincoln
Electronics Supply Co., Inc.
(402) 467-1550
Grainger
(402) 476-9014

Omaha
Allied Electronics
(402) 697-0038 or
(800) 433-5700
Grainger
(402) 339-1800

Distributors

Nebraska continued:

Also in this state:
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

NEVADA

Las Vegas
Allied Electronics
(702) 258-1087 or
(800) 433-5700
Grainger
(702) 385-6833
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
Zeus Electronics, Inc.
(800) 528-4512

Also in this state:
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Techni-Tool, Inc.
(408) 224-5032 or
(602) 345-2700
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

NEW HAMPSHIRE

Manchester
Grainger
(603) 668-7161

Nashua
Allied Electronics
(603) 883-3006 or
(800) 433-5700

Also in this state:
Beta Lambda Instruments
(800) 282-5632
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

NEW JERSEY

Cranbury
Metermaster
(800) 251-4443

Cranford
Grainger
(908) 272-7156

Edison
Allied Electronics
(908) 572-9600 or
(800) 433-5700
Brownell Electro, Inc.
(908) 287-3355

Englishtown
Beta Lambda Instruments
(800) 282-5632

Fairfield
Marshall Industries, Inc.
(201) 882-0320

Kinnelon
Techni-Tool, Inc.
(201) 492-1292 or
(610) 940-5467

Moorestown
Allied Electronics
(609) 234-7769 or
(800) 433-5700

Mt. Laurel
Marshall Industries, Inc.
(609) 234-9100

Parsippany
Allied Electronics
(201) 428-3350 or
(800) 433-5700

Also in this state:
Contact East, Inc.
(800) 225-5382
Harco Electronics, Inc.
(800) 638-7616
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
RAG Electronics, Inc.
(800) 732-3457
Sunshine Instruments
(800) 343-1149
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

NEW MEXICO

Alburquerque
Grainger
(505) 345-8631
Zeus Electronics, Inc.
(505) 842-6633

Bohemia
Exphil
800-5-EXPHIL

Also in this state:
Allied Electronics
(800) 433-5700
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(602) 345-2700
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

NEW YORK

Albany
Grainger
(518) 869-1414

Amherst
Allied Electronics
(716) 831-8101 or
(800) 433-5700

Binghamton
Beta Lambda Instruments
(800) 282-5632

Bohemia
Exphil Calibration Labs, Inc.
(800) 539-7445 or
(516) 563-3520

Endicott
Marshall Industries, Inc.
(607) 785-2345

Fairport
Allied Electronics
(716) 425-3850 or
(800) 433-5700

Hauppauge
Beta Lambda Instruments
(800) 282-5632
Marshall Industries, Inc.
(516) 273-2695
RS Electronics
(516) 231-3313 or
(800) 433-8952

Lagrangeville
Allied Electronics
(914) 452-1470 or
(800) 433-5700

Mineola
Allied Electronics
(516) 248-2360 or
(800) 433-5700

New York City
Allied Electronics
(908) 572-9600

Rochester
Beta Lambda Instruments
(800) 282-5632
Marshall Industries, Inc.
(716) 235-7620
Transcat
(800) 828-1470

Syracuse
Allied Electronics
(315) 463-2955 or
(800) 433-5700

Also in this state:
Brownell Electro, Inc.
(800) 332-3423
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(201) 492-1292
TESSCO
(800) 472-7373

NORTH CAROLINA

Cary
Inotek
(919) 380-0220 or
(800) 492-6767

Charlotte
Allied Electronics
(704) 525-0300 or
(800) 433-5700
Auto Advisors, Inc.
(704) 329-9446
Brownell Electro, Inc.
(800) 332-3423
Grainger
(704) 376-0785
Inotek
(704) 527-5000 or
(800) 492-6767
Resource Electronics/Dixie
(704) 521-8682
Transcat
(800) 828-1470

Greensboro
EMSCO
(800) 275-3034
Inotek
(910) 299-2950 or
(800) 492-6767

Raleigh
Allied Electronics
(800) 433-5700
Brownell Electro, Inc.
(919) 876-6525
Marshall Industries, Inc.
(919) 878-9882
Resource Electronics/Dixie
(919) 829-0704

Winston Salem
Resource Electronics/Dixie
(800) 854-1007

Also in this state:
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Tycom Industries, Inc.
(404) 378-6160

NORTH DAKOTA

Fargo
Grainger
(701) 282-8905

Also in this state:
Allied Electronics
(800) 433-5700
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
RAG Electronics, Inc.
(800) 732-3457
Stark Electronics, Inc.
(800) 334-6154
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

OHIO

Cincinnati
Allied Electronics
(513) 771-6990 or
(800) 433-5700
Beta Lambda Instruments
(800) 282-5632

Cleveland
Allied Electronics
(216) 831-4900 or
(800) 433-5700
Grainger
(216) 398-1880
Metermaster
(800) 251-4443
RS Electronics
(216) 351-2220 or
(800) 576-4533

Columbus
Allied Electronics
(614) 785-1270 or
(800) 433-5700
Grainger
(614) 276-5231
RS Electronics
(216) 351-2220 or
(800) 576-4533

Dayton
Beta Lambda Instruments
(800) 282-5632
Marshall Industries, Inc.
(513) 898-4480

Maumee
RS Electronics
(419) 893-0721
(800) 472-3231

Solon
Marshall Industries, Inc.
(216) 248-1788

Toledo
Allied Electronics
(419) 865-2246 or
(800) 433-5700

Also in this state:
Auto Advisors, Inc.
(704) 329-9446
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

OKLAHOMA

Edmond
Marshall Industries, Inc.
(405) 340-0198

Oklahoma City
Carlton-Bates
(405) 681-4446
Grainger
(405) 943-9631
Inotek
(405) 373-3359

Tulsa
Allied Electronics
(918) 664-0844 or
(800) 433-5700
Carlton-Bates
(918) 250-1626
Inotek
(918) 627-1500 or
(800) 492-6767

Distributors

Oklahoma continued:

Also in this state:
Contact East, Inc.
(800) 225-5382
EnTest
(800) 955-0077
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

OREGON

Beaverton
Allied Electronics
(800) 433-5700
Marshall Industries, Inc.
(503) 644-5050
NW Test and Measurement
(503) 645-9000
Platt Electric Supply
(800) 25-PLATT
(800) 257-5288

Clackamas
Automotive Scope Applications
(503) 777-3272

Portland
Grainger
(503) 283-0366
Radar Electric Co.
(503) 232-3404
Westcon, Inc.
(800) 547-4515

Also in this state:
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(602) 345-2700
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

PENNSYLVANIA

Bridgeville
Brownell Electro, Inc.
(412) 221-0074

Camp Hill
Allied Electronics
(717) 975-3570 or
(800) 433-5700

Chadds Ford
Allied Electronics
(610) 388-8455 or
(800) 433-5700

Jenkintown
Beta Lambda Instruments
(800) 282-5632

Lancaster
Harco Electronics, Inc.
(717) 291-1861 or
(800) 345-4941

Langhorne
Techni-Tool, Inc.
(610) 941-2400

Malverne
Beta Lambda Instruments
(800) 282-5632

Norristown
Grainger
(215) 630-9070

Philadelphia
Harco Electronics, Inc.
(800) 345-4941
Sunshine Instruments
(215) 673-5600
(800) 343-1199

Pittsburgh
Allied Electronics
(412) 367-4124 or
(800) 433-5700
Grainger
(412) 788-8890
Leff Electronics, Inc.
(412) 351-5000 or
(800) 245-4200
Transcat
(800) 828-1470

Plymouth Meeting
Techni-Tool, Inc.
(610) 941-2400

Trevose
Brownell Electro, Inc.
(215) 364-1401

West Chester
Transcat
(215) 692-0912 or
(800) 828-1470

Also in this state:
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
TESSCO
(800) 472-7373

RHODE ISLAND

East Greenwich
Beta Lambda Instruments
(800) 282-5632

Warwick
Grainger
(401) 467-9160

Also in this state:
Allied Electronics
(800) 433-5700
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(203) 231-9193
TESSCO
(800) 472-7373
Transcat
(800) 828-147

SOUTH CAROLINA

Charleston
Grainger
(803) 552-6504
Inotek
(803) 529-9400 or
(800) 492-6767

Columbia
Grainger
(803) 926-8100
Resource Electronics/Dixie
(803) 779-5332

Greenville
Allied Electronics
(803) 288-8835 or
(800) 433-5700
Grainger
(803) 288-0110
Inotek
(803) 370-1432 or
(800) 492-6767
Resource Electronics/Dixie
(803) 297-1430

Greer
EMSCO
(803) 879-4121

N. Charleston
Resource Electronics/Dixie
(803) 569-1410

Summerville
Brownell Electro, Inc.
(803) 875-5568

Also in this state:
Auto Advisors, Inc.
(704) 329-9446
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470
Tycom Industries, Inc.
(404) 378-6160

SOUTH DAKOTA

Sioux Falls
Grainger
(605) 339-9164

Also in this state:
Allied Electronics
(800) 433-5700
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
RAG Electronics, Inc.
(800) 732-3457
Stark Electronics, Inc.
(800) 334-6154
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

TENNESSEE

Gray
Resource Electronics/Dixie
(615) 477-2131

Jackson
Carlton-Bates
(901) 664-2714

Knoxville
Allied Electronics
(615) 693-3305 or
(800) 433-5700
Brownell Electro, Inc.
(800) 332-3423
Carlton-Bates Co.
(800) 226-6870
Inotek
(615) 457-1053 or
(800) 492-6767

Memphis
Allied Electronics
(901) 367-2895 or
(800) 433-5700
Brownell Electro, Inc.
(800) 332-3423
Carlton-Bates
(901) 365-3539

Nashville
Brownell Electro, Inc.
(615) 885-1302
Carlton-Bates
(615) 885-3232
Grainger
(615) 885-0332

Oak Ridge
Resource Electronics/Dixie
(615) 481-3393

Also in this state:
Auto Advisors, Inc.
(704) 329-9446
Contact East, Inc.
(800) 225-5382
EMSCO
(800) 275-2934
Innovative Measurement Products
(205) 883-6699
Inotek
(404) 458-6423 or
(800) 492-6767
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470
Tycom Industries, Inc.
(404) 378-6160

TEXAS

Austin
Allied Electronics
(512) 219-7171 or
(800) 433-5700
Carlton-Bates
(512) 837-9098
Inotek
(800) 492-6767
Marshall Industries Inc.
(512) 837-1991

Corpus Christi
Allied Electronics
(512) 857-2705 or
(800) 433-5700

Dallas
Allied Electronics
(214) 553-4370 or
(800) 433-5700
Carlton-Bates
(214) 235-7771
EnTest
(800) 955-0077
Grainger
(214) 637-2380
Inotek
(214) 243-7000 or
(800) 492-6767
Jensen Tools
(800) 426-1194

El Paso
Allied Electronics
(915) 779-6294 or
(800) 433-5700
Zeus Electronics
(800) 528-4512

Ft. Worth
Allied Electronics
(800) 443-5700
Carlton-Bates
(817) 293-5558
Inotek
(817) 877-5100
(800) 492-6767

Grand Prairie
Brownell Electro, Inc.
(800) 332-3423

Houston
Brownell Electro, Inc.
(713) 691-4347
Carlton-Bates
(713) 956-2244
EnTest
(713) 686-7306
Inotek
(713) 688-7000 or
(800) 492-6767
Marshall Industries, Inc.
(713) 467-1666
Metermaster
(800) 251-4443
Transcat
(800) 828-1470

Humble
Allied Electronics
(713) 446-8005 or
(800) 433-5700

Longview
Allied Electronics
(903) 295-1164 or
(800) 433-5700

Lubbock
Allied Electronics
(806) 785-0044 or
(800) 433-5700
Brownell Electro, Inc.
(806) 747-0211

Mesquite
Metermaster
(800) 251-4443

Richardson
Marshall Industries, Inc.
(214) 705-0600

Roanoke
Carlton-Bates
(800) 482-9313

San Antonio
Carlton-Bates
(210) 805-8300

Seabrook
Transcat
(713) 465-4399

Texarkana
Carlton-Bates
(800) 792-6923

Also in this state:
Contact East, Inc.
(800) 225-5382
Kent-Moore, SPX
(800) 345-2233
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373

Distributors

UTAH

Salt Lake City
Allied Electronics
(801) 261-5244 or
(800) 433-5700
Grainger
(801) 972-1340
Marshall Industries, Inc.
(801) 973-2288
Zeus Electronics, Inc.
(801) 487-9402

Sandy
Technology Sales, Inc.
(801) 572-1588

Also in this state:
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(602) 345-2700
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

VERMONT

Burlington
Grainger
(802) 658-4988

Also in this state:
Allied Electronics
(800) 433-5700
Beta Lambda Instruments
(800) 282-5632
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

VIRGINIA

Charlottesville
Harco Electronics, Inc.
(800) 999-8420

Harrisonburg
Harco Electronics, Inc.
(703) 434-8420 or
(800) 999-8420

Richmond
Allied Electronics
(804) 553-0188 or
(800) 433-5700
Grainger
(804) 649-0731
Inotek
(804) 743-1226 or 1663 or
(800) 492-6767

Springfield
Allied Electronics
(703) 644-9515 or
(800) 433-5700

Suffolk
Techni-Tool, Inc.
(301) 912-3062 or
(804) 459-3837

Virginia Beach
Allied Electronics
(804) 363-8662 or
(800) 433-5700

Also in this state:
Auto Advisors, Inc.
(704) 329-9446
Beta Lambda Instruments
(800) 282-5632
Contact East, Inc.
(800) 225-5382
Harco Electronics, Inc.
(800) 999-8420
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

WASHINGTON

Bellevue
NW Test and Measurement
(206) 881-8857
Westcon, Inc.
(206) 747-5055

Bothell
Marshall Industries, Inc.
(206) 486-5747

Everett
Allied Electronics
(206) 353-7313 or
(800) 433-5700

Longview
Platt Electric Supply
(206) 423-4800 or
(800) 25-PLATT

Richland
Radar Electric Co.
(509) 943-8336

Seattle
Grainger
(206) 251-5030
Radar Electric Co.
(206) 282-2511

Spokane
Grainger
(509) 535-9882
Radar Electric Co.
(509) 747-3053

Tacoma
Allied Electronics
(206) 572-7745 or
(800 433-5700

Vancouver
Platt Electric Supply
(206) 699-4833 or
(800) 25-PLATT

Also in this state:
Automotive Scope Applications
(503) 777-3272
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Platt Electric Supply
(800) 25-PLATT or
(503) 641-6121
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

WEST VIRGINIA

Charleston
Grainger
(304) 744-1383

Poca
Transcat
(800) 828-1470

Also in this state:
Auto Advisors, Inc.
(704) 329-9446
Beta Lambda Instruments
(800) 282-5632
Contact East, Inc.
(800) 225-5382
Harco Electronics, Inc.
(800) 999-8420
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457

Also in this state:
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373

WISCONSIN

Milwaukee
Dist-Tron
(414) 781-7770
Grainger
(414) 353-7400

New Berlin
Allied Electronics
(414) 796-1280 or
(800) 433-5700

Waukesha
Marshall Industries, Inc.
(800) 726-8512

Also in this state:
Contact East, Inc.
(800) 225-5382
Joseph Electronics
(800) 323-5925
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Metermaster
(800) 251-4443
RAG Electronics, Inc.
(800) 732-3457
Stark Electronics, Inc.
(800) 334-6154
Techni-Tool, Inc.
(610) 941-2400
TESSCO
(800) 472-7373
Transcat
(800) 828-1470

WYOMING

Casper
Grainger
(307) 577-5797

Also in this state:
Allied Electronics
(800) 433-5700
Contact East, Inc.
(800) 225-5382
Jensen Tools, Inc.
(800) 426-1194
Kent-Moore, SPX
(800) 345-2233
Marshall Industries, Inc.
(800) 432-2223
RAG Electronics, Inc.
(800) 732-3457
Techni-Tool, Inc.
(602) 345-2700
Technology Sales, Inc.
(801) 572-1588
TESSCO
(800) 472-7373
Transcat
(800) 828-1470
Zeus Electronics, Inc.
(800) 528-4512

Telecom Products

ALABAMA

Birmingham
Anixter (Datacom)
(205) 822-8066

Decatur
Antec (CATV)
(800) 242-1181
(404) 840-7901

ARIZONA

Phoenix
Anixter (Datacom)
(602) 968-7901

Tucson
Anixter (Datacom)
(602) 295-9844

ARKANSAS

Little Rock
Anixter (Datacom)
(501) 223-2824

CALIFORNIA

Anaheim
Anixter (Datacom)
(714) 779-0500

Bakersfield
Anixter (Datacom)
(805) 836-9191

Clayton
North Supply Company (Telco)
(510) 672-8658

Fresno
North Supply Company (Telco)
(209) 431-5136

Los Angeles
Anixter (Datacom)
(213) 625-7828

Martinez
North Supply Company (Telco)
(510) 947-0699

Pleasanton
Anixter (Datacom)
(510) 463-1223

Sacramento
Anixter (Datacom)
(916) 372-1207

San Bernadino
Anixter (Datacom)
(909) 825-7755

San Diego
Anixter (Datacom)
(619) 583-9960

San Francisco
Anixter (Datacom)
(415) 543-6070

Santa Clara
Anixter (Datacom)
(408) 435-1212

Santa Ana
Antec (CATV)
(800) 854-0443
(714) 757-1630

Torrance
Anixter (Datacom)
(310) 320-4783

Union City
Anixter (Datacom)
(510) 489-7100

COLORADO

Denver
Anixter (Datacom)
(303) 373-9200

Englewood
Antec (CATV)
(800) 841-1531
(303) 740-8949

CONNECTICUT

Branford
RJ Heffernan & Assoc (Security)
(203) 488-2235

Cheshire
Anixter (Datacom)
(203)-271-3600
E. Hartford
North Supply Company (Telco)
(203) 569-7988

Stamford
Anixter (Datacom)
(203) 325-0390

FLORIDA

Clearwater
North Supply Company (Telco)
(813) 535-0061

Dayton
Anixter (Datacom)
(513)-320-0020

Fort Lauderdale
Anixter (Datacom)
(305) 975-7722

Jacksonville
North Supply Company (Telco)
(904) 292-4902
Antec (CATV)
(800) 242-1181
Anixter (Datacom)
(904) 730-2703

Orlando
Anixter (Datacom)
(407) 240-1888
Antec (CATV)
(800) 242-1181
(404) 840-7901

Tampa
Anixter (Datacom)
(813) 626-7115

GEORGIA

Atlanta
North Supply Company (Telco)
(404) 231-0394
Anixter (Datacom)
(404) 921-3732

Lovejoy
Antec (CATV)
(800) 242-1181
(404) 940-7901

Lilburn
North Supply Company
(Telco)
(404) 925-8727

Norcross
Antec (CATV)
(800) 242-1181
(404) 840-7901

Stone Mountain
North Supply Company (Telco)
(404) 294-7369

Watkinsville
Antec (CATV)
(800) 242-1181
(404) 840-7901

Distributors/Representatives

ILLINOIS

Bensenville
Antec (CATV)
(800) 544-5368
(708) 350-7788

Bloomington
Anixter (Datacom)
(309) 452-8572

Buffalo Grove
North Supply Company (Telco)
(708) 465-0203

Chicago
Anixter (Datacom)
(312) 222-0009

Evanston
Anixter (Datacom)
(708) 869-8011

Skokie
Anixter (Datacom)
Brothers, Inc. (Datacom)
(800) 221-5217
(708) 677-6000

Speedpull
Anixter (Datacom)
(708) 597-7100

INDIANA

Elwood
Antec (CATV)
(317) 552-2120

Indianapolis
Anixter (Datacom)
(317) 243-2008

IOWA

Des Moines
Anixter (Datacom)
(515) 278-1722

KANSAS

Industrial Airport
North Supply Company (Telco)
(800) 755-1975
(913) 791-7000

Kansas City
Anixter (Datacom)
(913) 492-2622

Olathe
North Supply Company (Telco)
(913) 780-1589

Overland Park
North Supply Company (Telco)
(913) 894-5199

KENTUCKY

Louisville
Anixter (Datacom)
(502) 266-8555

LOUISIANA

Baton Rouge
Anixter (Datacom)
(504) 767-0080

New Orleans
Anixter (Datacom)
(504) 888-5114

MARYLAND

Baltimore
Anixter (Datacom)
(410) 290-7722

Shrewsbury
Antec (CATV)
(508) 791-6707

Sparks
TESSCO (Cellular)
(800) 638-7666
(410)472-7352

MASSACHUSETTS

Boston
Anixter (Datacom)
(508) 682-8870

Boston (South)
Anixter (Datacom)
(617) 828-3330

Springfield
Anixter (Datacom)
(413) 731-5100

MICHIGAN

Detroit
Anixter (Datacom)
(810) 478-3900

Grand Rapids
Anixter (Datacom)
(616) 698-7800

Iron Mountain
Antec (CATV)
(800) 624-8358
(906) 774-4111

MINNESOTA

Minneapolis
Anixter (Datacom)
(612) 542-1804

St. Paul
Anixter (Datacom)
(612) 224-2112

MISSOURI

Kansas City
North Supply Company (Telco)
(816) 741-8599

Peculiar
North Supply Company (Telco)
(816) 758-6744

St. Louis
Anixter (Datacom)
(314) 423-6161

NEBRASKA

Blair
North Supply Company (Telco)
(402) 426-9364

Lincoln
Anixter (Datacom)
(402) 466-8337

Omaha
Anixter (Datacom)
(402) 330-7455

NEW HAMPSHIRE

Manchester
Anixter (Datacom)
(603) 666-4416

NEW JERSEY

Princeton
Anixter (Datacom)
(609) 987-9777

Turnersville
Antec (CATV)
(609) 228-0554

Wharton
Antec (CATV)
(800) 631-9603
(201) 328-0980

Whippany
Anixter (Datacom)
(201) 515-3100

NEW MEXICO

Albuquerque
Anixter (Datacom)
(505) 345-1661

NEW YORK

Albany
Anixter (Datacom)
(518) 464-6251

Brooklyn
Anixter (Datacom)
(718) 821-0065

Buffalo
Anixter (Datacom)
(716) 631-0733

Clifton Park
North Supply Company (Telco)
(518) 383-0275

Monroe
Antec (CATV)
(201) 328-6679

Rochester
Anixter (Datacom)
(716) 426-3440

NORTH CAROLINA

Charleston
Anixter (Datacom)
(803) 572-5526

Charolette
Anixter (Datacom)
(704) 847-5900

Elm City
North Supply Company (Telco)
(919) 236-3812

Greensboro
Anixter (Datacom)
(910) 855-9131

Raleigh
Anixter (Datacom)
(919) 941-5023

Zirconia
North Supply Company (Telco)
(704) 693-4025

OHIO

Cincinnati
Anixter (Datacom)
(513) 489-21290

Cleveland
Anixter (Datacom)
(216) 546-4400

Columbus
Anixter (Datacom)
(614) 799-2600

Delaware
North Supply Company (Telco)
(614) 363-7180

Macedonia
Antec (CATV)
(800) 544-5368
(708) 350-7788

OKLAHOMA

Tulsa
Anixter (Datacom)
(918) 664-5558
Jarvis International (Security)
(918) 437-1100

OREGON

Portland
Anixter (Datacom)
(503) 306-4199
North Supply Company (Telco)
(503) 254-8499

PENNSYLVANIA

Gettysburg
North Supply Company (Telco)
(707) 642-5288

Harrisburg
Anixter (Datacom)
(717) 232-6219

Leechburg
North Supply Company (Telco)
(412) 845-6474

Philadelphia
Anixter (Datacom)
(610) 534-3900

PUERTO RICO

Guaynabo
Anixter (Datacom)
(809) 783-6300

San Juan
Telenetworks, Inc.
(809) 766-2829

SOUTH CAROLINA

Columbia
Anixter (Datacom)
(803) 691-9444

TENNESSEE

Memphis
Anixter (Datacom)
(901) 360-8222

Nashville
North Supply Company (Telco)
(615) 662-1632
Anixter (Datacom)
(615) 331-8190

Savannah
Antec (CATV)
(901) 925-8285

TEXAS

Arlington
North Supply Company (Telco)
(817) 277-6852
Antec (CATV)
(817) 548-9695

Dallas
Anixter (Datacom)
(214) 446-7337

Houston
Anixter (Datacom)
(713) 460-9473

Irving
Antec (CATV)
(800) 231-5006
214 717-4933

UTAH

Anixter (Datacom)
(801) 973-4472

VIRGINIA

Maidens
North Supply Company (Telco)
(804) 556-3450

Richmond
Anixter (Datacom)
(804) 527-0866

WASHINGTON

Edmonds
North Supply Company (Telco)
(206) 771-2283

Federal Way
Antec (CATV)
(800) 438-9290
(206) 838-9552

Seattle
Anixter (Datacom)
(206) 251-5287

WASHINGTON DC

Anixter (Datacom)
(703) 818-0150

WEST VIRGINIA

Huntington
Anixter (Datacom)
(304) 733-0845

WISCONSIN

Appleton
Anixter (Datacom)
(414) 730-9309

Eau Claire
North Supply Company (Telco)
(715) 878-4459

Milwaukee
Anixter (Datacom)
(414) 355-0222

CATV Products

NATIONWIDE

ANTEC Corporation
Englewood, CO
Jerry Conn Associates
Chambersburg, PA

Representatives

ALASKA

Frigid North
(907) 561-4633

ARKANSAS

Entest
(800) 955-0077

FLORIDA

(North)
EMSCO
(407) 849-6362

HAWAII

Ward/Davis Assoc.

IDAHO

Seltech
(503) 643-9202

KANSAS

Electronics Supply Co.
(816) 931-0250

LOUISANA

Entest
(800) 955-0077

MISSISSIPPI

Entest
(800) 955-0077

MISSOURI

(West)
Electronics Supply Co.
(816) 931-0250

MONTANA

Seltech
(503) 643-9202

NEBRASKA

Electronics Supply Co.
(816) 931-0250

NEVADA

(North)
Ward/Davis Assoc.
(310) 643-6977

OKLAHOMA

Entest
(800) 955-0077

UTAH

Seltech
(503) 643-9202

WYOMING

Seltech
(503) 643-9202

Representatives/Video Dealers/VARs

Value Added Resellers (VARs)

WESTERN STATES
Includes: AZ, CA, CO, NM, and UT

Audio-Video Recorders of AZ, Inc.
(602) 277-4723
Serves: AZ, CO, NM, UT

CALIFORNIA

Hoffman Video Systems
(818) 507-7116
Serves: So. CA

R.E. Snader & Associates, Inc.
(415) 332-7070
Serves: No. CA

Televideo San Diego
(619) 268-1100
Serves: San Diego County

VMI, Inc.
(408) 745-1700
Serves: No. CA

NORTHEASTERN STATES

Audio-Video Corp.
(518) 449-7213
Serves: NY except NYC, and Long Island

Comark Communications
(413) 569-0116
Serves: All Northeastern States

Communications Engineering Inc.
(703) 550-5800
Serves: All Northeastern States

Communications Systems Gp
(810) 399-2000
Serves: MI, NW Ohio (Toledo Area)

HB Communications
(203) 234-9246
Serves: New England and New York

The Lerro Corp.
(610) 650-4100
Serves: DE, Southern NJ, Eastern PA

Peirce-Phelps Inc.
(215) 879-7171
Serves: DC, DE, MD, NJ, PA, VA

Professional Products Inc.
(301) 657-2141
Serves: DC, DE, MD, NC, VA, WV

RPC Video, Inc.
(412) 828-1414
Serves: Eastern OH, PA, WV

Roscor Corp.
(708) 299-8080
Serves: IL, IN, MI, WI

VARs *continued*

CENTRAL STATES
Includes: AS, II, KS, OK MO

Fairview-AFX, Inc.
(918) 664-8020
Serves: OK, AS, Southern KS

Video Masters
(816) 587-0000
Serves: KS, Western MO

VMI Co. of St. Louis
(314) 569-1334
Serves: Southern IL, Eastern MO

GULF COAST
Includes: AL, FL, LA, MS

C & G Marketing, Inc.
C & G Video Systems
(205) 621-1971

FLORIDA

Broadcast International Group
(305) 599-2112

Gendra Broadcasting Corp.
(305) 372-8845

Professional Communications Systems, Inc.
(800) 447-4714

Video Production Systems, Inc.
(305) 592-5355

SOUTHEAST U. S.

Technical Industries, Inc., of GA
(404) 455-7610

TENNESSEE

Consolidated Media Systems, Inc.
(615) 244-3933
Serves: Middle TN

ALL OF THE U. S.

A.F. Associates
(201) 767-1200

BAF Communications
(407) 324-8250

DSI Video Systems
(908) 245-4833

Dwight Cavendish Co.
(708) 673-0937

Jimmy Rea Electronics
(614) 221-5170

Panasonic Broadcast & TV Systems
(201) 392-4610

Satellite Transmission Systems
(516) 231-1919

Scientific-Atlanta
(404) 903-5870

SDS International, Inc.
(770) 662-5233

Shook Electronics
(210) 651-5700

Wolf Coach
(508) 791-1950

VARs *continued*

WORLDWIDE

Broadcast Richmond
(317) 966-6468

Harris Corp.
(217) 222-8200

National Teleconsultants, Inc.
(213) 245-8000

Odetics, Inc.
(714) 774-2200

For Cable and Transmission Test Products:

Call Toll Free:
1-800-833-9200

CATV Manufacturers Representatives

HAWAII

Ward Davis
(808) 262-5305

SOUTHWEST STATES
Includes: CA and NV

Gemini Innovations
(800) 443-6462

NORTH CENTRAL STATES
Includes: IL, IN, MI, MN, ND, SD, WI

R. Alan Communications
(800) 367-1450
Serves: IL, IN, MI, WI

TSB, Inc.
(605) 426-6140
Serves: MN, ND, SD

SOUTHEAST STATES
Includes: AR, OK, TX

Spectrum
(817) 354-7500

Audio Manufacturers Representatives

SOUTHWEST STATES
Includes: AZ, CA, CO, NM, NV, UT

Preco, Inc.
(800) 227-8887

Professional Video Dealers

ALL THE U. S.

Reeves A/V Systems
(212) 573-8652

WESTERN STATES
Includes: AK, AZ, CA, CO, IA, ID, KS, MN, MT, ND, NE, NM, NV, OK, OR, SD, TX, UT, WA, WI, WY

AVI
(612) 949-3700
Serves: IA, MN, ND, NE, SD, WI

Burst Communications, Inc.
(303) 649-9600
Serves: CO, UT, WY,

Ceavco Audio-Visual Co., Inc.
(303) 238-6493
Serves: CO, NM, WY

Dyma Engineering
(800) 222-3962
Serves: AZ, CO, NM, So. KS, OK, TX

Emmons Associates, inc.
(612) 890-8920
Serves: IA, MN, ND, NE, SD, WI

Northern Video Systems, Inc.
(916) 575-1700
Serves: No. CA & No. NV

Pacific Video Products, Inc.
(714) 634-8585
Serves: So. CA & Las Vegas

Proline Industries, Inc.
(206) 451-1999
Serves: AK, CA, ID, MT, OR, WA

Shoreline, Ltd.
(213) 461-9800
Serves: Burbank/Nth Hollywood -L.A./Ventura Cnty

Videotape Products, Inc.
(213) 664-1144
Serves: L.A. & Bid Locations

Visual Technology
(801) 487-6000
Serves: ID, CO, MT, UT

NORTH CENTRAL STATES
Includes: IA, IL, IN, MI, WI

Swiderski Electronics, Inc.
(708) 364-1900

Professional Video Dealers *continued*

NEW ENGLAND STATES

Crimson Tech
(617) 499-4637

NEW ENGLAND & NEW YORK

DLE
(508) 947-6801

CONNECTICUT, NEW JERSEY, NEW YORK

Technisphere Corp.
(212) 777-5100

SOUTHEASTERN U. S.

Technical Video Systems, Inc.
(910) 748-0916

TEXAS

Industrial Audio/Video, Inc.
(800) 392-4384
Serves: Houston and South Texas

Telco Manufacturers Representatives

ALASKA

Frigid North
Anchorage, AK
(907) 561-4633

HAWAII

Ward Davis
(808) 262-5305

NORTHWESTERN STATES
Includes: ID, OR, MT, WA, and WY

RJM/Ron Moss
(206) 255-8918

SOUTHWESTERN STATES
Includes: AZ, CA, CO, NM, NV, UT

JohnCom
(619) 258-8640
Serves: CA, NV

RS Instruments, Inc.
(800) 341-1405
Serves: AZ, CO, NM, UT

Telco Manufacturers Representatives *continued*

NORTH CENTRAL STATES
Includes: IA, II, IN, MI, MN, ND, NE, OH, SD, WI

K-Comm
(612) 639-8675
Serves: IA, MI, MN, ND, NE, SD, WI

Global Sales and Marketing
(614) 895-3030
Serves: IL, IN, MI, OH

SOUTH CENTRAL STATES
Includes: AR, KS, MO, OK, and TX

Telmark and Associates
(512) 794-0770

STS
(214) 578-0456

NORTHEASTERN STATES
Includes: CT, MA, ME, NH, NJ, NY, PA, RI, VT

ATM
Wayne, NJ
Serves: NJ

Beta Lamda
(800) 282-5632
Serves: NY

Data Plus
(610) 388-2008
Serves: PA

FICO
(508) 649-3337
Serves: CT, MA, ME, NH, RI

SOUTHEASTERN STATES
Includes: AL, FL, GA, KY, LA, MD, MS, NC, PA, SC, TN, VA, WV,

CLC Associates
(301) 340-1175
Serves: MD, VA, WV,

NDOW
(706) 722-6887
Serves: AL, FL, GA, KY, LA, MS, NC, SC, TN

Products and Price Listing

PRICE INFORMATION

ADA400A $895
ADSRS $17,355
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 01 ..... $1,550
ADSRSZ2 ..... $785
AFG2020 ..... $8,495
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. B1 ..... $150
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 02 ..... $3,950
Opt. 1R $495
Opt. 1S $695
Opt. 95 ..... $150
Opt. 96 ..... $50
ALM01 ..... $27
AMS $12,855
Opt. 01 ..... $1,235
AM503B $1,795
Opt. C5 ..... $325
Opt. R2 ..... $100
AM503S $2,895
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $475
Opt. R2 ..... $160
Opt. 01 ..... $1,435
Opt. 03 ..... $670
Opt. 09 ..... –$735
Opt. 95 ..... $150
Opt. 96 ..... $50
AM5030 ..... $2,055
Opt. C5 ..... $325
Opt. R2 ..... $100
AM5030S $4,150
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. 02 ..... $350
AM524 ..... $39,225
AM7FR1 ..... $250
AM70 ..... $1,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A6 ..... NC
Opt. M2 ..... $195
Opt. 01 ..... $50
AM700 ..... $16,000
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. M2 ..... $595
Opt. M9 ..... $330
Opt. 1F $1,795
Opt. 1M $1,795
Opt. 1P $625
ASG100 ..... $1,800
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. M1 ..... $245
Opt. M2 ..... $120
Opt. M3 ..... $480
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. M9 ..... $65
ASG140 ..... $1,800
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. M1 ..... $245
Opt. M2 ..... $120
Opt. M3 ..... $480
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. M9 ..... $65
ASW100F $1,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. M2 ..... $195
ASW100M $1,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. M2 ..... $195
ATM1F2A $7,500
ATM1F8A $11,000
ATM150 ..... $29,500
Opt. 03 ..... $5,000
Opt. 05 ..... $3,500
Opt. 1M $200
Opt. 3C ..... NC
Opt. 4C ..... NC
Opt. 41 ..... –$2,000
Opt. 42 ..... –$2,000
AVTIME $1
Opt. 01 ..... $31,300
Opt. 02 ..... $31,300
Opt. 11 ..... $30,800
Opt. 12 ..... $30,800
AWDK1 ..... $2,540
AWG2005 ..... $8,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 02 ..... $4,495
Opt. 04 ..... $1,895
Opt. 05 ..... $1,895
Opt. 09 ..... $2,495
Opt. 1R $595
Opt. 1S $695
Opt. 95 ..... $150
Opt. 96 ..... $50
AWG2020 ..... $11,495
AWG2021 ..... $11,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. B1 ..... $150
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 02 ..... $4,395
Opt. 03 ..... $1,895
Opt. 04 ..... $1,895
Opt. 09 ..... $2,495
Opt. 1R $595
Opt. 1S $695
Opt. 95 ..... $150
Opt. 96 ..... $50
AWG2040 ..... $19,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. B1 ..... $150
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 01 ..... $4,695
Opt. 03 ..... $2,495
Opt. 09 ..... $2,495
Opt. 1R $595
Opt. 1S $695
Opt. 95 ..... $150
Opt. 96 ..... $50
AWG5102 ..... $2,095
AWG5105 ..... $5,500
A01434 ..... $110
A02455 ..... $330
A02459 ..... $330
A02603 ..... $140
A02712 ..... $415
A02722 ..... $145
A02804 ..... $220
A02806 ..... $165
A08012 ..... $330
A08013 ..... $440
A08018 ..... $110
A08020 ..... $440
A08021 ..... $165
A08024 ..... $715
A08035 ..... $65
A08090 ..... $440
A08096 ..... $440
A09505 ..... $550
A09506 ..... $1,400
A09507 ..... $140
A1001 ..... $125
A1002 ..... $225
A1003 ..... $225
A1004 ..... $225
A1005 ..... $225
A1006 ..... $345
A1007 ..... $365
A1008 ..... $365
A1009 ..... $360
A1010 ..... $525
A1023 ..... $315
A1024 ..... $315
A603 ..... $70
A605 ..... $80
A610 ..... $180
A620 ..... $370
A621 ..... $365
A622 ..... $390
A6302 ..... $820
Opt. C5 ..... $275
Opt. R2 ..... $60
A6302XL $975
Opt. C5 ..... $275
Opt. R2 ..... $60
A6303 ..... $1,540
Opt. C5 ..... $325
Opt. R2 ..... $100
A6303XL $1,645
Opt. C5 ..... $325
Opt. R2 ..... $100
A6304XL $1,995
Opt. C5 ..... $325
Opt. R2 ..... $100
A6905S $2,555
Opt. A1 ..... NC
Opt. C5 ..... $475
Opt. R2 ..... $160
Opt. 01 ..... $175
Opt. 02 ..... $610
A6906S $6,975
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $725
Opt. R2 ..... $260
Opt. 01 ..... $205
Opt. 02 ..... $1,215
Opt. 03 ..... $2,520
Opt. 04 ..... $90
Opt. 95 ..... $150
Opt. 96 ..... $50
A6907 ..... $6,750
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $725
Opt. R2 ..... $260
Opt. 95 ..... $150
Opt. 96 ..... $50
A6909 ..... $3,595
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $425
Opt. R2 ..... $160
Opt. 10 ..... $265
Opt. 95 ..... $150
Opt. 96 ..... $50
BAT200 ..... $295
CADLINK $1,500
Opt. 3M $1,000
CAL4100 ..... $55
CAL4200 ..... $65
CAL4300 ..... $95
CAL4400 ..... $145
CAL4500 ..... $210
CAL4600 ..... $245
CATV $36,660
CATVK1 ..... $1,980
CAT200 ..... $430
CDC250 ..... $545
CDM250 ..... $399
CENTRAK $950
Opt. 1D ..... –$25
CFC250 ..... $399
CFG250 ..... $415
CFG253 ..... $475
CFG280 ..... $1,030
CIT $2,135
CITZ1 ..... $135
CITZ11 ..... $125
CITZ12 ..... $125
CITZ13 ..... $125
CITZ14 ..... $125
CITZ21 ..... $225
CITZ22 ..... $225
CITZ23 ..... $225
CITZ25 ..... $225
CITZ26 ..... $225
CMC250 ..... $555
CMC251 ..... $620
CMDAZ1 ..... $1,875
CMD55 ..... $31,285
Opt. C5 ..... $2,350
Opt. R2 ..... $1,130
Opt. 01 ..... $1,035
Opt. 02 ..... $215
Opt. 03 ..... $3,105
Opt. 04 ..... $705
Opt. 05 ..... $1,330
Opt. 06 ..... $1,385
Opt. 07 ..... $345
Opt. 08 ..... $465
Opt. 10 ..... $3,195
Opt. 13 ..... $1,515
CMD57 ..... $36,080
Opt. C5 ..... $2,350
Opt. R2 ..... $1,130
Opt. 01 ..... $1,035
Opt. 02 ..... $215
Opt. 04 ..... $705
Opt. 05 ..... $1,330
Opt. 07 ..... $345
Opt. 08 ..... $465
Opt. 10 ..... $3,195
Opt. 11 ..... $8,750
Opt. 12 ..... $370
Opt. 14 ..... *1
CMD80 ..... $48,000
Opt. 01 ..... $1,035
Opt. 02 ..... $2,500
Opt. 03 ..... *1
Opt. 04 ..... $704
Opt. 07 ..... $345
Opt. 08 ..... $465
Opt. R2 ..... *1
Opt. C5 ..... *1
CMM150 ..... $45
CMP100 ..... $14,900
Opt. 01 ..... $190
CMP200 ..... $19,900
CMP500 ..... $59,400
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. 01 ..... $1,950
Opt. 20 ..... NC
Opt. 40 ..... $4,000

*1 *Contact your local Tektronix representative for price information.*

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Products and Price Listing

PRICE INFORMATION

CMSZ1 ..... $190
CMSZ2 ..... $375
CMSZ5 ..... $105
CMSZ7 ..... $50
CMS50 ..... $12,840
Opt. R2 ..... $400
Opt. 01 ..... $1,075
Opt. 02 ..... $1,895
Opt. 03 ..... $1,075
Opt. 06 ..... $1,315
Opt. 08 ..... $180
Opt. 10 ..... $980
Opt. 11 ..... $1,040
Opt. 13 ..... $845
Opt. 14 ..... $540
Opt. 15 ..... $630
Opt. 16 ..... $235
Opt. 17 ..... $1,370
Opt. 18 ..... $2,465
Opt. 19 ..... $120
Opt. 20 ..... $3,035
Opt. 21 ..... $310
Opt. 22 ..... $590
Opt. 23 ..... $6,740
Opt. 24 ..... $1,235
CMS52 ..... $15,990
Opt. R2 ..... $400
Opt. 01 ..... $1,075
Opt. 02 ..... $1,895
Opt. 03 ..... $1,075
Opt. 04 ..... $1,755
Opt. 05 ..... $3,150
Opt. 06 ..... $1,820
Opt. 07 ..... $4,175
Opt. 08 ..... $180
Opt. 09 ..... $1,390
Opt. 10 ..... $980
Opt. 11 ..... $1,040
Opt. 13 ..... $845
Opt. 14 ..... $540
Opt. 15 ..... $630
Opt. 16 ..... $235
Opt. 17 ..... $1,370
Opt. 18 ..... $1,750
Opt. 19 ..... $120
Opt. 20 ..... *1
Opt. 22 ..... $590
Opt. 23 ..... $6,740
Opt. 24 ..... *1
CMS54 ..... $17,170
Opt. R2 ..... $400
Opt. 01 ..... $1,075
Opt. 02 ..... $1,895
Opt. 03 ..... $1,075
Opt. 05 ..... $3,150
Opt. 06 ..... $1,820
Opt. 07 ..... $4,175
Opt. 08 ..... $180
Opt. 09 ..... *1
Opt. 10 ..... $980
Opt. 11 ..... $1,040
Opt. 13 ..... $845
Opt. 14 ..... $540
Opt. 15 ..... $630
Opt. 16 ..... $235
Opt. 17 ..... $1,370
Opt. 18 ..... $2,465
Opt. 19 ..... $120
Opt. 20 ..... *1
Opt. 22 ..... $590
Opt. 23 ..... $6,740
CMS57 ..... $26,115
Opt. R2 ..... $590
Opt. 01 ..... $1,075
Opt. 02 ..... $1,895
Opt. 03 ..... $1,075
Opt. 04 ..... $1,755
Opt. 05 ..... $3,150
Opt. 06 ..... $1,820
Opt. 07 ..... $4,175
Opt. 08 ..... $180
Opt. 09 ..... $1,390
Opt. 10 ..... $980
Opt. 11 ..... $1,040
Opt. 13 ..... $845
Opt. 14 ..... $540
Opt. 15 ..... $630
Opt. 16 ..... $235
Opt. 17 ..... $1,370
Opt. 18 ..... $2,465
Opt. 19 ..... $120
Opt. 20 ..... *1
Opt. 22 ..... $590
Opt. 23 ..... $6,740
Opt. 24 ..... $1,365
Opt. 25 ..... *1
CMTAK97 ..... $850
CMTAU90 ..... $645
CMTA54 ..... $46,950
Opt. R2 ..... $2,130
Opt. 03 ..... $1,070
Opt. 20 ..... $7,515
Opt. 21 ..... $995
Opt. 22 ..... $3,230
Opt. 31 ..... $2,780
CMTA84 ..... $59,445
Opt. R2 ..... $2,130
Opt. 03 ..... $1,070
Opt. 06 ..... $2,255
Opt. 07 ..... $1,135
Opt. 11 ..... $3,115
Opt. 21 ..... $995
Opt. 31 ..... $2,780
CMTZ6 ..... $1,100
CMZ1 ..... $235
CMZ20 ..... $2,495
CMZ22 ..... $1,235
CMZ23 ..... $50
CMZ24 ..... $140
CMZ30 ..... $6,740
CMZ39 ..... $1,230
CMZ5 ..... $435
CPS250 ..... $495
CRTC02 ..... $219,355
Opt. 01 ..... $4,205
Opt. 04 ..... $705
Opt. 07 ..... $1,580
CRTPK22 ..... $28,200
CRTPK23 ..... $25,375
CRTPK24 ..... $28,200
CRTPK26 ..... $4,230
CRTPK52 ..... $17,420
CRTPK53 ..... $17,420
CRTPK54 ..... $17,420
CRTPK58 ..... $19,355
CRTPK59 ..... $10,490
CRTPK62 ..... $17,420
CRTPK63 ..... $17,420
CRTPK64 ..... $17,420
CRTPK68 ..... $19,355
CRTPK69 ..... $10,490
CRTP02 ..... $213,870
Opt. 01 ..... $4,205
Opt.04 ..... $705
Opt.07 ..... $1,580
Opt.R2 ..... *1
Opt.C5 ..... *1
CRTSK1 ..... $5,275
CRTSK2 ..... *1
CRTSK22 ..... $19,735
CRTSK23 ..... $17,630
CRTSK24 ..... $24,675
CRTSK26 ..... $3,630
CRTSK48 ..... $24,675
CRTU1 ..... $3,495
CRTZ2 ..... $200
CR02PH2 ..... $20,970
CR48PH2 ..... $24,475
CSA803A $25,150
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 1R $250
Opt. 10 ..... –$1,000
Opt. 95 ..... $150
Opt. 96 ..... $50
CSILINK $950
CSS150 ..... $500
CSS500 ..... $2,000
CTS7F01 ..... $1,900
CTS7F03 ..... $8,500
CTS7F04 ..... $17,900
CTS7F05 ..... $21,900
CTS7F22 ..... $6,600
CTS7F36 ..... $8,600
CTS710 ..... $15,900
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 03 ..... $7,500
Opt. 04 ..... $16,900
Opt. 05 ..... $20,900
Opt. 06 ..... $29,900
Opt. 22 ..... $5,900
Opt. 48 ..... NC
Opt. 96 ..... $50
CTS750 ..... $15,900
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 03 ..... $7,500
Opt. 04 ..... $16,900
Opt. 05 ..... $16,900
Opt. 06 ..... $24,900
Opt. 36 ..... $7,900
Opt. 48 ..... NC
Opt. 96 ..... $50
CT1 ..... $305
Opt. 09 ..... –$100
CT100 ..... $2,395
Opt. C5 ..... $325
Opt. R2 ..... $100
Opt. 1B $495
Opt. 2A $495
Opt. 3B $495
Opt. 46 ..... $50
CT12AF $495
CT12BF $895
CT13BF $495
CT2 ..... $280
Opt. 09 ..... –$100
CT4 ..... $1,495
Opt. C5 ..... $275
Opt. R2 ..... $60
CVS1N $5,995
C1850G $1,395
Opt. 03 ..... $85
Opt. 05 ..... $85
C3280 ..... $7,650
C9 ..... $630
Opt. C5 ..... $275
Opt. R2 ..... $60
Opt. 04 ..... $70
Opt. 05 ..... $70
Opt. 06 ..... $45
Opt. 07 ..... $45
Opt. 1A $270
Opt. 1F $140
Opt. 1P $85
Opt. 11 ..... $80
Opt. 20 ..... $45
DABK1 ..... $725
DASNT $11,800
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. K1 ..... $320
Opt. K2 ..... $640
Opt. K3 ..... $960
Opt. Q0 ..... $400
Opt. 04 ..... $3,100
Opt. 05 ..... $600
Opt. 1A ..... NC
Opt. 1B $750
Opt. 18 ..... $360
Opt. 22C $2,100
Opt. 23X $2,800
Opt. 24X $4,660
Opt. 25C ..... NC
Opt. 295 ..... $150
Opt. 296 ..... $50
DASXP $11,800
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. K1 ..... $320
Opt. K2 ..... $640
Opt. K3 ..... $960
Opt. Q0 ..... $300
Opt. 04 ..... $3,100
Opt. 05 ..... $600
Opt. 1A ..... NC
Opt. 1B $750
Opt. 18 ..... $360
Opt. 2C $2,100
Opt. 4X $1,860
Opt. 5C ..... NC
Opt. 95 ..... $150
Opt. 96 ..... $50
DAS92E9 ..... $7,050
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. K1 ..... $320
Opt. K2 ..... $640
Opt. K3 ..... $960
Opt. Q0 ..... $200
Opt. 05 ..... $600
Opt. 1A ..... NC
Opt. 1B $750
Opt. 2C $2,100
Opt. 95 ..... $150
Opt. 96 ..... $50
DAS9221 ..... $10,300
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. K1 ..... $320
Opt. K2 ..... $640
Opt. K3 ..... $960
Opt. Q0 ..... $200
Opt. 04 ..... $3,100
Opt. 05 ..... $600
Opt. 1A ..... NC
Opt. 1B $750
Opt. 1R ..... NC
Opt. 18 ..... $360
Opt. 2C $2,100
Opt. 95 ..... $150
Opt. 96 ..... $50
DBS8700 ..... $4,200
Opt. X1 ..... $505
Opt. 10 ..... NC
Opt. 11 ..... NC
Opt. 96 ..... $50
DBS8701 ..... $4,950
Opt. X1 ..... $595
Opt. 10 ..... NC
Opt. 11 ..... NC
Opt. 96 ..... $50
DBS8710 ..... $3,900
Opt. X1 ..... $470
Opt. 10 ..... NC
DBS8720 ..... $1,490
Opt. X1 ..... $180
Opt. 10 ..... NC
DBS8750 ..... $4,190
Opt. X1 ..... $505
Opt. 96 ..... $50
DBS8751 ..... $3,770
Opt. X1 ..... $455
Opt. 96 ..... $50
DBS8752 ..... $3,770
Opt. X1 ..... $455
Opt. 96 ..... $50
DC5010 ..... $5,625
Opt. 95 ..... $150
Opt. 96 ..... $50
DC503A $2,250

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Products and Price Listing

PRICE INFORMATION

DL11 ..... $4,295
DMM150 ..... $59
DMM155 ..... $75
DMM157 ..... $95
DMM247 ..... $145
DMM249 ..... $185
DMM252 ..... $225
DMM254 ..... $250
DMM353 ..... $110
DM2510 ..... $625
DM2510G $755
DM501A $1,450
Opt. 02 ..... –$80
DPS $4,985
DPSP $7,395
DS1200 ..... $11,900
ECO170A $2,375
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M1 ..... $315
Opt. M2 ..... $175
Opt. M3 ..... $615
Opt. M7 ..... $220
Opt. M8 ..... $440
Opt. M9 ..... $95
ECO422 ..... $2,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. M1 ..... $435
Opt. M2 ..... $125
Opt. M3 ..... $945
Opt. M7 ..... $360
Opt. M8 ..... $720
Opt. M9 ..... $75
EMFTBG5 ..... $19,100
EPC7B $5,705
Opt. 1A $646
Opt. 12 ..... $996
Opt. 13 ..... $436
Opt. 15 ..... $80
Opt. 16 ..... $80
Opt. 17 ..... $80
Opt. 18 ..... $120
Opt. 20 ..... $281
Opt. 22 ..... $1,040
Opt. 23 ..... $330
Opt. 24 ..... $770
Opt. 25 ..... $236
Opt. 26 ..... $356
Opt. 27 ..... $252
Opt. 28 ..... $220
Opt. 29 ..... $220
Opt. 30 ..... $236
Opt. 31 ..... $400
Opt. 32 ..... $400
Opt. 40 ..... $272
Opt. 41 ..... $336
Opt. 43 ..... $716
Opt. 45 ..... $1,650
Opt. 46 ..... $3,410
EPC7D $9,555
ESAI $67,050
Opt. R2 ..... $2,130
ESBI $74,550
Opt. R2 ..... $2,130
ESHS10 ..... $26,160
Opt. R2 ..... $590
ESHS30 ..... $41,965
Opt. R2 ..... $590
ESH2Z1 ..... $1,245
ESH2Z11 ..... $660
ESH2Z2 ..... $1,440
ESH2Z3 ..... $1,305
ESH2Z31 ..... $225
ESH2Z5 ..... $9,450
ESH3Z2 ..... $700
ESH3Z3 ..... $1,600
ESH3Z4 ..... $1,135
ESH3Z5 ..... $3,980
ESH3Z6 ..... $1,775
ESK1 ..... $3,735
ESK2 ..... *1
ESK10 ..... $4,585
ESK11 ..... *1
ESK100 ..... $5,345
ESK11 ..... $4,585
ESK12 ..... $4,585
ESK13 ..... $4,585
ESK14 ..... $5,770
ESK15 ..... $4,585
ESK2 ..... $4,585
ESK30 ..... $4,585
ESK31 ..... $4,585
ESK32 ..... $4,585
ESK33 ..... $4,585
ESK34 ..... $4,585
ESK35 ..... $3,075
ESK36 ..... $3,075
ESK80 ..... $1,730
ESMI $104,000
Opt. R2 ..... $2,130
ESN $71,290
Opt. R2 ..... $1,130
Opt. 01 ..... $9,495
ESS $81,695
Opt. C5 ..... *1
Opt. R2 ..... $1,130
Opt. 01 ..... $3,250
ESVB $46,325
Opt. R2 ..... $1,130
Opt. 01 ..... $3,995
Opt. 02 ..... $5,500
ESVD $42,510
Opt. R2 ..... $1,130
Opt. 01 ..... $3,995
Opt. 02 ..... $5,500
ESVN20 ..... $46,325
Opt. R2 ..... $1,130
Opt. 01 ..... $3,250
ESVN30 ..... $53,005
Opt. R2 ..... $1,130
Opt. 01 ..... $3,250
ESVS10 ..... $28,885
Opt. R2 ..... $590
Opt. 01 ..... $1,505
ESVS30 ..... $41,965
Opt. C5 ..... *1
Opt. R2 ..... $1,130
Opt. 01 ..... $1,505
ESVZ1 ..... $1,610
Opt. R2 ..... $60
ESVZ3 ..... $2,075
EZ1002 ..... $2,375
EZ1003 ..... $2,375
EZ11 ..... $105
EZ12 ..... $1,960
EZ13 ..... $310
EZ14 ..... $325
EZ15 ..... $85
EZ16 ..... $240
EZ1702 ..... $1,550
EZ1703 ..... $1,550
EZ18 ..... $3,410
EZ19 ..... $75
EZ4 ..... $330
EZ5 ..... $310
EZ6 ..... $310
EZ8 ..... $1,270
FASTRAK $950
Opt. 2P ..... NC
FG1300 ..... $11,800
Opt. 30 ..... NC
Opt. 31 ..... NC
Opt. 32 ..... NC
Opt. 33 ..... NC
Opt. 34 ..... NC
Opt. 35 ..... NC
Opt. 36 ..... NC
Opt. 37 ..... NC
Opt. 38 ..... NC
Opt. 39 ..... NC
FG1315 ..... $14,000
Opt. 30 ..... NC
Opt. 31 ..... NC
Opt. 32 ..... NC
Opt. 33 ..... NC
Opt. 34 ..... NC
Opt. 35 ..... NC
Opt. 36 ..... NC
Opt. 37 ..... NC
Opt. 38 ..... NC
Opt. 39 ..... NC
FG5010 ..... $6,450
FG502 ..... $1,450
FG503 ..... $1,045
FL1300 ..... $14,075
Opt. AP $300
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 30 ..... NC
Opt. 31 ..... NC
Opt. 32 ..... NC
Opt. 33 ..... NC
Opt. 34 ..... NC
Opt. 35 ..... NC
Opt. 36 ..... NC
Opt. 37 ..... NC
Opt. 38 ..... NC
Opt. 39 ..... NC
Opt. 95 ..... $150
Opt. 96 ..... $50
FL1315 ..... $20,400
Opt. AP $300
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 30 ..... NC
Opt. 31 ..... NC
Opt. 32 ..... NC
Opt. 33 ..... NC
Opt. 34 ..... NC
Opt. 35 ..... NC
Opt. 36 ..... NC
Opt. 37 ..... NC
Opt. 38 ..... NC
Opt. 39 ..... NC
Opt. 95 ..... $150
Opt. 96 ..... $50
FL1500 ..... $17,750
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 30 ..... NC
Opt. 31 ..... NC
Opt. 32 ..... NC
Opt. 33 ..... NC
Opt. 34 ..... NC
Opt. 35 ..... NC
Opt. 36 ..... NC
Opt. 37 ..... NC
Opt. 38 ..... NC
Opt. 39 ..... NC
Opt. 95 ..... $150
Opt. 96 ..... $50
FMA $25,415
Opt. R2 ..... $1,130
Opt. 01 ..... $1,985
Opt. 02 ..... $2,525
Opt. 03 ..... $3,080
Opt. 05 ..... $3,470
Opt. 07 ..... $3,400
Opt. 08 ..... $12,320
Opt. 09 ..... $1,660
Opt. 10 ..... $9,170
Opt. 12 ..... $1,505
FMAB $32,380
Opt. R2 ..... $1,130
Opt. 05 ..... $3,470
Opt. 07 ..... $3,975
Opt. 08 ..... $12,320
Opt. 09 ..... $1,660
Opt. 10 ..... $9,170
Opt. 12 ..... $1,505
FMAS $52,980
Opt. R2 ..... $1,130
FMAV $23,940
Opt. R2 ..... $1,130
Opt. 01 ..... $1,985
Opt. 02 ..... $2,525
Opt. 03 ..... $3,080
Opt. 05 ..... $3,470
Opt. 08 ..... $12,320
Opt. 12 ..... $1,505
FMAZ1 ..... $2,955
FMB $32,380
Opt. R2 ..... $1,130
Opt. 01 ..... $1,985
Opt. 02 ..... $2,525
Opt. 03 ..... $3,080
Opt. 05 ..... $3,470
Opt. 07 ..... $3,975
Opt. 08 ..... $12,320
Opt. 09 ..... $1,660
Opt. 10 ..... $9,170
Opt. 12 ..... $1,505
FMTAP $995
FM1300 ..... $13,750
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 20 ..... NC
Opt. 21 ..... NC
Opt. 22 ..... NC
Opt. 24 ..... NC
Opt. 25 ..... NC
Opt. 26 ..... NC
Opt. 27 ..... NC
Opt. 29 ..... NC
Opt. 95 ..... $150
Opt. 96 ..... $50
FM8500 ..... $7,140
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 20 ..... NC
Opt. 21 ..... NC
Opt. 22 ..... NC
Opt. 23 ..... NC
Opt. 24 ..... NC
Opt. 25 ..... NC
Opt. 26 ..... NC
Opt. 27 ..... NC
Opt. 29 ..... NC
Opt. 95 ..... $150
Opt. 96 ..... $50
FM8513 ..... $16,320
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 20 ..... NC
Opt. 21 ..... NC
Opt. 22 ..... NC
Opt. 23 ..... NC
Opt. 24 ..... NC
Opt. 25 ..... NC
Opt. 26 ..... NC
Opt. 95 ..... $150
Opt. 96 ..... $50
FSA $52,980
Opt. R2 ..... $1,130
Opt. 01 ..... $21,415
Opt. 02 ..... $25,380
Opt. 03 ..... $10,230
Opt. 05 ..... $2,960
FSAC $98,670
Opt. R2 ..... $2,130
Opt. 03 ..... $10,230
Opt. 04 ..... $4,625
Opt. 05 ..... $2,960
FSAS $90,810
Opt. R2 ..... $1,130
Opt. 02 ..... $25,380
Opt. 03 ..... $10,230
Opt. 05 ..... $2,960
FSB $70,265
Opt. R2 ..... $1,130
Opt. 01 ..... $21,415
Opt. 02 ..... $25,380
Opt. 03 ..... $10,230
Opt. 05 ..... *1
FSBC $90,030
Opt. R2 ..... $2,130
Opt. 03 ..... $10,230
Opt. 04 ..... $4,625
FSBS $78,910
Opt. R2 ..... $1,130
Opt. 02 ..... $25,380
Opt. 03 ..... $10,230
FSEA20 ..... $29,995
Opt. 01 ..... $2,950
Opt.02 ..... $14,000
Opt. 04 ..... $4,465
Opt. 05 ..... $3,450
Opt.07 ..... $17,600
Opt. 15 ..... $2,740
Opt.16 ..... $1,375
Opt.17 ..... $1,375
Opt.49 ..... $1,375

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Products and Price Listing

PRICE INFORMATION

FSEA30 ..... $43,895
Opt. 02 ..... $14,000
Opt. 07 ..... $17,600
Opt. 15 ..... $2,740
Opt. 16 ..... $1,375
Opt. 17 ..... $1,375
Opt. 49 ..... $1,375
FSEB *1
FSEB20 ..... $34,995
Opt. 01 ..... $2,950
Opt. 04 ..... $4,465
Opt. 05 ..... $3,450
Opt. 07 ..... $17,600
Opt. 15 ..... $2,740
Opt. 16 ..... $1,375
Opt. 17 ..... $1,375
Opt. 49 ..... $1,375
FSEB30 ..... $55,600
Opt. 07 ..... $17,600
Opt. 15 ..... $2,740
Opt. 16 ..... $1,375
Opt. 17 ..... $1,375
Opt. 49 ..... $1,375
FSEK0 ..... *1
FSEZ1 ..... *1
FSK1 ..... $3,150
FSK3 ..... $4,655
FSM $87,560
Opt. 01 ..... $20,715
Opt. 03 ..... $10,230
FSMS26 ..... $109,910
Opt. R2 ..... $2,130
FSTIP $125
FSZ1 ..... $3,315
FSZ15 ..... $1,460
FSZ16 ..... $19,140
FSZ17 ..... $2,470
FSZ18 ..... $2,975
FSZ19 ..... $4,745
FSZ2 ..... $1,305
FSZ20 ..... $5,275
FSZ21 ..... $5,615
FSZ4 ..... $7,340
FS1300 ..... $15,000
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 30 ..... NC
Opt. 31 ..... NC
Opt. 32 ..... NC
Opt. 34 ..... NC
Opt. 35 ..... NC
Opt. 36 ..... NC
Opt. 37 ..... NC
Opt. 38 ..... NC
Opt. 39 ..... NC
Opt. 95 ..... $150
Opt. 96 ..... $50
FS1315 ..... $23,000
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 30 ..... NC
Opt. 31 ..... NC
Opt. 32 ..... NC
Opt. 33 ..... NC
Opt. 34 ..... NC
Opt. 35 ..... NC
Opt. 36 ..... NC
Opt. 37 ..... NC
Opt. 38 ..... NC
Opt. 39 ..... NC
Opt. 41 ..... NC
Opt. 42 ..... NC
Opt. 95 ..... $150
Opt. 96 ..... $50
FS1500 ..... $17,500
Opt. AP $300
Opt. C5 ..... $1,225
Opt. NF $200
Opt. R2 ..... $590
Opt. 30 ..... NC
Opt. 31 ..... NC
Opt. 32 ..... NC
Opt. 33 ..... NC
Opt. 34 ..... NC
Opt. 35 ..... NC
Opt. 36 ..... NC
Opt. 37 ..... NC
Opt. 38 ..... NC
Opt. 39 ..... NC
Opt. 95 ..... $150
Opt. 96 ..... $50
FS156 ..... $913
FS52 ..... $811
FS622 ..... $1,015
F7524A1 ..... $11,980
F7527A1 ..... $5,205
F7535A2 ..... $18,860
F7539A1 ..... $12,680
GB1400 ..... $50,000
Opt. 1R $200
Opt. 1T $200
Opt. 2A $1,500
Opt. 2R $800
Opt. 2T $800
Opt. 4R ..... –$26,000
Opt. 4S $1,000
Opt. 4T ..... –$24,000
Opt. 5A $4,000
Opt. 5R $2,000
Opt. 5T $2,000
Opt. 7T $2,000
Opt. 8R $5,000
Opt. 8T $5,000
Opt. 9R $2,000
Opt. 9T $2,000
GB700 ..... $39,000
Opt. 1R $200
Opt. 1T $200
Opt. 2A $1,500
Opt. 2R $800
Opt. 2T $800
Opt. 4R ..... –$15,000
Opt. 4S $1,000
Opt. 4T ..... –$15,000
GCRF00 ..... $350
Opt. M0 ..... $125
GCRF01 ..... $350
Opt. M0 ..... $125
GCRF03 ..... $350
Opt. M0 ..... $125
GCRF200 ..... $350
Opt. M0 ..... $125
GS525 ..... $12,350
GS525K1 ..... $860
HCC $7,915
HCMB1 ..... $1,460
HCMB2 ..... $2,925
HCMB3 ..... $730
HCMF04 ..... $14,990
HCMF06 ..... $15,705
HCMM04 ..... $16,830
HCMM06 ..... $17,625
HCT1202 ..... $15,090
HCT1203 ..... $ 12,240
HC100 ..... $1,325
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. 01 ..... $130
Opt. 02 ..... $60
Opt. 04 ..... $40
HC220 ..... $485
HC411 ..... $470
Opt. A1 ..... NC
Opt. 01 ..... $25
Opt. 02 ..... $45
Opt. 03 ..... $58
Opt. 04 ..... $45
HFH2Z1 ..... $6,160
HFH2Z2 ..... $6,160
HFH2Z4 ..... $665
HFH2Z6 ..... $3,045
HFS9DG1 ..... $12,000
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 96 ..... $50
HFS9DG2 ..... $8,600
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 96 ..... $50
HFS9003 ..... $13,825
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 01 ..... $995
Opt. 1R $300
Opt. 96 ..... $50
HFS9009 ..... $21,825
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 01 ..... $995
Opt. 96 ..... $50
HFUMZ02 ..... $7,580
HFUTZ02 ..... $2,245
HFU2Z4 ..... $800
HFU2Z5 ..... $625
HFVZ $310
HK116 ..... $2,435
HL023A1 ..... $4,000
HL223 ..... $2,715
HL223Z1 ..... $705
HM020Z1 ..... $1,080
HM020Z2 ..... $560
HM020Z3 ..... $2,620
HM525 ..... $16,045
HM525Z1 ..... $425
HUFZ1 ..... $2,680
HUFZ4 ..... $3,145
HZ1 ..... $800
HZ10 ..... $650
HZ1102 ..... $1,515
HZ1103 ..... $1,515
HZ12 ..... $5,010
HZ13 ..... $4,290
HZ14 ..... $5,010
HZ17 ..... $1,195
HZ18 ..... $230
HZ19 ..... $250
HZ2 ..... $2,280
HZ3 ..... $300
HZ4 ..... $330
HZ9 ..... $1,750
IPA510 ..... $17,000
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. 02 ..... $1,600
Opt. 03 ..... $950
Opt. 04 ..... $950
Opt. 1C $1,200
Opt. 1E $1,245
Opt. 1F $4,000
Opt. 1G $615
Opt. 1M $1,000
Opt. 1R $250
Opt. 1S $2,000
Opt. 1U $8,000
Opt. 2E $3,500
Opt. 2F $4,800
Opt. 2S $8,000
Opt. 2U $8,000
Opt. 26 ..... $25,000
Opt. 27 ..... $5,250
Opt. 28 ..... $10,000
Opt. 29 ..... $1,650
Opt. 3E ..... $ –1,245
Opt. 3F $23,000
Opt. 3S $10,000
Opt. 30 ..... $1,650
Opt. 31 ..... $1,650
Opt. 32 ..... $1,650
Opt. 33 ..... $1,650
Opt. 34 ..... $1,650
Opt. 35 ..... $4,200
Opt. 36 ..... $600
Opt. 4F $5,200
Opt. 4S $12,000
Opt. 5S $42,500
Opt. 6S $13,000
IQSIMK $935
J17 ..... $1,095
J18 ..... $1,995
J1803 ..... $595
J1805 ..... $595
J1806 ..... $595
J1810 ..... $1,495
J1811 ..... $695
J1812 ..... $795
J1820 ..... $1,495
KNW242 ..... $4,490
KNW403D $2,690
KNW407 ..... $2,530
KT10 ..... $5,950
KT20 ..... $5,950
K212 ..... $ 425
Opt. 10 ..... $80
Opt. 12 ..... $100
Opt. 22 ..... $165
K218 ..... $875
K415 ..... $750
K420 ..... $750
K465 ..... $850
K475 ..... $950
LABROWS $100
Opt. 01 ..... $2,850
Opt. 05 ..... $8,850
Opt. 08 ..... $29,850
Opt. 41 ..... $950
Opt. 45 ..... $2,500
Opt. 48 ..... $7,500
LACART $850
LADM932 ..... $6,000
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. 01 ..... $1,200
Opt. 02 ..... $2,450
Opt. 03 ..... $2,450
Opt. 05 ..... $2,450
Opt. 1D ..... –$1,500
LADM933 ..... $3,500
Opt. 1D ..... –$1,500
LAFM932 ..... $250
LAF01 ..... $6,600
LAF02 ..... $10,700
LAF03 ..... $14,800
LAF04 ..... $6,600
LAF05 ..... $10,700
LAF06 ..... $6,600
LAHDP2 ..... $1,200
Opt. 01 ..... $750
Opt. 02 ..... $250
LALINK $10
Opt. 1P $940
Opt. 1R $940
Opt. 1W $940
Opt. 1X $940
Opt. 1Y $940
Opt. 2Y $1,485
LAOFFLN $100
Opt. 01 ..... $4,850
Opt. 05 ..... $14,850
Opt. 08 ..... $49,850
Opt. 11 ..... $2,850
Opt. 15 ..... $8,850
Opt. 18 ..... $29,850
Opt. 41 ..... $950
Opt. 45 ..... $2,500
Opt. 48 ..... $7,500
LAPIKB $295
LAPIKPV $295
LF02A2 ..... $3,795
LF02A3 ..... $3,795
LF02XFE $200
LF02XFI $200
LF02XFZ $200
LF02XHA $200
LF02XHB $200
LF02XHC $200
LF02XPF $595

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Products and Price Listing

PRICE INFORMATION

LF02XTA $495
LF02XTB $495
LVWIN $1,995
Opt. 10 ..... NC
Opt. 21 ..... $395
LVWINAB $995
LVWINRT $495
LVWINTE $495
LWCVI $1,995
Opt. 10 ..... NC
Opt. 21 ..... $395
LWCVIRT $495
LWCVITE ..... $ 495
LWDOS $1,495
Opt. 10 ..... NC
LWDOSRT $195
MB100 ..... $53,100
Opt. 1R $200
Opt. 1T $200
Opt. 2B $3,600
Opt. 2C $3,600
Opt. 3B $13,400
Opt. 3C $25,200
Opt. 3E $12,000
Opt. 3F $14,000
Opt. 3G $16,000
MCTAP $95
MDS21 ..... $4,730
MDS22 ..... $ 4,205
MSS170A $11,325
MTS100 ..... $45,000
MXICBLS $10
Opt. 10 ..... $250
Opt. 11 ..... $265
Opt. 12 ..... $295
Opt. 20 ..... $265
Opt. 21 ..... $295
Opt. 30 ..... $255
Opt. 31 ..... $270
Opt. 41 ..... $40
MXIEXT $1,995
Opt. 10 ..... $400
MXIWIN $3,635
Opt. 10 ..... $400
NAPZ2 ..... $360
NAPZ3 ..... $1,500
Opt. C5 ..... $475
Opt. R2 ..... $160
NAPZ4 ..... $1,865
Opt. C5 ..... $725
Opt. R2 ..... $260
NAPZ5 ..... $1,875
Opt. C5 ..... $725
Opt. R2 ..... $260
NAPZ6 ..... $1,895
Opt. C5 ..... $725
Opt. R2 ..... $260
NAPZ7 ..... $2,475
Opt. C5 ..... $725
Opt. R2 ..... $260
NAPZ8 ..... $2,475
Opt. C5 ..... $725
Opt. R2 ..... $260
NAPZ9 ..... $1,855
NAP02 ..... $2,345
Opt. C5 ..... $725
Opt. R2 ..... $260
NAP04 ..... $3,010
Opt. C5 ..... $725
Opt. R2 ..... $260
NAS $1,110
Opt. C5 ..... $475
Opt. R2 ..... $160
NASZ1 ..... $910
Opt. C5 ..... $475
Opt. R2 ..... $160
NASZ10 ..... $160
NASZ2 ..... $1,100
Opt. C5 ..... $475
Opt. R2 ..... $160
NASZ3 ..... $910
Opt. C5 ..... $475
Opt. R2 ..... $160
NASZ5 ..... $885
NASZ6 ..... $1,200
NASZ7 ..... *1
NASZ9 ..... $65
NAZ10 ..... $140
NAZ30 ..... $320
NRVD $5,670
Opt. C5 ..... $725
Opt. R2 ..... $260
Opt. 01 ..... $655
NRVDS1 ..... *1
NRVS $2,845
Opt. C5 ..... $475
Opt. R2 ..... $160
NRVS1 ..... *1
NRVZ1 ..... *1
NRVZ102 ..... $1,375
Opt. C5 ..... $725
Opt. R2 ..... $260
NRVZ103 ..... $1,505
Opt. C5 ..... $725
Opt. R2 ..... $260
NRVZ2 ..... *1
NRVZ231 ..... *1
NRVZ202 ..... $1,655
Opt. C5 ..... $725
Opt. R2 ..... $260
NRVZ203 ..... $1,790
Opt. C5 ..... $725
Opt. R2 ..... $260
NRVZ3 ..... *1
NRVZ302 ..... $1,220
Opt. C5 ..... $475
Opt. R2 ..... $160
NRVZ31 ..... *1
NRVZ4 ..... *1
NRVZ402 ..... $1,145
Opt. C5 ..... $475
Opt. R2 ..... $160
NRVZ403 ..... $1,295
Opt. C5 ..... $475
Opt. R2 ..... $160
NRVZ5 ..... *1
NRVZ502 ..... $1,670
Opt. C5 ..... $475
Opt. R2 ..... $160
NRVZ503 ..... $1,800
Opt. C5 ..... $475
Opt. R2 ..... $160
NRVZ51 ..... $1,340
Opt. C5 ..... $275
Opt. R2 ..... $60
NRVZ52 ..... $1,615
Opt. C5 ..... $325
Opt. R2 ..... $100
NRVZ6 ..... $1,735
Opt. C5 ..... $325
Opt. R2 ..... $100
NRVZ7 ..... $865
Opt. C5 ..... $275
Opt. R2 ..... $60
NRVZ8 ..... $1,275
Opt. C5 ..... $275
Opt. R2 ..... $60
OA5002 ..... $7,395
Opt. C5 ..... $725
Opt. R2 ..... $260
OA5012 ..... $7,135
Opt. C5 ..... $725
Opt. R2 ..... $260
OA5022 ..... $7,135
Opt. C5 ..... $725
Opt. R2 ..... $260
OA5032 ..... $7,135
Opt. C5 ..... $725
Opt. R2 ..... $260
OCP5002 ..... $9,500
Opt. C5 ..... $1,050
Opt. R2 ..... $400
OCP5502 ..... $9,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. R2 ..... $400
OIG501 ..... $9,435
Opt. C5 ..... $1,050
Opt. R2 ..... $400
OIG502 ..... $9,945
Opt. C5 ..... $1,050
Opt. R2 ..... $400
ORS156 ..... $11,395
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 1P ..... –$495
Opt. 11 ..... –$6,300
Opt. 12 ..... –$6,300
Opt. 13 ..... –$6,300
Opt. 14 ..... –$6,300
Opt. 15 ..... –$6,300
Opt. 31 ..... $1,500
ORS2488 ..... $17,950
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 1P ..... –$495
ORS52 ..... $11,295
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 1P ..... –$495
Opt. 11 ..... –$6,300
Opt. 12 ..... –$6,300
Opt. 13 ..... –$6,300
Opt. 14 ..... –$6,300
Opt. 15 ..... –$6,300
Opt. 21 ..... –$7,300
Opt. 22 ..... –$7,300
Opt. 23 ..... –$7,300
Opt. 24 ..... –$7,300
Opt. 25 ..... –$7,300
ORS622 ..... $11,495
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 1P ..... –$495
Opt. 31 ..... $1,500
Opt. 41 ..... $1,600
PB200 ..... $33,000
Opt. 1M $200
Opt. 4S $1,000
PCAZ1 ..... $1,355
PCS $52,810
Opt. R2 ..... $1,130
PCSK1 ..... $1,925
PCSK10 ..... $1,855
PCSK2 ..... $2,690
PDR0F01 ..... $5,250
PDR0F02 ..... $12,180
PDR0F1A $2,400
PDR0F1L $300
PDR0F1M $1,400
PDR0F1V $7,875
PDR0F2V $5,630
PDR0F3V $3,640
PDR1F03 ..... $44,800
PDR100 ..... $43,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. U9 ..... $8,770
Opt. 1L $285
Opt. 1T $2,350
Opt. 20 ..... $9,930
Opt. 21 ..... $21,530
Opt. 22 ..... $15,530
Opt. 23 ..... $27,130
Opt. 24 ..... $19,245
Opt. 25 ..... $24,854
Opt. 26 ..... $22,700
Opt. 40 ..... $36,460
Opt. 41 ..... $26,530
Opt. 42 ..... $36,700
Opt. 43 ..... $44,200
Opt. 44 ..... $29,990
Opt. 45 ..... $32,130
PDX103 ..... $6,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. 01 ..... $23,200
Opt. 02 ..... $46,400
Opt. 03 ..... $23,200
PE50X20 ..... $170
PE50X25 ..... $185
PE50X26 ..... $190
PE50X36 ..... $200
PE50X38 ..... $210
PE50X40 ..... $220
PE50X52 ..... $265
PE50X60 ..... $270
PE50X76 ..... $340
PE65X20 ..... $145
PE65X28 ..... $175
PE65X36 ..... $190
PE65X40 ..... $215
PE65X46 ..... $205
PGFD1 ..... $350
PGFD2 ..... $350
PGF26 ..... $500
PG501 ..... $995
PG502 ..... $3,695
PG5110 ..... $6,950
PJ22030 ..... $165
PJ25X17 ..... $140
PJ25X20 ..... $150
PJ25X21 ..... $165
PJ25X25 ..... $170
PJ25X30 ..... $175
PJ25X33 ..... $185
PJ25X41 ..... $ 200
PJ25X49 ..... $220
PJ25X52 ..... $230
PJ25X60 ..... $250
PPMS100 ..... $15,995
PPMS200 ..... $5,995
PPM201B $795
PPM201C $795
PPM203B $1,295
PPM203C $1,295
PR326150 ..... *1
PR326160 ..... *1
PR326170 ..... *1
PSAZ1 ..... *1
PS2510 ..... $925
PS2510G $1,130
PS2511 ..... $925
PS2511G $1,130
PS2520 ..... $1,195
PS2520G $1,395
PS2521 ..... $1,195
PS2521G $1,395
PS280 ..... $725
PS281 ..... $405
PS282 ..... $405
PS283 ..... $699
PS5004 ..... $2,325
Opt. 95 ..... $150
Opt. 96 ..... $50
PS503A $1,095
PZ11 ..... *1
P400 ..... $110
P5100 ..... $199
P5102 ..... $199
P5200 ..... $399
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC

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Products and Price Listing

PRICE INFORMATION

Opt. A5 ..... NC
Opt. A6 ..... NC
P5205 ..... $895
P6007 ..... $240
Opt. 01 ..... $40
Opt. 03 ..... $45
Opt. 04 ..... $50
P6009 ..... $365
P6015A $995
Opt. C5 ..... $275
Opt. R2 ..... $60
Opt. 1R $60
Opt. 2R $175
Opt. 25 ..... $130
P6021 ..... $595
Opt. 03 ..... $55
P6022 ..... $630
Opt. 03 ..... $55
P6041 ..... $105
P6046 ..... $2,495
Opt. A6 ..... NC
Opt. C5 ..... $325
Opt. R2 ..... $100
P6062B $285
Opt. 01 ..... $50
Opt. 03 ..... $50
P6063B $360
Opt. 01 ..... $50
P6101B $65
P6103B $70
P6105A $185
Opt. 01 ..... $45
Opt. 03 ..... $50
P6106A $215
Opt. 01 ..... $40
Opt. 03 ..... $45
P6109B $85
P6111B $140
P6113B $75
P6119B $95
P6122 ..... $125
Opt. 02 ..... $50
Opt. 03 ..... $55
P6129B $110
P6131 ..... $200
Opt. 02 ..... $45
Opt. 03 ..... $50
P6133 ..... $180
Opt. 01 ..... $45
Opt. 03 ..... $50
Opt. 25 ..... $40
P6134C $250
P6135A $825
P6136 ..... $215
Opt. 25 ..... $40
P6137 ..... $225
P6138 ..... $200
P6139A $285
P6150 ..... $995
P6156 ..... $285
Opt. 25 ..... $80
Opt. 26 ..... $80
Opt. 27 ..... $80
Opt. 28 ..... $230
P6201 ..... $1,675
Opt. C5 ..... $325
Opt. R2 ..... $100
P6202A $1,175
Opt. C5 ..... $275
Opt. R2 ..... $60
P6204 ..... $1,675
Opt. C5 ..... $325
Opt. R2 ..... $100
P6205 ..... $630
Opt. C5 ..... $275
Opt. R2 ..... $60
P6207 ..... $3,695
Opt. C5 ..... $475
Opt. R2 ..... $160
P6217 ..... $3,695
Opt. C5 ..... $475
Opt. R2 ..... $160
P6240 ..... $185
Opt. C5 ..... $275
Opt. R2 ..... $60
P6243 ..... $395
P6243S $1,295
P6245 ..... $1,395
Opt. C5 ..... $325
Opt. R2 ..... $100
P6408 ..... $570
P6460 ..... $950
P6463A $1,050
Opt. K1 ..... $150
Opt. K2 ..... $300
Opt. K3 ..... $450
Opt. 40 ..... NC
P6465 ..... $3,100
Opt. K1 ..... $200
Opt. K2 ..... $400
Opt. K3 ..... $600
P6467 ..... $5,000
P6468 ..... $2,000
P6480 ..... $750
Opt. 1F $450
P6486 ..... $1,000
Opt. 1L $500
P6487 ..... $1,100
Opt. 1L $500
P6490 ..... $1,200
P6561A $205
P6561AS $385
P6562A $225
P6562AS $795
P6563A $245
P6563AS $850
P6701A ..... NC
Opt. 01 ..... $2,678
Opt. 02 ..... $2,678
Opt. 03 ..... $2,678
Opt. 04 ..... $2,678
Opt. 05 ..... $2,678
P6703A ..... NC
Opt. 01 ..... $3,677
Opt. 02 ..... $3,677
Opt. 03 ..... $3,677
Opt. 04 ..... $3,677
Opt. 05 ..... $3,677
P6711 ..... NC
Opt. 01 ..... $2,142
Opt. 02 ..... $2,142
Opt. 03 ..... $2,142
Opt. 04 ..... $2,142
Opt. 05 ..... $2,142
P6713 ..... NC
Opt. 01 ..... $2,550
Opt. 02 ..... $2,550
Opt. 03 ..... $2,550
Opt. 04 ..... $2,550
Opt. 05 ..... $2,550
P6721 ..... $1,523
Opt. C5 ..... $325
Opt. R2 ..... $100
P6751 ..... $467
Opt. C5 ..... $275
Opt. R2 ..... $60
P850 ..... $120
Q32605 ..... $13,210
Q81201 ..... $1,210
Opt. C5 ..... $275
Opt. R2 ..... $60
Q81202 ..... $1,980
Opt. C5 ..... $325
Opt. R2 ..... $100
Q81203 ..... $3,080
Opt. C5 ..... $475
Opt. R2 ..... $160
Q81204 ..... $2,860
Opt. C5 ..... $475
Opt. R2 ..... $160
Q81205 ..... $3,855
Opt. C5 ..... $475
Opt. R2 ..... $160
Q81206 ..... $5,505
Opt. C5 ..... $725
Opt. R2 ..... $260
Q81207 ..... $6,055
Q81211 ..... $5,505
Opt. C5 ..... $725
Opt. R2 ..... $260
Q81212 ..... $8,255
Opt. C5 ..... $725
Opt. R2 ..... $ 260
Q82018A $1,760
Opt. C5 ..... $325
Opt. R2 ..... $100
Q82039 ..... $4,405
Opt. C5 ..... $475
Opt. R2 ..... $160
Q82202 ..... $1,100
Opt. C5 ..... $275
Opt. R2 ..... $60
Q82208 ..... $5,285
Opt. C5 ..... $475
Opt. R2 ..... $160
Q8221 ..... $2,080
Opt. C5 ..... $325
Opt. R2 ..... $100
Q82214 ..... $880
Opt. C5 ..... $275
Opt. R2 ..... $60
Q82215 ..... $1,320
Opt. C5 ..... $275
Opt. R2 ..... $60
Q82216 ..... $3,745
Opt. C5 ..... $475
Opt. R2 ..... $160
Q82226 ..... $3,550
Opt. C5 ..... $475
Opt. R2 ..... $160
Q8344A $36,495
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 01 ..... $2,200
Opt. 10 ..... $1,100
Q8347 ..... $83,995
Q8381A $35,000
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Q8383 ..... $43,900
Opt. R2 ..... $1,130
Q8460A $8,805
Opt. C5 ..... $725
Opt. R2 ..... $260
Opt. 80 ..... $1,100
Q84601 ..... $18,715
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Q84605 ..... $11,560
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Q84605P $11,560
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Q84606 ..... $16,515
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Q84621A $23,120
Opt. C5 ..... $1,225
Opt. R2 ..... $590
RAD $190
RAD50 ..... $175
RAD600 ..... $175
RAM $570
RAU $1,135
RAZ $570
RBS1000 ..... $4,790
RBU07 ..... $1,995
RBU17 ..... $3,735
RBU37 ..... $4,045
RC210 ..... $1,200
Opt. A6 ..... NC
Opt. M1 ..... $195
Opt. M2 ..... $85
Opt. M3 ..... $385
Opt. M7 ..... $150
Opt. M8 ..... $300
Opt. M9 ..... $45
RC211 ..... $1,200
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A6 ..... NC
Opt. M1 ..... $195
Opt. M2 ..... $85
Opt. M3 ..... $385
Opt. M7 ..... $150
Opt. M8 ..... $300
Opt. M9 ..... $45
REP4100 ..... $30
REP4200 ..... $50
REP4300 ..... $80
REP4400 ..... $130
REP4500 ..... $200
REP4600 ..... $295
REP4700 ..... $565
REP4800 ..... $1,065
REP5100 ..... $150
REP5200 ..... $170
REP5300 ..... $200
REP5400 ..... $250
REP5500 ..... $320
REP5600 ..... $415
REP5700 ..... $685
REP5800 ..... $1,185
RFM150 ..... $2,250
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. A6 ..... NC
Opt. M2 ..... $275
Opt. M8 ..... $895
Opt. 01 ..... $160
RFM90 ..... $995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A6 ..... NC
RGB2SUN $595
RGB3F1L $2,000
Opt. A0 ..... NC
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. S0 ..... $350
Opt. S3 ..... $42
Opt. 00 ..... NC
Opt. 10 ..... $300
RGB3F2P $1,500
Opt. S0 ..... $350
RNB $105
RSG $8,005
RSM $10,595
RSP $13,105
Opt. C5 ..... $1,050
Opt. R2 ..... $400
RTDF215 ..... $16,400
RTDF219 ..... $3,400
RTD720A $26,680
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. 06 ..... $2,750
Opt. 10 ..... $6,000
Opt. 15 ..... $13,900
Opt. 19 ..... $3,100
Opt. 95 ..... $150
Opt. 96 ..... $50
RVZ $990
R14601 ..... $1,100
Opt. C5 ..... $275
Opt. R2 ..... $60
R16056A $1,100
R16059 ..... $1,100
R16060 ..... $1,320
R16072 ..... $1,320
R16211A $530
R16216 ..... $495
R16601 ..... $85
R16905 ..... $430
R2465A $57,000
Opt. R2 ..... $1,130
R2465B $66,500
Opt. R2 ..... $1,130
R2471A $63,000
Opt. R2 ..... $1,130
R2471B $74,860

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Products and Price Listing

PRICE INFORMATION

Opt. R2 ..... $2,130
R2531 ..... $39,630
Opt. C5 ..... $1,225
Opt. R2 ..... $590
R2532 ..... $34,200
Opt. C5 ..... $1,225
Opt. R2 ..... $590
R2533 ..... $45,685
Opt. C5 ..... $1,225
Opt. R2 ..... $590
R2534 ..... $39,500
Opt. R2 ..... $1,130
R3261C $13,950
Opt.C5 ..... *1
Opt.R2 ..... *1
Opt. 1K $2,000
Opt. 12 ..... $1,095
Opt. 15 ..... $2,195
Opt.40 ..... NC
R3261CN $13,950
Opt.C5 ..... *1
Opt.R2 ..... *1
Opt. 12 ..... $1,095
Opt. 15 ..... $2,195
Opt.40 ..... NC
Opt.1K *1
R3261D $19,865
Opt.C5 ..... *1
Opt.R2 ..... *1
Opt. 1K $2,000
Opt. 12 ..... $1,095
Opt. 15 ..... $2,195
Opt.40 ..... NC
R3265 ..... $28,500
R3265A $32,250
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 07 ..... $750
R3271A $36,364
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 21 ..... $660
R3272 ..... $28,990
Opt. C5 ..... *1
Opt. R2 ..... *1
R3361C $19,980
Opt.C5 ..... *1
Opt.R2 ..... *1
Opt. 1K $2,000
Opt. 12 ..... $1,095
Opt. 15 ..... $2,195
Opt.40 ..... *1
R3361CN $19,980
Opt.C5 ..... *1
Opt.R2 ..... *1
Opt.1K *1
Opt. 12 ..... $1,095
Opt. 15 ..... $2,195
Opt.40 ..... *1
R3361D $25,795
Opt.C5 ..... *1
Opt.R2 ..... *1
Opt. 1K $2,000
Opt. 12 ..... $1,095
Opt. 15 ..... $2,195
Opt.40 ..... *1
R3365A $42,750
Opt. R2 ..... $1,130
R3371A $50,500
Opt. C5 ..... *1
Opt. R2 ..... $1,130
R3465 ..... *1
Opt. C5 ..... *1
Opt. R2 ..... *1
R4131D $10,395
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 14 ..... *1
R9211A $15,300
Opt. 07 ..... $2,200
Opt. 10 ..... $2,750
Opt. 11 ..... $2,200
Opt. 12 ..... $2,750
R9211B $17,700
Opt. 07 ..... $2,200
Opt. 10 ..... $2,750
Opt. 11 ..... $2,200
R9211C $23,800
Opt. 07 ..... $2,200
Opt. 10 ..... $2,750
R9211E $12,900
Opt. 06 ..... $1,100
Opt. 07 ..... $2,200
Opt. 10 ..... $2,750
SAF $22,410
SA42 ..... $3,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $475
Opt. R2 ..... $160
SA46 ..... $6,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $475
Opt. R2 ..... $160
SCDF019 ..... $3,400
SCD5000 ..... $53,935
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. 01 ..... $3,500
Opt. 1P $3,500
Opt. 2E $400
Opt. 2F $4,900
Opt. 20 ..... –$1,000
Opt. 9E $1,400
Opt. 95 ..... $150
Opt. 96 ..... $50
SC502 ..... $3,295
SDA601 ..... $2,595
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A6 ..... NC
Opt. M2 ..... $195
Opt. M8 ..... $400
Opt. 01 ..... $55
SD14 ..... $4,500
Opt. C5 ..... $475
Opt. R2 ..... $160
Opt. 01 ..... $250
Opt. 95 ..... $150
Opt. 96 ..... $50
SD20 ..... $4,400
Opt. C5 ..... $475
Opt. R2 ..... $160
Opt. 95 ..... $150
Opt. 96 ..... $50
SD22 ..... $3,780
Opt. C5 ..... $475
Opt. R2 ..... $160
Opt. 95 ..... $150
Opt. 96 ..... $ 50
SD24 ..... $5,250
Opt. C5 ..... $725
Opt. R2 ..... $260
Opt. 95 ..... $150
Opt. 96 ..... $50
SD26 ..... $3,780
Opt. C5 ..... $475
Opt. R2 ..... $160
Opt. 95 ..... $150
Opt. 96 ..... $50
SD30 ..... $9,450
Opt. C5 ..... $725
Opt. R2 ..... $260
Opt. 96 ..... $50
SD32 ..... $12,500
Opt. C5 ..... $725
Opt. R2 ..... $260
Opt. 96 ..... $50
SD42 ..... $3,995
Opt. C5 ..... $475
Opt. R2 ..... $160
SD46 ..... $6,995
Opt. C5 ..... $475
Opt. R2 ..... $160
SD51 ..... $4,200
Opt. C5 ..... $475
Opt. R2 ..... $160
Opt. 96 ..... $75
S3FG230 ..... *1
SFF $17,920
SFZ $39,340
Opt. AT $6,150
Opt. BS $630
Opt. CC $2,250
Opt. D2 ..... $2,820
Opt. FM $2,190
Opt. IF $7,620
Opt. NG $8,790
Opt. NT ..... $ 2,250
SF501 ..... $40
SF502 ..... $40
SF503 ..... $40
SGMF $7,980
SGMF02 ..... $7,980
SGMF34 ..... $8,990
SGPF $7,980
SGSF $10,690
SG5010 ..... $6,250
Opt. 95 ..... $150
Opt. 96 ..... $50
SG502 ..... $1,800
SG503 ..... $3,995
Opt. 95 ..... $150
Opt. 96 ..... $50
SG5030 ..... $11,250
Opt. 95 ..... $150
Opt. 96 ..... $50
SG504 ..... $5,395
Opt. 95 ..... $150
Opt. 96 ..... $50
SIU800 ..... $1,950
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. A6 ..... NC
SI5010 ..... $3,100
SJ30FA6 ..... $3,000
SJ30FE4 ..... $11,500
SJ30F03 ..... $7,500
SJ30F04 ..... $7,500
SJ30F06 ..... $10,000
SJ30F07 ..... $750
SJ300E $29,000
Opt. 03 ..... $3,000
Opt. 04 ..... $6,000
Opt. 06 ..... $8,000
Opt. 07 ..... $5,000
Opt. 08 ..... $5,000
Opt. 1M $200
Opt. 3C ..... NC
Opt. 4C ..... $ NC
Opt. 4S $2,000
Opt. 7C ..... NC
SMCK1 ..... $105
SMC14 ..... $ 45
SMC16 ..... $49
SMC20 ..... $50
SMC24 ..... $58
SMC8 ..... $45
SME02 ..... $19,450
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 01 ..... $1,060
Opt. 02 ..... $910
Opt. 03 ..... $2,340
Opt. 04 ..... $1,100
Opt. 05 ..... $1,820
Opt. 06 ..... $2,520
Opt. 11 ..... $1,690
Opt. 12 ..... $1,010
Opt. 19 ..... $245
SME03 ..... $25,500
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 01 ..... $1,060
Opt. 02 ..... $910
Opt. 04 ..... $1,100
Opt. 05 ..... $1,820
Opt. 06 ..... $2,520
Opt. 08 ..... $2,450
Opt. 11 ..... $1,960
Opt. 12 ..... $1,010
Opt. 19 ..... $245
SMGLZ10 ..... $305
SMGUZ2 ..... $2,290
SMGZ2 ..... $870
SMG50 ..... $99
SMHU58 ..... $ 43,600
Opt. C5 ..... *1
Opt. R2 ..... $1,130
Opt. 01 ..... $2,800
Opt. 02 ..... $2,800
Opt. 03 ..... $2,800
Opt. 04 ..... $3,520
Opt. 06 ..... $6,910
Opt. 10 ..... $255
SMP02 ..... $31,775
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 01 ..... $1,155
Opt. 02 ..... $990
Opt. 05 ..... $1,985
Opt. 11 ..... $4,090
Opt. 12 ..... $3,815
Opt. 13 ..... $1,200
Opt. 14 ..... $915
Opt. 15 ..... $2,890
Opt. 18 ..... $655
SMP03 ..... $39,895
Opt. C5 ..... *1
Opt. R2 ..... *1
Opt. 01 ..... $1,155
Opt. 02 ..... $990
Opt. 05 ..... $1,985
Opt. 11 ..... $1,840
Opt. 12 ..... $3,815
Opt. 13 ..... $1,200
Opt. 14 ..... $915
Opt. 15 ..... $2,890
Opt. 18 ..... $655
SMP04 ..... $46,545
Opt. C5 ..... *1
Opt. R2 ..... *1
Opt. 01 ..... $1,155
Opt. 02 ..... $990
Opt. 05 ..... $1,985
Opt. 11 ..... $ 4,090
Opt. 12 ..... $3,815
Opt. 13 ..... $1,200
Opt. 14 ..... $915
Opt. 15 ..... $2,890
Opt. 18 ..... $655
SMP22 ..... $ 42,185
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 01 ..... $1,155
Opt. 02 ..... $990
Opt. 05 ..... $1,985
Opt. 11 ..... $4,090
Opt. 12 ..... $3,815
Opt. 13 ..... $1,200
Opt. 14 ..... $915
Opt. 15 ..... $2,890
Opt. 18 ..... $655
SMQK1 ..... $280
SMQ20 ..... $97
SMQ28 ..... $120
SMQ44 ..... $120
SMQ52 ..... $145
SMQ68 ..... $150
SMQ84 ..... $145
SMT02 ..... $11,100
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 01 ..... $1,060
Opt. 02 ..... $910
Opt. 03 ..... $2,340
Opt. 04 ..... $1,100
Opt. 06 ..... $2,520
Opt. 20 ..... $210
SMT03 ..... $14,600
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 01 ..... $1,060
Opt. 02 ..... $910
Opt. 04 ..... $1,100

*1 *Contact your local Tektronix representative for price information.*

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Products and Price Listing

PRICE INFORMATION

Opt. 06	$2,520
Opt. 08	$2,450
Opt. 20	$210
SMXZ2	$545
SMY01	$6,750
Opt. C5	$725
Opt. R2	$260
Opt. 01	$940
SMY02	$7,900
Opt. C5	$725
Opt. R2	$260
Opt. 01	$940
SMZ2	$1,135
SM11	$25,500
Opt. A1	NC
Opt. A2	NC
Opt. A3	NC
Opt. A4	NC
Opt. A5	NC
Opt. C5	$1,225
Opt. Q0	$100
Opt. R2	$590
Opt. 1R	$275
SPG1000	$6,075
Opt. A1	NC
Opt. A2	NC
Opt. A3	NC
Opt. M1	$525
Opt. M2	$315
Opt. M3	$1,015
Opt. M7	$350
Opt. M8	$700
Opt. M9	$175
Opt. 01	$ NC
Opt. 02	NC
Opt. 03	NC
Opt. 04	NC
Opt. 15	NC
Opt. 16	NC
SPG170A	$3,475
Opt. M1	$475
Opt. M2	$245
Opt. M3	$925
Opt. M7	$340
Opt. M8	$680
Opt. M9	$135
Opt. 01	$1,000
Opt. 1J	NC
Opt. 2J	$1,000
SPG271	$3,150
Opt. A1	NC
Opt. A2	NC
Opt. A3	NC
Opt. M1	$ 475
Opt. M2	$245
Opt. M3	$925
Opt. M7	$ 340
Opt. M8	$ 680
Opt. M9	$135
Opt. 01	$635
Opt. 02	NC
SPG422	$3,900
Opt. A1	NC
Opt. A2	NC
Opt. A3	NC
Opt. A5	NC
Opt. M1	$530
Opt. M2	$210
Opt. M3	$550
Opt. M7	$410
Opt. M8	$820
Opt. M9	$120
Opt. 01	$1,000
Opt. 02	$900
SP232	$625
Opt. 01	$ NC
Opt. 02	NC
Opt. 03	NC
ST10FPS	$3,500
ST10FR4	NC
ST10F4R	$9,000
ST10F4T	$9,000
ST103A	$37,000
Opt. 04	$16,000
Opt. 06	$500
Opt. 1C	NC
Opt. 1R	$200
Opt. 1T	$200
Opt. 3C	NC
Opt. 3R	$ –15,000
Opt. 3T	$ –14,000
Opt. 4C	NC
Opt. 4R	–$25,000
Opt. 4T	–$24,000
ST11FE4	$15,500
ST11FR3	NC
ST11FR4	NC
ST11F03	$7,500
ST11F04	$11,500
ST112	$19,900
Opt. 03	$7,000
Opt. 04	$15,600
Opt. 06	$500
Opt. 07	$2,500
Opt. 1C	NC
Opt. 1M	$200
Opt. 2C	NC
Opt. 3C	NC
Opt. 4C	NC
ST24FR3	NC
ST24F3R	$42,500
ST24F3T	$42,500
ST24F5R	$42,500
ST24F5T	$42,500
ST2400	$75,000
Opt. 04	$24,000
Opt. 3C	NC
Opt. 3R	–$32,500
Opt. 3T	–$32,500
Opt. 4C	NC
Opt. 5C	NC
Opt. 6C	NC
SWVF	$34,205
SX4610	$47,000
Opt. A1	NC
Opt. A2	NC
Opt. A3	NC
Opt. A4	NC
Opt. A5	NC
Opt. R2	$1,130
Opt. 03	$7,500
Opt. 04	$16,900
Opt. 1C	–$3,000
Opt. 22	$6,000
Opt. 36	$8,000
Opt. 48	NC
S26EM12	$1,840
S26RF00	$895
Opt. 1A	NC
Opt. 1B	NC
Opt. 48	–$775
S26UT00	*1
Opt. 09	*1
S26UT10	$650
S3FG210	$395
Opt. 48	$ –130
S3FG220	$495
Opt. 48	–$170
S3FG222	$695
S3FT400	$895
Opt. 48	–$695
S37DITS	$2,590
S48P104	$525
Opt. 01	NC
S48P105	$525
S48P401	$2,050
Opt. 01	NC
S59ADGS	$11,840
Opt. S9	$2,069
S59AITP	$15,450
Opt. S9	$1,799
S59ASFL	$2,570
Opt. S9	$299
S59ATVD	$6,175
Opt. S9	$1,079
S60DWAV	$195
S60G210	$520
S60G220	$625
S85HFS1	$995
Opt. 48	–$945
TAS220	$795
TAS250	$1,195
TDSXF1F	$ 595
TDS310	$2,295
Opt. A1	NC
Opt. A2	NC
Opt. A3	NC
Opt. A4	NC
Opt. A5	NC
Opt. L1	NC
Opt. L3	NC
Opt. L4	NC
Opt. L9	NC
Opt. 14	$530
Opt. 95	$150
Opt. 96	$50
TDS320	$3,049
Opt. A1	NC
Opt. A2	NC
Opt. A3	NC
Opt. A4	NC
Opt. A5	NC
Opt. L1	NC
Opt. L3	NC
Opt. L4	NC
Opt. L9	NC
Opt. 14	$525
Opt. 95	$150
Opt. 96	$50
TDS350	$ 4,295
Opt. A1	NC
Opt. A2	NC
Opt. A3	NC
Opt. A4	NC
Opt. A5	NC
Opt. L1	NC
Opt. L3	NC
Opt. L9	NC
Opt. 14	$525
Opt. 95	$150
Opt. 96	$50
TDS4F13	$595
Opt. 1D	–$175
TDS4F2F	$1,390
Opt. 1D	$ –175
TDS4F5P	$495
Opt. 1D	–$175
TDS4U01	$395
Opt. 1D	–$175
Opt. 13	$495
Opt. 2F	$995
Opt. 3P	$695
TDS410A	$4,950
Opt. A1	NC
Opt. A2	NC
Opt. A3	NC
Opt. A4	NC
Opt. A5	NC
Opt. C5	$725
Opt. R2	$260
Opt. 02	$60
Opt. 05	$995
Opt. 1F	$495
Opt. 1K	$ 425
Opt. 1M	$815
Opt. 1R	$350
Opt. 13	$495
Opt. 2A	$1,320
Opt. 2F	$995
Opt. 22	$400
Opt. 28	$895
Opt. 3P	$725
Opt. 95	$150
Opt. 96	$50
TDS420A	$6,295
Opt. A1	NC
Opt. A2	NC
Opt. A3	NC
Opt. A4	NC
Opt. A5	NC
Opt. C5	$725
Opt. R2	$260
Opt. 02	$60
Opt. 05	$995
Opt. 1F	$495
Opt. 1K	$ 425
Opt. 1M	$1,095
Opt. 1R	$350
Opt. 13	$495
Opt. 2A	$1,600
Opt. 2F	$995
Opt. 22	$ 400
Opt. 28	$895
Opt. 3P	$725
Opt. 95	$150
Opt. 96	$50
TDS460A	$7,685
Opt. A1	NC
Opt. A2	NC
Opt. A3	NC
Opt. A4	NC
Opt. A5	NC
Opt. C5	$725
Opt. R2	$260
Opt. 02	$60
Opt. 05	$995
Opt. 1F	$495
Opt. 1K	$425
Opt. 1M	$1,095
Opt. 1R	$350
Opt. 13	$495
Opt. 2A	$1,600
Opt. 2F	$995
Opt. 22	$400
Opt. 28	$895
Opt. 3P	$725
Opt. 95	$150
Opt. 96	$50
TDS5F05	$1,995
Opt. 1D	$ –75
TDS5F13	$595
Opt. 1D	$ –75
TDS5F2F	$1,295
Opt. 1D	–$75
TDS520A	$9,150
Opt. A1	NC
Opt. A2	NC
Opt. A3	NC
Opt. A4	NC
Opt. A5	NC
Opt. C5	$725
Opt. R2	$260
Opt. 05	$1,495
Opt. 1F	$495
Opt. 1K	$750
Opt. 1R	$400
Opt. 13	$495
Opt. 2D	–$570
Opt. 2F	$995
Opt. 22	$570
Opt. 23	$1,260
Opt. 3I	$1,450
Opt. 3P	$1,450
Opt. 95	$150
Opt. 96	$50
TDS524A	$11,195
Opt. A1	NC
Opt. A2	NC
Opt. A3	NC
Opt. A4	NC
Opt. A5	NC
Opt. C5	$1,050
Opt. R2	$400
Opt. 05	$1,495
Opt. 1K	$750
Opt. 1R	$400
Opt. 2D	–$570
Opt. 22	$570

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**1 Contact your local Tektronix representative for price information.*

Products and Price Listing

PRICE INFORMATION

Opt. 23 ..... $1,260
Opt. 3I $1,450
Opt. 3P $1,450
Opt. 95 ..... $150
Opt. 96 ..... $50

TDS540A $14,340
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 05 ..... $1,495
Opt. 1F ..... $ 495
Opt. 1K $750
Opt. 1R $400
Opt. 13 ..... $495
Opt. 2F $995
Opt. 23 ..... $1,260
Opt. 3I $1,450
Opt. 3P $1,450
Opt. 4D ..... –$1,140
Opt. 95 ..... $150
Opt. 96 ..... $50

TDS544A $16,790

TDS6F05 ..... $1,995
Opt. 1D ..... –$75

TDS6F13 ..... $595
Opt. 1D ..... $ –75

TDS6F2F $1,295
Opt. 1D ..... –$75

TDS620B $12,495
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 05 ..... $1,495
Opt. 1F $495
Opt. 1K $750
Opt. 1R $400
Opt. 13 ..... $495
Opt. 2D ..... –$735
Opt. 2F $995
Opt. 3P $1,450
Opt. 3I $1,450
Opt. 95 ..... $150
Opt. 96 ..... $50

TDS644B $21,495
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 05 ..... $1,495
Opt. 1K $750
Opt. 1R $400
Opt. 24 ..... $1,140
Opt. 3P $1,450
Opt. 3I $1,450
Opt. 4D $1,470
Opt. 95 ..... $150
Opt. 96 ..... $50
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC

TDS68U1 ..... $795
Opt. 05 ..... $1,495
Opt. 1D ..... –$95
Opt. 1K $750
Opt. 1R $400
Opt. 3P $1,450
Opt. 3I $1,450
Opt. 95 ..... $150
Opt. 96 ..... $50
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC

TDS680B $18,995
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 05 ..... $1,495
Opt. 13 ..... $495
Opt. 1F $495
Opt. 1K $750
Opt. 1R $400
Opt. 24 ..... $1,140
Opt. 27 ..... $2,595
Opt. 2F $995
Opt. 3P $1,450
Opt. 3I $1,450
Opt. 95 ..... $150
Opt. 96 ..... $50
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC

TDS684B $29,995
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 05 ..... $1,495
Opt. 1K $750
Opt. 1R $400
Opt. 24 ..... $1,140
Opt. 26 ..... $5,195
Opt. 3P $1,450
Opt. 3I $1,450
Opt. 95 ..... $150
Opt. 96 ..... $50
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC

TDS744A $17,950
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 05 ..... $1,495
Opt. 1K $750
Opt. 1M $2,495
Opt. 1R ..... $ 400
Opt. 23 ..... $1,260
Opt. 3I $1,450
Opt. 3P $1,450
Opt. 95 ..... $150
Opt. 96 ..... $50

TDS784A $34,495
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 05 ..... $1,495
Opt. 1K $750
Opt. 1M $2,995
Opt. 1R $400
Opt. 24 ..... $1,140
Opt. 26 ..... $5,195
Opt. 3I $1,450
Opt. 3P $1,450
Opt. 95 ..... $150
Opt. 96 ..... $50

TDS820 ..... $20,990
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 1R ..... $ 410
Opt. 13 ..... $495
Opt. 2D ..... –$3,300
Opt. 2F $1,495
Opt. 95 ..... $150
Opt. 96 ..... $50

TD3F14A $525

TFC200 ..... $1,305
Opt. C5 ..... $325
Opt. R2 ..... $100
Opt. 0C $45
Opt. 1C $65
Opt. 2C $65
Opt. 20 ..... NC
Opt. 21 ..... NC
Opt. 22 ..... NC
Opt. 24 ..... NC
Opt. 25 ..... NC
Opt. 27 ..... NC
Opt. 28 ..... NC
Opt. 95 ..... $150
Opt. 96 ..... $50

TFP2A $12,600
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. L1 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. L5 ..... NC
Opt. L6 ..... NC
Opt. L7 ..... NC
Opt. R2 ..... $400
Opt. 01 ..... $7,140
Opt. 02 ..... $13,750
Opt. 03 ..... $16,320
Opt. 04 ..... $15,000
Opt. 05 ..... $17,500
Opt. 06 ..... $23,000
Opt. 07 ..... $14,075
Opt. 08 ..... $20,400
Opt. 09 ..... $17,750
Opt. 1R $400
Opt. 1T $895
Opt. 10 ..... $11,800
Opt. 11 ..... $14,000
Opt. 14 ..... $870
Opt. 16 ..... $1,400
Opt. 17 ..... $1,095
Opt. 19 ..... $200
Opt. 2T $995
Opt. 20 ..... NC
Opt. 21 ..... NC
Opt. 22 ..... NC
Opt. 23 ..... NC
Opt. 24 ..... NC
Opt. 25 ..... NC
Opt. 26 ..... NC
Opt. 27 ..... NC
Opt. 28 ..... NC
Opt. 29 ..... NC
Opt. 3T $1,255
Opt. 30 ..... NC
Opt. 31 ..... NC
Opt. 32 ..... NC
Opt. 33 ..... NC
Opt. 34 ..... NC
Opt. 35 ..... NC
Opt. 36 ..... NC
Opt. 37 ..... NC
Opt. 38 ..... NC
Opt. 39 ..... NC
Opt. 4T $1,690
Opt. 5T $795
Opt. 6T $1,445
Opt. 95 ..... $150
Opt. 96 ..... $50

TFP2AM $10,800
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. L1 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. L5 ..... NC
Opt. L6 ..... NC
Opt. L7 ..... NC
Opt. R2 ..... $ 400
Opt. 01 ..... $7,140
Opt. 02 ..... $13,750
Opt. 03 ..... $16,320
Opt. 04 ..... $15,000
Opt. 05 ..... $17,500
Opt. 06 ..... $23,000
Opt. 07 ..... $14,075
Opt. 08 ..... $20,400
Opt. 09 ..... $17,750
Opt. 1R $400
Opt. 1T $895
Opt. 10 ..... $11,800
Opt. 11 ..... $14,000
Opt. 14 ..... $870
Opt. 16 ..... $1,400
Opt. 17 ..... $895
Opt. 19 ..... $200
Opt. 2T $995
Opt. 20 ..... NC
Opt. 21 ..... NC
Opt. 22 ..... NC
Opt. 23 ..... NC
Opt. 24 ..... NC
Opt. 25 ..... NC
Opt. 26 ..... NC
Opt. 27 ..... NC
Opt. 28 ..... NC
Opt. 29 ..... NC
Opt. 3T $1,255
Opt. 30 ..... NC
Opt. 31 ..... NC
Opt. 32 ..... NC
Opt. 33 ..... NC
Opt. 34 ..... NC
Opt. 35 ..... NC
Opt. 36 ..... NC
Opt. 37 ..... NC
Opt. 38 ..... NC
Opt. 39 ..... NC
Opt. 4T $1,690
Opt. 5T $795
Opt. 6T $1,445
Opt. 95 ..... $150
Opt. 96 ..... $50

TFS2020 ..... $25
Opt. C5 ..... $725
Opt. MC $6,175
Opt. MM $8,900
Opt. MN $9,425
Opt. R2 ..... $260
Opt. 02 ..... $5,225
Opt. 03 ..... $5,440
Opt. 09 ..... $5,650
Opt. 1C ..... NC
Opt. 2C ..... NC
Opt. 20 ..... NC
Opt. 21 ..... NC
Opt. 22 ..... NC
Opt. 24 ..... NC
Opt. 25 ..... NC
Opt. 28 ..... NC
Opt. 30 ..... NC
Opt. 31 ..... NC
Opt. 32 ..... NC
Opt. 34 ..... NC
Opt. 35 ..... NC
Opt. 38 ..... NC
Opt. 40 ..... NC
Opt. 41 ..... NC
Opt. 42 ..... NC
Opt. 44 ..... NC
Opt. 45 ..... NC
Opt. 46 ..... NC
Opt. 48 ..... NC
Opt. 95 ..... $150

TFS3031 ..... $4,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. A6 ..... NC
Opt. C5 ..... $1,050
Opt. L1 ..... NC
Opt. L4 ..... NC
Opt. L5 ..... NC
Opt. L6 ..... NC
Opt. L7 ..... NC
Opt. R2 ..... $400
Opt. 01 ..... $4,400
Opt. 03 ..... $8,000
Opt. 04 ..... $4,400
Opt. 06 ..... $7,000
Opt. 08 ..... $11,000
Opt. 09 ..... $9,900
Opt. 1S $500
Opt. 1T ..... $ 260
Opt. 11 ..... $400
Opt. 16 ..... $525
Opt. 2T $995
Opt. 20 ..... NC
Opt. 21 ..... NC
Opt. 22 ..... NC
Opt. 24 ..... NC
Opt. 25 ..... NC
Opt. 26 ..... NC

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Products and Price Listing

PRICE INFORMATION

Opt. 28 ..... NC
Opt. 3T $1,255
Opt. 30 ..... NC
Opt. 31 ..... NC
Opt. 32 ..... NC
Opt. 34 ..... NC
Opt. 35 ..... NC
Opt. 36 ..... NC
Opt. 38 ..... NC
Opt. 4T $1,690
Opt. 41 ..... NC
Opt. 42 ..... NC
Opt. 5T $795
Opt. 6T $1,445

TG501A $3,800

THMCOM1 ..... $295
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A6 ..... NC

THM420 ..... $595

THM5AC $45
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A6 ..... NC

THM5BAT $39

THM5CHG $129
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A6 ..... NC

THM5HCA $67

THM5SCA $67

THM560 ..... $895
Opt. L0 ..... NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. L5 ..... NC
Opt. L6 ..... NC

THM565 ..... $1,295
Opt. L0 ..... NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. L5 ..... NC
Opt. L6 ..... NC

THS7BAT $49

THS7CHG $179

THS7HCA $110

THS710 ..... $1,795
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A6 ..... NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. L5 ..... NC
Opt. L6 ..... NC
Opt. L7 ..... NC
Opt. L8 ..... NC
Opt. L9 ..... NC
Opt. 1B $228
Opt. 2B $228
Opt. 3B $228

THS720 ..... $2,195
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A6 ..... NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. L5 ..... NC
Opt. L6 ..... NC
Opt. L7 ..... NC
Opt. L8 ..... NC
Opt. L9 ..... NC
Opt. 1B $228
Opt. 2B $228
Opt. 3B $228

TKIT14E ..... $ 499

TLA510 ..... $18,350
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. K1 ..... $320
Opt. K2 ..... $640
Opt. K3 ..... $960
Opt. Q0 ..... $300
Opt. 01 ..... $ 4,100
Opt. 02 ..... $8,200
Opt. 03 ..... $12,300
Opt. 04 ..... $2,500
Opt. 06 ..... $22,000
Opt. 1P $600
Opt. 1X ..... NC
Opt. 30 ..... $7,550
Opt. 4X $1,850
Opt. 5C ..... NC
Opt. 8S $2,000
Opt. 95 ..... $150
Opt. 96 ..... $50

TLA520 ..... $30,600
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. K1 ..... $415
Opt. K2 ..... $830
Opt. K3 ..... $1,245
Opt. Q0 ..... $350
Opt. 01 ..... $8,200
Opt. 02 ..... $16,400
Opt. 03 ..... $24,600
Opt. 04 ..... $2,500
Opt. 06 ..... $44,000
Opt. 1D ..... $ –3,600
Opt. 1P $1,200
Opt. 1X ..... NC
Opt. 4X $1,850
Opt. 5C ..... NC
Opt. 8S $4,000
Opt. 95 ..... $150
Opt. 96 ..... $50

TLS216 ..... $27,490
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 1B $1,500
Opt. 1K $750
Opt. 1R $400
Opt. 1S ..... NC
Opt. 24 ..... $740
Opt. 3I $1,450
Opt. 3P $1,450
Opt. 95 ..... $150
Opt. 96 ..... $50

TM5003 ..... $1,450

TM5006A $1,650
Opt. 12 ..... $395

TM502A $475

TM503B $650

TM506A $1,350

TOP130 ..... $995

TOP140 ..... $1,255

TOP150 ..... $1,690

TOP200 ..... $795

TOP300 ..... $1,445

TPAK142 ..... $41
Opt. 01 ..... $ 4
Opt. 05 ..... NC
Opt. 40 ..... –$5

TPAK145 ..... $41
Opt. 01 ..... $4
Opt. 05 ..... NC
Opt. 40 ..... –$5

TPG20 ..... $13,950
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. M2 ..... $795
Opt. M8 ..... $1,080
Opt. 1M ..... NC
Opt. 2M ..... NC

TPG625 ..... $6,075
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M1 ..... $575
Opt. M2 ..... $275
Opt. M3 ..... $1,115
Opt. M7 ..... $420
Opt. M8 ..... $840
Opt. M9 ..... $155
Opt. 01 ..... NC

TQ82014 ..... $660
Opt. C5 ..... $275
Opt. R2 ..... $60

TQ82015 ..... $1,100
Opt. C5 ..... $275
Opt. R2 ..... $60

TQ82017 ..... $357
Opt. C5 ..... $275
Opt. R2 ..... $60

TQ8210 ..... $860
Opt. C5 ..... $275
Opt. R2 ..... $60

TQ8325 ..... $19,495
Opt. C5 ..... $1,225
Opt. R2 ..... $590

TR14101 ..... $1,100

TR14201 ..... $770

TR14202 ..... $770

TR14203 ..... $770

TR14204 ..... $770

TR1711 ..... $6,055

TR1720 ..... $2,750

TR17201 ..... $7,155

TR17203 ..... $3,855

TR17204 ..... $6,395

TR17207 ..... $550

TR1722 ..... $2,750

TR17291 ..... $1,100

TR17305 ..... $24,000

TR4153B $5,725

TR4154 ..... $13,210

TR45103 ..... $1,650

TR4515 ..... $46,500
Opt. 10 ..... $3,800
Opt. 32 ..... NC
Opt. 42 ..... NC
Opt. 44 ..... NC

TSG100 ..... $1,300
Opt. M1 ..... $235
Opt. M2 ..... $95
Opt. M3 ..... $ 455
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. M9 ..... $55
Opt. 01 ..... NC

TSG1001 ..... $17,400
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M1 ..... $900
Opt. M2 ..... $810
Opt. M3 ..... $1,710
Opt. M7 ..... $450
Opt. M8 ..... $900
Opt. M9 ..... $450
Opt. 1Z ..... –$2,000

TSG111 ..... $1,575
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M1 ..... $200
Opt. M2 ..... $105
Opt. M3 ..... $385
Opt. M7 ..... $140
Opt. M8 ..... $280
Opt. M9 ..... $60
Opt. 01 ..... NC
Opt. 02 ..... $300
Opt. 10 ..... $100

TSG120 ..... $1,900
Opt. M1 ..... $225
Opt. M2 ..... $85
Opt. M3 ..... $445
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. M9 ..... $ 45
Opt. 01 ..... $300
Opt. 02 ..... NC

TSG130A $2,695
Opt. M1 ..... $280
Opt. M2 ..... $110
Opt. M3 ..... $550
Opt. M7 ..... $220
Opt. M8 ..... $440
Opt. M9 ..... $60
Opt. 01 ..... NC
Opt. 02 ..... $300
Opt. 03 ..... $300
Opt. 04 ..... $300
Opt. 10 ..... $100

TSG170A $5,250
Opt. M1 ..... $495
Opt. M2 ..... $315
Opt. M3 ..... $955
Opt. M7 ..... $320
Opt. M8 ..... $640
Opt. M9 ..... $175
Opt. 01 ..... $1,000
Opt. 1J ..... NC
Opt. 1V ..... NC
Opt. 2J $1,000

TSG170D $5,600
Opt. M1 ..... $545
Opt. M2 ..... $330
Opt. M3 ..... $1,050
Opt. M7 ..... $360
Opt. M8 ..... $720
Opt. M9 ..... $185
Opt. 1J ..... NC
Opt. 1S $950
Opt. 1V ..... NC

TSG200 ..... $2,050
Opt. M1 ..... $325
Opt. M2 ..... $185
Opt. M3 ..... $625
Opt. M7 ..... $220
Opt. M8 ..... $440
Opt. M9 ..... $105
Opt. 1J ..... NC

TSG271 ..... $5,200
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M1 ..... $480
Opt. M2 ..... $320
Opt. M3 ..... $920
Opt. M7 ..... $300
Opt. M8 ..... $600
Opt. M9 ..... $180
Opt. 01 ..... $635
Opt. 03 ..... $500
Opt. 05 ..... NC

TSG273 ..... $7,600
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M1 ..... $495
Opt. M2 ..... $355
Opt. M3 ..... $955
Opt. M7 ..... $300
Opt. M8 ..... $600
Opt. M9 ..... $195
Opt. 1S $950

TSG300 ..... $6,825
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M1 ..... $665
Opt. M2 ..... $425
Opt. M3 ..... $1,285

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Products and Price Listing

PRICE INFORMATION

Opt. M7 ..... $430
Opt. M8 ..... $860
Opt. M9 ..... $235
Opt. 01 ..... NC

TSG300E $6,825
Opt. M1 ..... $665
Opt. M2 ..... $425
Opt. M3 ..... $1,285
Opt. M7 ..... $430
Opt. M8 ..... $860
Opt. M9 ..... $235

TSG371 ..... $5,050
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M1 ..... $430
Opt. M2 ..... $310
Opt. M3 ..... $830
Opt. M7 ..... $260
Opt. M8 ..... $520
Opt. M9 ..... $170

TSG422 ..... $5,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M1 ..... $655
Opt. M2 ..... $330
Opt. M3 ..... $1,270
Opt. M7 ..... $470
Opt. M8 ..... $940
Opt. M9 ..... $185
Opt. 1S $950

TSG601 ..... $2,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. A6 ..... NC
Opt. M2 ..... $225
Opt. M8 ..... $440
Opt. 01 ..... $55

TSG95 ..... $895
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A6 ..... NC
Opt. M1 ..... $315
Opt. M2 ..... $95
Opt. M3 ..... $555
Opt. M7 ..... $230
Opt. M8 ..... $460
Opt. M9 ..... $58
Opt. 01 ..... $55

TS100 ..... $3,330
Opt. C5 ..... $475
Opt. L1 ..... NC
Opt. L4 ..... NC
Opt. L6 ..... NC
Opt. R2 ..... $160
Opt. 01 ..... $135
Opt. 1C ..... NC
Opt. 2C ..... NC
Opt. 3C ..... NC
Opt. 95 ..... $150
Opt. 96 ..... $50

TTIP $499

TVA001 ..... $350

TVGF01 ..... $1,200
Opt. 2J ..... NC

TVGF02 ..... $760

TVGF03 ..... $400

TVGF06 ..... $200

TVGF1S $1,000
Opt. M0 ..... $150
Opt. 1V ..... NC

TVGF1SA $1,000
Opt. M0 ..... $100

TVGF1SB $1,000
Opt. M0 ..... $150

TVGF1V $350
Opt. M0 ..... $100
Opt. 01 ..... NC

TVGF10 ..... $200

TVGF11A $100

TVGF13 ..... $200

TVGF14 ..... $200

TVS621 ..... $5,900
Opt. 95 ..... $150
Opt. 96 ..... $50

TVS625 ..... $17,900
Opt. 95 ..... $150
Opt. 96 ..... $50

TVS641 ..... $10,900
Opt. 95 ..... $150
Opt. 96 ..... $50

TVS645 ..... $24,900
Opt. 95 ..... $150
Opt. 96 ..... $50

TV110 ..... $2,995
Opt. C5 ..... $475
Opt. R2 ..... $160
Opt. 1C ..... NC
Opt. 2C ..... NC
Opt. 3C ..... NC
Opt. 95 ..... $150
Opt. 96 ..... $50

TV1330 ..... $18,500
Opt. 11 ..... NC
Opt. 13 ..... NC
Opt. 14 ..... NC
Opt. 21 ..... NC
Opt. 23 ..... NC
Opt. 24 ..... NC
Opt. 30 ..... NC

TV1340 ..... $18,500
Opt. 10 ..... NC
Opt. 20 ..... NC
Opt. 23 ..... NC
Opt. 31 ..... NC
Opt. 40 ..... NC
Opt. 41 ..... NC
Opt. 46 ..... NC

TV1350 ..... $20,500
Opt. 01 ..... $1,000
Opt. 02 ..... NC
Opt. 10 ..... NC
Opt. 11 ..... NC
Opt. 16 ..... $3,000
Opt. 20 ..... $3,000
Opt. 21 ..... $3,000
Opt. 23 ..... $3,000
Opt. 24 ..... $3,000
Opt. 25 ..... $3,000
Opt. 26 ..... $3,000
Opt. 27 ..... $3,000
Opt. 28 ..... $3,000
Opt. 29 ..... $3,000
Opt. 30 ..... $3,000
Opt. 31 ..... $3,000
Opt. 40 ..... $3,000
Opt. 41 ..... $3,000
Opt. 42 ..... $3,000
Opt. 43 ..... $3,000
Opt. 44 ..... $3,000
Opt. 45 ..... $3,000
Opt. 46 ..... $3,000

TWD120 ..... $3,295
Opt. A1 ..... NC
Opt. GE $249
Opt. 95 ..... $150
Opt. 96 ..... $50

TXMDXPB $99

UAFM $17,500

UPD $19,980
Opt. B1 ..... $1,100
Opt. B2 ..... $1,990
Opt. B3 ..... $4,260
Opt. B4 ..... $1,290

UPDK1 ..... $1,100

UPD04 ..... $18,290
Opt. B1 ..... $1,100
Opt. B2 ..... $1,990
Opt. B3 ..... $4,260
Opt. B4 ..... $1,290

UPD05 ..... $19,790
Opt. B1 ..... $1,100
Opt. B2 ..... $1,990
Opt. B3 ..... $4,260
Opt. B4 ..... $1,290

UPIK100 ..... $495

UPIK132 ..... $495

UPIK196 ..... $2,500

UPIK3M ..... $ 495

UPIK44 ..... $495

UPIK52 ..... $495

UPIK68 ..... $495

UPIK84 ..... $495

URE2 ..... $3,835

URE3 ..... $5,120
Opt. 01 ..... $725

URVZ $200

URVZ3 ..... $570

URVZ4 ..... $1,630
Opt. C5 ..... $325
Opt. R2 ..... $100

URVZ6 ..... $385

URVZ7 ..... $1,270
Opt. C5 ..... $275
Opt. R2 ..... $60

URVZ8 ..... $1,010
Opt. C5 ..... $275
Opt. R2 ..... $60

URV3502 ..... $2,665
Opt. C5 ..... $325
Opt. R2 ..... $100

URV3503 ..... $2,745
Opt. C5 ..... $325
Opt. R2 ..... $100

URV5 ..... $5,895
Opt. C5 ..... $475
Opt. R2 ..... $160
Opt. 01 ..... $500

URV5Z1 ..... $420
Opt. C5 ..... $475
Opt. R2 ..... $160

URV5Z2 ..... *1

URV5Z25 ..... *1

URV5Z26 ..... $1,345
Opt. C5 ..... $475
Opt. R2 ..... $160

URV5Z44 ..... $1,290
Opt. C5 ..... $475
Opt. R2 ..... $160

URV5Z45 ..... $1,430
Opt. C5 ..... $475
Opt. R2 ..... $160

URV5Z46 ..... $1,320
Opt. C5 ..... $475
Opt. R2 ..... $160

URV5Z47 ..... $1,430
Opt. C5 ..... $475
Opt. R2 ..... $160

URV5Z7 ..... *1

URV5Z70 ..... $1,235
Opt. C5 ..... $475
Opt. R2 ..... $160

URV5Z702 ..... *1

URV5Z703 ..... *1

URV5Z72 ..... $1,255
Opt. C5 ..... $475
Opt. R2 ..... $160

URV5Z9 ..... $1,370
Opt. C5 ..... $475
Opt. R2 ..... $160

URVZ50 ..... *1

URV55 ..... $3,215
Opt. C5 ..... $475
Opt. R2 ..... $160

UZ35 ..... *1

UZ35Z1 ..... *1

UZ22 ..... *1

U3FG100 ..... NC

U3FT400 ..... $395
Opt. C5 ..... $275
Opt. R2 ..... $60

U37DITS ..... NC

U4941 ..... $14,500
Opt. C5 ..... $1,225
Opt. R2 ..... $590

U4941N $14,500
Opt. C5 ..... *1
Opt. R2 ..... *1

U75WVWR ..... NC
Opt. 48 ..... NC

VITS100 ..... $2,400
Opt. M1 ..... $270
Opt. M2 ..... $165
Opt. M3 ..... $525
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. M9 ..... $90
Opt. 02 ..... NC
Opt. 1J ..... NC
Opt. 1M $250

VITS200 ..... $5,200
Opt. M1 ..... $465
Opt. M2 ..... $265
Opt. M3 ..... $905
Opt. M7 ..... $320
Opt. M8 ..... $640
Opt. M9 ..... $145
Opt. 1C ..... NC
Opt. 1J ..... NC

VITS201 ..... $4,200
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M1 ..... $450
Opt. M2 ..... $255
Opt. M3 ..... $875
Opt. M7 ..... $310
Opt. M8 ..... $620
Opt. M9 ..... $140
Opt. 05 ..... NC
Opt. 10 ..... NC

VMBKUP $300

VMCONF $65
Opt. 01 ..... NC
Opt. 11 ..... NC

VMREMGR $300

VMT $195

VM100 ..... $4,995

VM7FC1 ..... $350

VM7FR1 ..... $350

VM7F02 ..... $1,250
Opt. 01 ..... $2,500
Opt. 1B ..... –$600
Opt. 1D ..... NC
Opt. 1E ..... NC
Opt. 1F ..... NC
Opt. 1G $800
Opt. 1H ..... NC
Opt. 1K ..... NC
Opt. 1M ..... NC
Opt. 1R ..... NC
Opt. 11 ..... $2,500
Opt. 2B ..... –$400
Opt. 2E $1,500
Opt. 2K $1,000
Opt. 20 ..... $3,000
Opt. 21 ..... $4,500
Opt. 22 ..... $395
Opt. 3B $3,900
Opt. 30 ..... $2,500
Opt. 4B ..... $ –400
Opt. 40 ..... $4,000
Opt. 41 ..... $4,600
Opt. 42 ..... $1,500
Opt. 45 ..... NC
Opt. 48 ..... $2,500
Opt. 5B ..... –$600
Opt. 6B $3,900
Opt. 7B ..... –$600
Opt. 8B ..... –$600
Opt. 9B ..... –$600

VM7F1J $1
Opt. 01 ..... $2,500
Opt. 1B $650
Opt. 1D ..... NC
Opt. 1E ..... NC
Opt. 1F ..... NC
Opt. 1G $800
Opt. 1H ..... NC
Opt. 1K ..... NC
Opt. 1L ..... NC
Opt. 1M ..... NC
Opt. 1R ..... NC
Opt. 1Y $2,000
Opt. 11 ..... $2,500
Opt. 2B $750
Opt. 2K $1,000
Opt. 20 ..... $3,000
Opt. 21 ..... $4,500
Opt. 22 ..... $395
Opt. 3B $5,100
Opt. 30 ..... $2,500
Opt. 4B $750
Opt. 40 ..... $4,000
Opt. 41 ..... $4,600

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Products and Price Listing

PRICE INFORMATION

Opt. 42 ..... $1,500
Opt. 45 ..... $1,120
Opt. 48 ..... $2,500
Opt. 5B $650
Opt. 6B $5,150
Opt. 7B $650
Opt. 8B $650
Opt. 9B $650

VM700A $17,450
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. M1 ..... $1,100
Opt. M2 ..... $1,000
Opt. M3 ..... $2,100
Opt. M7 ..... $750
Opt. M8 ..... $1,440
Opt. M9 ..... $450
Opt. 01 ..... $4,500
Opt. 1C ..... NC
Opt. 1F $1,795
Opt. 1G $800
Opt. 1P $625
Opt. 1Z $500
Opt. 11 ..... $4,500
Opt. 20 ..... $3,000
Opt. 21 ..... $4,500
Opt. 3Z $1,500
Opt. 30 ..... $2,500
Opt. 40 ..... $4,000
Opt. 41 ..... $4,600
Opt. 42 ..... $1,500
Opt. 48 ..... $2,500
Opt. 74 ..... $100

VNA $18,990

VS21AF1 ..... $1,695

VS210 ..... $8,395
Opt. M1 ..... $365
Opt. M2 ..... $335
Opt. M3 ..... $695
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. M9 ..... $185
Opt. 1A $4,400
Opt. 1S $1,695
Opt. 2A $5,200
Opt. 3A $6,000

VS210F1 ..... $1,995
Opt. M0 ..... $150

VS210F2 ..... $1,695
Opt. M0 ..... $150

VS211A $7,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M1 ..... $845
Opt. M2 ..... $350
Opt. M3 ..... $1,650
Opt. M7 ..... $650
Opt. M8 ..... $1,300
Opt. M9 ..... $195
Opt. 1A $3,400
Opt. 1S $1,695
Opt. 2A $4,300

VS211F3 ..... $1,595

VXIGPIB $1,800

VXI566 ..... $5,595
Opt. 10 ..... $1,550
Opt. 11 ..... $1,550
Opt. 12 ..... $2,850
Opt. 13 ..... $3,550
Opt. 14 ..... $4,050
Opt. 15 ..... $5,250
Opt. 16 ..... $4,775
Opt. 17 ..... $5,975
Opt. 21 ..... $1,995
Opt. 22 ..... $395
Opt. 25 ..... $1,495
Opt. 30 ..... $1,995
Opt. 31 ..... $395
Opt. 42 ..... $300
Opt. 43 ..... $395
Opt. 44 ..... $30

VXI599 ..... $7,495
Opt. 13 ..... $3,050
Opt. 14 ..... $3,550
Opt. 15 ..... $4,750
Opt. 16 ..... $3,875
Opt. 17 ..... $5,075
Opt. 21 ..... $1,995
Opt. 22 ..... $395
Opt. 25 ..... $1,495
Opt. 30 ..... $1,995
Opt. 31 ..... $395
Opt. 42 ..... $300
Opt. 43 ..... $395
Opt. 44 ..... $30

VXOA41 ..... $7,905
Opt. X1 ..... $475
Opt. X2 ..... $795
Opt. X3 ..... $950
Opt. 01 ..... –$255
Opt. 02 ..... –$255
Opt. 03 ..... –$255

VXP16C $4,205
Opt. X1 ..... $245
Opt. X2 ..... $410
Opt. X3 ..... $490

VXP16T $4,205
Opt. X1 ..... $245
Opt. X2 ..... $410
Opt. X3 ..... $490

VXP64C $3,000
Opt. X1 ..... $180
Opt. X2 ..... $300
Opt. X3 ..... $360

VXP64T $3,000
Opt. X1 ..... $180
Opt. X2 ..... $300
Opt. X3 ..... $360

VXSKGPB $7,700
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. 1M $795
Opt. 1R $350
Opt. 1U $125
Opt. 2R ..... $ 550
Opt. 2U $250

VXSKMXI $10,015
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. 1M $795
Opt. 1R $350
Opt. 1U $125
Opt. 10 ..... $400
Opt. 2R $550
Opt. 2U $250

VXSK566 ..... $11,900
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. 1M $795
Opt. 1R $350
Opt. 1U $125
Opt. 10 ..... $1,550
Opt. 11 ..... $1,550
Opt. 12 ..... $2,850
Opt. 13 ..... $3,550
Opt. 14 ..... $4,050
Opt. 15 ..... $5,250
Opt. 16 ..... $4,775
Opt. 17 ..... $5,975
Opt. 2R $550
Opt. 2U $250
Opt. 21 ..... $1,995
Opt. 22 ..... $395
Opt. 25 ..... $1,495
Opt. 30 ..... $1,995
Opt. 31 ..... $395
Opt. 42 ..... $300
Opt. 43 ..... $395
Opt. 44 ..... $30

VXSK599 ..... $13,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. 1M $795
Opt. 1R $350
Opt. 1U $125
Opt. 13 ..... $3,050
Opt. 14 ..... $3,550
Opt. 15 ..... $4,750
Opt. 16 ..... $3,875
Opt. 17 ..... $5,075
Opt. 2R $550
Opt. 2U $250
Opt. 21 ..... $1,995
Opt. 22 ..... $395
Opt. 25 ..... $1,495
Opt. 30 ..... $1,995
Opt. 31 ..... $395
Opt. 42 ..... $300
Opt. 43 ..... $395
Opt. 44 ..... $30

VX1401 ..... $5,695
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. X1 ..... $340
Opt. X2 ..... $570
Opt. X3 ..... $685

VX1406 ..... $3,400
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. 1R $300

VX1410 ..... $6,495
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. X3 ..... $780
Opt. 1D ..... –$1,695
Opt. 1M $895
Opt. 1R $350
Opt. 1U $125
Opt. 2R $550
Opt. 2U ..... $ 250

VX1630 ..... $665

VX1630S $200

VX1632P $150

VX1632S $130

VX1635 ..... $150

VX1638S $225

VX1640S $200

VX1650 ..... $450

VX1650S $125

VX1657P $305

VX1657S $305

VX1660 ..... $470

VX1661 ..... $80

VX1662 ..... $120

VX1663 ..... $260

VX1664 ..... $130

VX1665 ..... $240

VX1666 ..... $325

VX1667 ..... $350

VX1681A $155

VX1682 ..... $31

VX1683 ..... $26

VX1727 ..... $220

VX1729 ..... $80
Opt. AA ..... NC
Opt. 01 ..... NC
Opt. 03 ..... NC

VX1730 ..... $57
Opt. AA ..... NC
Opt. 01 ..... NC
Opt. 03 ..... NC
Opt. 7L $35

VX1731 ..... $50
Opt. 01 ..... NC
Opt. 03 ..... NC

VX1732 ..... $155

VX1733 ..... $250

VX1734 ..... $250

VX1735 ..... $150

VX1742P $125

VX1756 ..... $400

VX1770 ..... $50

VX1780P $52

VX1780S $52

VX1782P $37

VX1782S $37

VX1783P $32

VX1783S $32

VX1784P $26

VX1784S $26

VX1785P $35

VX1785S $37

VX1786P $37

VX1786S $37

VX1811A $1,525
Opt. 1D ..... –$175

VX1812A $1,960

VX1813 ..... $455

VX1814A $1,900

VX1815A $2,650
Opt. 1D ..... $ –50

VX1817A $2,050
Opt. 1D ..... –$165

VX4224 ..... $3,450
Opt. X1 ..... $415
Opt. X2 ..... $690
Opt. X3 ..... $830
Opt. 01 ..... $500
Opt. 03 ..... $900
Opt. 96 ..... $50

VX4234 ..... $1,480
Opt. X1 ..... $90
Opt. X2 ..... $150
Opt. X3 ..... $180
Opt. 96 ..... $50

VX4237 ..... $4,265
Opt. X1 ..... $515
Opt. X2 ..... $855
Opt. X3 ..... $1,025

VX4240 ..... $7,205
Opt. X1 ..... $425
Opt. X2 ..... $705
Opt. X3 ..... $845
Opt. 02 ..... $1,030
Opt. 96 ..... $50

VX4244 ..... $11,995
Opt. X1 ..... $ 720
Opt. X2 ..... $1,200
Opt. X3 ..... $1,440

VX4281 ..... $2,995
Opt. X1 ..... $180
Opt. X2 ..... $300
Opt. X3 ..... $360
Opt. 01 ..... $570

VX4286 ..... $2,570
Opt. X1 ..... $155
Opt. X2 ..... $255
Opt. X3 ..... $310
Opt. 01 ..... $260
Opt. 1A $206
Opt. 1B $206
Opt. 1C $206
Opt. 2A $206
Opt. 2B $206
Opt. 2C $206
Opt. 3A $206
Opt. 3B $206
Opt. 3C $206
Opt. 4A $206
Opt. 4B $206
Opt. 4C $206
Opt. 96 ..... $50

VX4287 ..... $3,600
Opt. X1 ..... $215
Opt. X2 ..... $360
Opt. X3 ..... $430
Opt. 96 ..... $100

VX4320 ..... $2,500
Opt. X3 ..... $326
Opt. 01 ..... $550

VX4330 ..... $2,850
Opt. X3 ..... $368
Opt. 01 ..... $550

VX4342 ..... $2,275

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Products and Price Listing

PRICE INFORMATION

Opt. 01 ..... $206
Opt. 02 ..... $206
Opt. 05 ..... $206
Opt. 1M $206
Opt. 10 ..... $206
VX4350 ..... $2,100
Opt. X3 ..... $278
Opt. 01 ..... $550
VX4353 ..... $1,400
Opt. X1 ..... $ 85
Opt. X2 ..... $140
Opt. X3 ..... $170
VX4355 ..... $1,400
Opt. X1 ..... $85
Opt. X2 ..... $140
Opt. X3 ..... $170
VX4356 ..... $1,450
Opt. X1 ..... $85
Opt. X2 ..... $145
Opt. X3 ..... $175
VX4357 ..... $1,700
Opt. X1 ..... $100
Opt. X2 ..... $170
Opt. X3 ..... $205
VX4372 ..... $1,600
Opt. X1 ..... $95
Opt. X2 ..... $160
Opt. X3 ..... $190
VX4374 ..... $1,495
Opt. X1 ..... $90
Opt. X2 ..... $150
Opt. X3 ..... $180
VX4380 ..... $4,100
Opt. X3 ..... $566
Opt. 01 ..... $550
VX4385 ..... $2,525
Opt. X1 ..... $150
Opt. X2 ..... $245
Opt. X3 ..... $295
VX4428 ..... $7,850
Opt. X1 ..... $455
Opt. X2 ..... $755
Opt. 10 ..... $825
VX4456 ..... $11,000
Opt. 04 ..... $6,500
Opt. 06 ..... $12,700
Opt. 08 ..... $19,500
VX4457 ..... $3,085
Opt. X1 ..... $180
Opt. X2 ..... $300
Opt. X3 ..... $360
VX4469A $6,310
Opt. 01 ..... $3,685
Opt. 02 ..... $7,040
VX4491 ..... $5,665
Opt. X1 ..... $370
Opt. X2 ..... $610
Opt. X3 ..... $735
Opt. 10 ..... $2,060
Opt. 96 ..... $50
VX4521 ..... $3,290
Opt. X1 ..... $190
Opt. X2 ..... $315
Opt. X3 ..... $380
VX46F01 ..... $1,900
VX46F03 ..... $8,500
VX46F04 ..... $17,900
VX46F22 ..... $6,900
VX46F36 ..... $8,900

VX4610 ..... $32,000
Opt. 03 ..... $7,500
Opt. 04 ..... $16,900
Opt. 22 ..... $6,000
Opt. 36 ..... $8,000
Opt. 48 ..... NC
VX4730 ..... $3,795
Opt. X1 ..... $230
Opt. X2 ..... $380
Opt. X3 ..... $455
Opt. 1M ..... $ 400
Opt. 10 ..... –$600
Opt. 96 ..... $50
VX4750 ..... $5,995
Opt. X1 ..... $360
Opt. X2 ..... $600
Opt. X3 ..... $720
Opt. 01 ..... $310
Opt. 96 ..... $100
VX4790A $3,600
Opt. X1 ..... $235
Opt. X2 ..... $390
Opt. X3 ..... $470
Opt. 01 ..... $620
Opt. 02 ..... $1,240
Opt. 96 ..... $50
VX4792 ..... $10,095
Opt. X1 ..... $600
Opt. X2 ..... $1,000
Opt. X3 ..... $1,200
Opt. 1S $695
Opt. 95 ..... $150
Opt. 96 ..... $50
VX4801 ..... $1,895
Opt. X1 ..... $115
Opt. X2 ..... $190
Opt. X3 ..... $225
VX4802 ..... $1,895
Opt. X1 ..... $115
Opt. X2 ..... $190
Opt. X3 ..... $225
Opt. 01 ..... $52
Opt. 02 ..... $52
VX4820 ..... $5,995
Opt. X1 ..... $360
Opt. X2 ..... $600
Opt. X3 ..... $720
Opt. 11 ..... –$4,205
WFM300A $3,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $195
Opt. M3 ..... $675
Opt. M7 ..... $240
Opt. M8 ..... $480
Opt. 05 ..... –$250
Opt. 10 ..... NC
Opt. 14 ..... NC
WFM601 ..... $4,995
Opt. A1 ..... $ NC
Opt. A2 ..... $ NC
Opt. A3 ..... NC
Opt. M2 ..... $260
Opt. M3 ..... $2,315
Opt. M8 ..... $1,800
WFM601I $6,495
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $195

Opt. M8 ..... $1,040
WFM90 ..... $1,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A6 ..... NC
Opt. M2 ..... $195
Opt. M8 ..... $460
Opt. 01 ..... $85
Opt. 33 ..... $175
WFM91 ..... $1,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A6 ..... NC
Opt. M2 ..... $195
Opt. M8 ..... $460
Opt. 01 ..... $85
Opt. 33 ..... $175
WM490A $2,250
Opt. C5 ..... $475
Opt. R2 ..... $160
WM490K $2,080
Opt. C5 ..... $475
Opt. R2 ..... $160
WM490U $2,615
Opt. C5 ..... $475
Opt. R2 ..... $160
WM490W $4,020
Opt. C5 ..... $475
Opt. R2 ..... $160
WM780A $2,220
Opt. C5 ..... $475
Opt. R2 ..... $160
WM780D $5,720
Opt. C5 ..... $475
Opt. R2 ..... $160
WM780E $3,730
Opt. C5 ..... $475
Opt. R2 ..... $160
WM780F $4,095
Opt. C5 ..... $475
Opt. R2 ..... $160
WM780G $5,875
Opt. C5 ..... $475
Opt. R2 ..... $160
WM780J $7,420
Opt. C5 ..... $475
Opt. R2 ..... $160
WM780K $2,205
Opt. C5 ..... $475
Opt. R2 ..... $160
WM780Q $2,550
Opt. C5 ..... $475
Opt. R2 ..... $160
WM780R $1,965
Opt. C5 ..... $475
Opt. R2 ..... $160
WM780U $3,035
Opt. C5 ..... $475
Opt. R2 ..... $160
WM780V $3,440
Opt. C5 ..... $475
Opt. R2 ..... $160
WM780W $3,840
Opt. C5 ..... $475
Opt. R2 ..... $160
WM78010 ..... $5,985
Opt. C5 ..... $475
Opt. R2 ..... $160

WM78011 ..... $9,825
Opt. C5 ..... $475
Opt. R2 ..... $160
WM78012 ..... $15,540
Opt. C5 ..... $475
Opt. R2 ..... $160
WM7802 ..... $4,110
Opt. C5 ..... $475
Opt. R2 ..... $160
WM7803 ..... $6,940
Opt. C5 ..... $475
Opt. R2 ..... $160
WM782A $2,445
Opt. C5 ..... $475
Opt. R2 ..... $160
WM782D $6,655
Opt. C5 ..... $475
Opt. R2 ..... $160
WM782E $4,350
Opt. C5 ..... $475
Opt. R2 ..... $160
WM782F $4,780
Opt. C5 ..... $475
Opt. R2 ..... $160
WM782G $5,940
Opt. C5 ..... $475
Opt. R2 ..... $160
WM782J $8,800
Opt. C5 ..... $475
Opt. R2 ..... $160
WM782Q $2,845
Opt. C5 ..... $475
Opt. R2 ..... $160
WM782U $3,375
Opt. C5 ..... $475
Opt. R2 ..... $160
WM782V $3,825
Opt. C5 ..... $475
Opt. R2 ..... $160
WM782W $4,255
Opt. C5 ..... $475
Opt. R2 ..... $160
WM78210 ..... $6,335
Opt. C5 ..... $475
Opt. R2 ..... $160
WM78211 ..... $10,405
Opt. C5 ..... $475
Opt. R2 ..... $160
WM78212 ..... $16,455
Opt. C5 ..... $475
Opt. R2 ..... $160
WM7826 ..... $5,540
Opt. C5 ..... $475
Opt. R2 ..... $160
WM7827 ..... $8,255
Opt. C5 ..... $475
Opt. R2 ..... $160
WM7828 ..... $12,035
Opt. C5 ..... $475
Opt. R2 ..... $160
WM7829 ..... $17,425
Opt. C5 ..... $475
Opt. R2 ..... $160
WNDFADD $500
WNDINS $750
WNDM01 ..... $875
WNDM02 ..... $250
WNDM03 ..... $500
WNDM04 ..... $2,250

WNDM05 ..... $4,250
WNDM06 ..... $75
WNDM07 ..... $500
WNDM08 ..... $1,500
WNDM09 ..... $2,000
WNDM10 ..... $250
WNDSALL $7,500
WNDS05 ..... $3,000
WNDS10 ..... $5,000
WP200 ..... $310
WVR500 ..... $1,795
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $90
Opt. M8 ..... $780
XHBSIT1 ..... $385
Opt. DO ..... NC
Opt. ML $71
Opt. NT ..... NC
Opt. OS ..... NC
Opt. WI ..... NC
XHBSIT2 ..... $335
Opt. DO ..... NC
Opt. ML $61
Opt. NT ..... NC
Opt. OS ..... NC
Opt. WI ..... NC
XHBSIT3 ..... $289
Opt. DO ..... NC
Opt. ML $53
Opt. NT ..... $ NC
Opt. OS ..... NC
Opt. WI ..... NC
XHBSIT4 ..... $245
Opt. DO ..... NC
Opt. ML $45
Opt. NT ..... NC
Opt. OS ..... NC
Opt. WI ..... NC
XHBSIT5 ..... $222
Opt. DO ..... NC
Opt. ML $41
Opt. NT ..... NC
Opt. OS ..... NC
Opt. WI ..... NC
XLR100 ..... $1,700
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
XPCD $850
XPCD07 ..... $850
Opt. S0 ..... $425
XPFAV $300
Opt. S0 ..... $350
XPFAX $200
Opt. S0 ..... $350
XPFBL $50
XPFCC $100
XPFDV $595
XPFD01 ..... $250
XPFEX $220
Opt. S0 ..... $350
XPFPL $100
XPFPS $250
XPFRS $50
Opt. S0 ..... $350
XPFSN $60

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Products and Price Listing

PRICE INFORMATION

Opt. S0 ..... $350
XPFSV $150
XPFSX $750
XPFVN $100
XPFVX $200
XPFXN $50
XPFYN $150
XPF021 ..... $100
XPF022 ..... $200
XPF024 ..... $400
XPF025 ..... $800
XPF028 ..... $1,600
Opt. S0 ..... $350
XPF029 ..... $3,200
XPF1A $350
XPF1B $595
XPF1P $150
XPF3A $75
XPF3L $60
XPF3N $145
XPF3P $295
XPF3Q $495
XPF3V $60
XPF4L ..... $ 60
XPF4N $145
XPF422 ..... $200
Opt. S0 ..... $350
XPF424 ..... $400
XPLFADD $500
XPLHELP $3,000
XPLUSER $149
XPNFS01 ..... $995
XPPCU01 ..... $100
XPPC00 ..... $3,495
XPPC05 ..... $995
XPPC10 ..... $1,990
XPPC100 ..... $16,995
XPPC50 ..... $8,995
XPSW01 ..... $850
Opt. S0 ..... $425
XPSW04 ..... $850
Opt. S0 ..... $425
XPSW05 ..... $850
Opt. S0 ..... $425
XPSW07 ..... $850
Opt. S0 ..... $425
XPSW08 ..... $850
Opt. S0 ..... $425
XPSW09 ..... $850
Opt. S0 ..... $425
XPSW10 ..... $850
Opt. S0 ..... $425
XPSW11 ..... $850
Opt. S0 ..... $425
XPSX07 ..... $750
XPSX10 ..... $750
XPS0 ..... $175
XPS03 ..... NC
Opt. S0 ..... $425
Opt. 01 ..... $500
Opt. 04 ..... $500
Opt. 05 ..... $500
Opt. 06 ..... $500
Opt. 07 ..... $500
Opt. 1S ..... NC
Opt. 3S $500

XPWS01 ..... $295
XPWS10 ..... $1,950
XPWS100 ..... $7,995
XPWS50 ..... $5,995
XPXUS $850
XP1BAC $252
XP1E3 ..... $199
XP1FGS $300
XP1S1 ..... $180
XP1S2 ..... $375
XP1S3 ..... $555
XP100D $3,695
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. BL $50
Opt. B9 ..... $50
Opt. EX $220
Opt. PL $100
Opt. PS $250
Opt. RS $50
Opt. SN $60
Opt. SX $275
Opt. SY $565
Opt. SZ $840
Opt. S0 ..... $175
Opt. S1 ..... $215
Opt. S2 ..... $445
Opt. S3 ..... $660
Opt. TX ..... NC
Opt. TY ..... NC
Opt. U2 ..... $120
Opt. U3 ..... $204
Opt. 1A $350
Opt. 1B $595
Opt. 22 ..... $200
Opt. 25 ..... $800
Opt. 3L $60
Opt. 3N $145
Opt. 3P $295
Opt. 3Q $495
Opt. 3V $60
Opt. 32 ..... $2,350
Opt. 33 ..... $3,500
Opt. 4L $60
Opt. 4N $145
XP2BAC $252
XP2E3 ..... $199
XP2S1 ..... $180
XP2S2 ..... $375
XP2S3 ..... $555
XP200 ..... $1,245
Opt. AV $300
Opt. AX $200
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. BL $50
Opt. B9 ..... $50
Opt. EX $220
Opt. E3 ..... $199
Opt. PL $100
Opt. PS $250
Opt. RS $50
Opt. SN $60
Opt. ST ..... NC
Opt. S0 ..... $175
Opt. S1 ..... $180

Opt. S2 ..... $375
Opt. S3 ..... $555
Opt. U2 ..... $96
Opt. U3 ..... $164
Opt. 1A $350
Opt. 1B $595
Opt. 1P $150
Opt. 22 ..... $200
Opt. 24 ..... $400
Opt. 25 ..... $800
Opt. 28 ..... $1,600
Opt. 3L $60
Opt. 3N $145
Opt. 3P $295
Opt. 3Q $495
Opt. 3V $60
Opt. 4L $60
Opt. 4N $145
XP200CH $1,945
Opt. AV $300
Opt. AX $200
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. BL $50
Opt. B9 ..... $50
Opt. EX $220
Opt. E3 ..... $199
Opt. PL $100
Opt. PS $250
Opt. RS $50
Opt. SN $60
Opt. ST ..... NC
Opt. S0 ..... $175
Opt. S1 ..... $180
Opt. S2 ..... $375
Opt. S3 ..... $555
Opt. U2 ..... $96
Opt. U3 ..... $164
Opt. 1A $350
Opt. 1B $595
Opt. 1P $150
Opt. 22 ..... $200
Opt. 24 ..... $400
Opt. 25 ..... $800
Opt. 28 ..... $1,600
Opt. 3L $60
Opt. 3N $145
Opt. 3P $295
Opt. 3Q $495
Opt. 3V $60
Opt. 4L $60
Opt. 4N $145
XP214C $1,445
Opt. AV $300
Opt. AX $200
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. BL $50
Opt. B9 ..... $50
Opt. EX $220
Opt. E3 ..... $199
Opt. PL $100
Opt. PS $250
Opt. RS $50
Opt. SN $60
Opt. SX $240
Opt. SY $495
Opt. SZ $735

Opt. S0 ..... $175
Opt. S1 ..... $180
Opt. S2 ..... $375
Opt. S3 ..... $555
Opt. TX ..... NC
Opt. TY ..... NC
Opt. U2 ..... $ 96
Opt. U3 ..... $164
Opt. 1A $350
Opt. 1B ..... $ 595
Opt. 1P $150
Opt. 22 ..... $200
Opt. 24 ..... $400
Opt. 25 ..... $800
Opt. 28 ..... $1,600
Opt. 3L $60
Opt. 3N $145
Opt. 3P $295
Opt. 3Q $495
Opt. 3V ..... $ 60
Opt. 4L $60
Opt. 4N $145
XP214M $1,045
Opt. AV $300
Opt. AX $200
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. BL $50
Opt. B9 ..... $50
Opt. EX $220
Opt. E3 ..... $199
Opt. PL $100
Opt. PS $250
Opt. RS $50
Opt. SN $60
Opt. S0 ..... $175
Opt. S1 ..... $180
Opt. S2 ..... $375
Opt. S3 ..... $555
Opt. U2 ..... $ 96
Opt. U3 ..... $164
Opt. 1A $350
Opt. 1B $595
Opt. 1P $150
Opt. 22 ..... $200
Opt. 24 ..... $400
Opt. 25 ..... $800
Opt. 28 ..... $1,600
Opt. 3L $60
Opt. 3N $145
Opt. 3P $295
Opt. 3Q $495
Opt. 3V $60
Opt. 4L $60
Opt. 4N $145
XP217C $2,145
Opt. AV $300
Opt. AX $200
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. BL $50
Opt. B9 ..... $50
Opt. EX $220
Opt. E3 ..... $199
Opt. PL $100
Opt. PS $250
Opt. RS $50
Opt. SN $60

Opt. SX $240
Opt. SY $495
Opt. SZ $735
Opt. S0 ..... $175
Opt. S1 ..... $180
Opt. S2 ..... $375
Opt. S3 ..... $555
Opt. TX ..... NC
Opt. TY ..... NC
Opt. U2 ..... $96
Opt. U3 ..... $164
Opt. 1A $350
Opt. 1B $595
Opt. 1P $150
Opt. 22 ..... $200
Opt. 24 ..... $400
Opt. 25 ..... $800
Opt. 28 ..... $1,600
Opt. 3L $60
Opt. 3N $145
Opt. 3P $295
Opt. 3Q $495
Opt. 3V $60
Opt. 4L $60
Opt. 4N $145
XP217CH $2,545
Opt. AV $300
Opt. AX $200
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. BL $50
Opt. B9 ..... $50
Opt. EX $220
Opt. E3 ..... $199
Opt. PL $100
Opt. PS $250
Opt. RS $50
Opt. SN $60
Opt. SX $240
Opt. SY $495
Opt. SZ $735
Opt. S0 ..... $175
Opt. S1 ..... $180
Opt. S2 ..... $375
Opt. S3 ..... $555
Opt. TX ..... NC
Opt. TY ..... NC
Opt. U2 ..... $96
Opt. U3 ..... $164
Opt. 1A $350
Opt. 1B $595
Opt. 1P $150
Opt. 22 ..... $200
Opt. 24 ..... $400
Opt. 25 ..... $800
Opt. 28 ..... $1,600
Opt. 3L $60
Opt. 3N $145
Opt. 3P $295
Opt. 3Q $495
Opt. 3V $60
Opt. 4L $60
Opt. 4N $145
XP219CH $3,345
Opt. AV $300
Opt. AX $200
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC

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Products and Price Listing

PRICE INFORMATION

Opt. BL.....$50
Opt. B9.....$50
Opt. EX.....$220
Opt. E3.....$199
Opt. PL.....$100
Opt. PS.....$250
Opt. RS.....$50
Opt. SN.....$60
Opt. SX.....$240
Opt. SY.....$495
Opt. SZ.....$735
Opt. S0.....$175
Opt. S1.....$180
Opt. S2.....$375
Opt. S3.....$555
Opt. TX.....NC
Opt. TY.....NC
Opt. U2.....$96
Opt. U3.....$164
Opt. 1A.....$350
Opt. 1B.....$595
Opt. 1P.....$150
Opt. 22.....$200
Opt. 24.....$400
Opt. 25.....$800
Opt. 28.....$1,600
Opt. 3L.....$60
Opt. 3N.....$145
Opt. 3P.....$295
Opt. 3Q.....$495
Opt. 3V.....$60
Opt. 4L.....$60
Opt. 4N.....$145

XP219GH.....$2,745
Opt. AV.....$300
Opt. AX.....$200
Opt. A1.....NC
Opt. A2.....NC
Opt. A3.....NC
Opt. A5.....NC
Opt. BL.....$50
Opt. B9.....$50
Opt. EX.....$ 220
Opt. E3.....$199
Opt. PL.....$100
Opt. PS.....$250
Opt. RS.....$50
Opt. SN.....$60
Opt. S0.....$175
Opt. S1.....$180
Opt. S2.....$375
Opt. S3.....$555
Opt. U2.....$96
Opt. U3.....$164
Opt. 1A.....$350
Opt. 1B.....$595
Opt. 1P.....$150
Opt. 22.....$200
Opt. 24.....$400
Opt. 25.....$800
Opt. 28.....$1,600
Opt. 3L.....$60
Opt. 3N.....$145
Opt. 3P.....$295
Opt. 3Q.....$495
Opt. 3V.....$60
Opt. 4L.....$60
Opt. 4N.....$145

XP219MH.....$1,945
Opt. AV.....$300
Opt. AX.....$200
Opt. A1.....NC
Opt. A2.....NC
Opt. A3.....NC
Opt. A5.....NC
Opt. BL.....$50
Opt. B9.....$50
Opt. EX.....$220
Opt. E3.....$199
Opt. PL.....$100
Opt. PS.....$250
Opt. RS.....$50
Opt. SN.....$60
Opt. S0.....$175
Opt. S1.....$180
Opt. S2.....$375
Opt. S3.....$555
Opt. U2.....$96
Opt. U3.....$164
Opt. 1A.....$350
Opt. 1B.....$595
Opt. 1P.....$150
Opt. 22.....$200
Opt. 24.....$400
Opt. 25.....$800
Opt. 28.....$1,600
Opt. 3L.....$60
Opt. 3N.....$145
Opt. 3P.....$295
Opt. 3Q.....$495
Opt. 3V.....$60
Opt. 4L.....$60
Opt. 4N.....$145

XP3BAC.....$300
XP3E3.....$299
XP3S1.....$215
XP3S2.....$445
XP3S3.....$660

XP300V.....$2,895
Opt. A1.....NC
Opt. A2.....NC
Opt. A3.....NC
Opt. A5.....NC
Opt. BL.....$50
Opt. B9.....$50
Opt. EX.....$220
Opt. PL.....$100
Opt. PS.....$250
Opt. RS.....$50
Opt. SN.....$60
Opt. S0.....$175
Opt. S1.....$215
Opt. S2.....$445
Opt. S3.....$660
Opt. U2.....$120
Opt. U3.....$204
Opt. VX.....$200
Opt. WR.....NC
Opt. 1A.....$350
Opt. 1B.....$595
Opt. 24.....$400
Opt. 25.....$800
Opt. 28.....$1,600
Opt. 3L.....$60
Opt. 3N.....$145
Opt. 3P.....$295
Opt. 3Q.....$495
Opt. 3V.....$ 60
Opt. 32.....$450
Opt. 33.....$1,445
Opt. 34.....$2,300
Opt. 4L.....$60
Opt. 4N.....$145

XP4BAC.....$300
XP4E3.....$299
XP4S1.....$215
XP4S2.....$445
XP4S3.....$660

XP400.....$2,645
Opt. AV.....$300
Opt. AX.....$200
Opt. A1.....NC
Opt. A2.....NC
Opt. A3.....NC
Opt. A5.....NC
Opt. BL.....$50
Opt. B9.....$50
Opt. DV.....$595
Opt. EX.....$220
Opt. E3.....$299
Opt. PL.....$100
Opt. PS.....$250
Opt. RS.....$50
Opt. SN.....$60
Opt. S0.....$175
Opt. S1.....$215
Opt. S2.....$445
Opt. S3.....$660
Opt. TR.....$750
Opt. U2.....$120
Opt. U3.....$204
Opt. 1A.....$350
Opt. 1B.....$595
Opt. 1P.....$150
Opt. 24.....$400
Opt. 25.....$800
Opt. 28.....$1,600
Opt. 3A.....$ 75
Opt. 3L.....$60
Opt. 3N.....$145
Opt. 3P.....$295
Opt. 3Q.....$495
Opt. 3V.....$60
Opt. 4L.....$60
Opt. 4N.....$145

XP417C.....$3,245
Opt. AV.....$300
Opt. AX.....$200
Opt. A1.....NC
Opt. A2.....NC
Opt. A3.....NC
Opt. A5.....NC
Opt. BL.....$50
Opt. B9.....$50
Opt. DV.....$ 595
Opt. EX.....$220
Opt. E3.....$299
Opt. PL.....$100
Opt. PS.....$250
Opt. RS.....$50
Opt. SN.....$60
Opt. SX.....$275
Opt. SY.....$565
Opt. SZ.....$840
Opt. S0.....$ 175
Opt. S1.....$215
Opt. S2.....$445
Opt. S3.....$ 660
Opt. TR.....$750
Opt. TX.....NC
Opt. TY.....NC
Opt. U2.....$120
Opt. U3.....$204
Opt. 1A.....$350
Opt. 1B.....$595
Opt. 1P.....$150
Opt. 24.....$400
Opt. 25.....$800
Opt. 28.....$1,600
Opt. 3A.....$75
Opt. 3L.....$60
Opt. 3N.....$145
Opt. 3P.....$295
Opt. 3Q.....$495
Opt. 3V.....$60
Opt. 32.....$500
Opt. 4L.....$60
Opt. 4N.....$145

XP419C.....$4,145
Opt. AV.....$300
Opt. AX.....$200
Opt. A1.....NC
Opt. A2.....NC
Opt. A3.....NC
Opt. A5.....NC
Opt. BL.....$50
Opt. B9.....$50
Opt. DV.....$595
Opt. EX.....$220
Opt. E3.....$299
Opt. PL.....$100
Opt. PS.....$250
Opt. RS.....$50
Opt. SN.....$60
Opt. SX.....$275
Opt. SY.....$565
Opt. SZ.....$840
Opt. S0.....$175
Opt. S1.....$215
Opt. S2.....$445
Opt. S3.....$660
Opt. TR.....$750
Opt. TX.....NC
Opt. TY.....NC
Opt. U2.....$120
Opt. U3.....$204
Opt. 1A.....$350
Opt. 1B.....$595
Opt. 1P.....$150
Opt. 24.....$400
Opt. 25.....$800
Opt. 28.....$1,600
Opt. 3A.....$75
Opt. 3L.....$60
Opt. 3N.....$145
Opt. 3P.....$295
Opt. 3Q.....$495
Opt. 3V.....$60
Opt. 32.....$500
Opt. 4L.....$60
Opt. 4N.....$145

XP421CH.....$4,745
Opt. AV.....$300
Opt. AX.....$200
Opt. A1.....NC
Opt. A2.....NC
Opt. A3.....NC
Opt. A5.....NC
Opt. BL.....$50
Opt. B9.....$50
Opt. EX.....$220
Opt. E3.....$299
Opt. PL.....$100
Opt. PS.....$250
Opt. RS.....$50
Opt. SN.....$60
Opt. S0.....$175
Opt. S1.....$215
Opt. S2.....$445
Opt. S3.....$660
Opt. TR.....$750
Opt. U2.....$120
Opt. U3.....$204
Opt. 1A.....$350
Opt. 1B.....$595
Opt. 1P.....$150
Opt. 24.....$400
Opt. 25.....$800
Opt. 28.....$1,600
Opt. 3A.....$75
Opt. 3L.....$60
Opt. 3N.....$145
Opt. 3P.....$295
Opt. 3Q.....$495
Opt. 3V.....$60
Opt. 4L.....$60
Opt. 4N.....$145

XSCD080.....$850
Opt. S0.....$ 425

XSC7080.....$850
Opt. S0.....$425

XSRM.....$23,840
Opt. C5.....$1,225
Opt. R2.....$590

XSRMZC.....$760
XSRMZF.....$3,335
XSRMZL.....$1,575
XSRMZP.....$4,860
XSRMZR.....$760

XSRMZ3.....$2,645
Opt. C5.....$325
Opt. R2.....$100

XS00WU.....$125
XS000D.....$545
XS000N.....$545
XS0000S.....$545
XS000W.....$545
XS000X.....$249
XS005D.....$2,315
XS0050S.....$2,315
XS005W.....$2,315
XS010D.....$ 4,360
XS0100S.....$4,360
XS010W.....$4,360
XS01080.....$850
Opt. S0.....$425
XS04080.....$850
Opt. S0.....$425
XS05080.....$850
Opt. S0.....$425
XS07080.....$850
Opt. S0.....$ 425
XS08080.....$850
Opt. S0.....$425
XS09080.....$850
Opt. S0.....$425
XS10080.....$850
Opt. S0.....$425
XS11080.....$850
Opt. S0.....$425
XY1.....$365
YT1.....$995
YT1S.....$1,100
YT5060.....$35
YT5100.....$40

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Products and Price Listing

PRICE INFORMATION

ZCAN52 ..... $3,225
ZCAN72 ..... $3,350
ZCSBAC $144
ZCSE3 ..... $149
ZCSE3A $199
ZCSS1 ..... $119
ZCSS2 ..... $225
ZCSS3 ..... $325
ZRB252 ..... $3,395
Opt. C5 ..... $475
Opt. R2 ..... $160
ZRB253 ..... $1,930
Opt. C5 ..... $325
Opt. R2 ..... $100
ZRB255 ..... $3,395
Opt. C5 ..... $475
Opt. R2 ..... $160
ZRB256 ..... $1,930
Opt. C5 ..... $325
Opt. R2 ..... $100
ZRB273 ..... $2,025
Opt. C5 ..... $325
Opt. R2 ..... $100
ZRB276 ..... $2,025
Opt. C5 ..... $325
Opt. R2 ..... $100
ZZA11 ..... $415
ZZA12 ..... $530
ZZA123 ..... $460
ZZA13 ..... $780
ZZA8 ..... $380
ZZA9 ..... $250
ZZA91 ..... $145
ZZA911 ..... $75
ZZA92 ..... $175
ZZA921 ..... $90
ZZA93 ..... $180
ZZA931 ..... $90
ZZA94 ..... $185
ZZA941 ..... $95
ZZA95 ..... $200
ZZA951 ..... $100
ZZA97 ..... $345
ZZA98 ..... $380
ZZA99 ..... $450
ZZA991 ..... $405
ZZG91 ..... $95
ZZG92 ..... $100
ZZG93 ..... $105
ZZG94 ..... $110
ZZG95 ..... $115
ZZK011 ..... $620
ZZK1 ..... $355
ZZK913 ..... $605
ZZK914 ..... $625
ZZK923 ..... $640
ZZK924 ..... $655
ZZK925 ..... $680
ZZK933 ..... $705
ZZK934 ..... $730
ZZK935 ..... $770
ZZK943 ..... $720
ZZK944 ..... $770
ZZK945 ..... $825
ZZK953 ..... $750
ZZK954 ..... $800
ZZK955 ..... $840
ZZK973 ..... $550
ZZK974 ..... $565
ZZK983 ..... $580
ZZK984 ..... $600
ZZK993 ..... $670
ZZK994 ..... $685
ZZM32 ..... $82
ZZM512 ..... $1,155
ZZT91 ..... $115
ZZT92 ..... $135
ZZT96 ..... $90
ZZT97 ..... $130
ZZT98 ..... $215
Z240 ..... $3,695
Opt. A0 ..... NC
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. E3 ..... $395
Opt. L0 ..... NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. S0 ..... $350
Opt. S1 ..... $395
Opt. S2 ..... $749
Opt. S3 ..... $1,065
Opt. WR ..... NC
Opt. 00 ..... NC
Opt. 01 ..... NC
Z240BAC $480
Z240D $5,920
Opt. A0 ..... NC
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. L0 ..... NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. 00 ..... NC
Opt. 01 ..... NC
Z240EV $5,920
Z240E3 ..... $395
Z240E3A $475
Z240F40 ..... $1,995
Opt. S0 ..... NC
Z240S1 ..... $395
Z240S2 ..... $749
Z240S3 ..... $1,065
Z340 ..... $4,995
Opt. A0 ..... NC
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. BZ ..... NC
Opt. ES ..... NC
Opt. L0 ..... NC
Opt. L1 ..... $ NC
Opt. L2 ..... $ NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. P0 ..... NC
Opt. P1 ..... $595
Opt. P2 ..... $295
Opt. P3 ..... $245
Opt. P4 ..... $895
Opt. S0 ..... $350
Opt. S1 ..... $695
Opt. S2 ..... $1,195
Opt. S3 ..... $1,848
Opt. WR ..... NC
Opt. 00 ..... NC
Opt. 01 ..... NC
Opt. 04 ..... $345
Z340BAC $840
Z340D $8,325
Opt. A0 ..... NC
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. L0 ..... NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. WR ..... NC
Opt. 00 ..... NC
Opt. 01 ..... NC
Z340J $7,100
Opt. PJ $2,000
Opt. P0 ..... NC
Opt. P1 ..... $595
Opt. P2 ..... $295
Opt. P3 ..... $245
Opt. P4 ..... $895
Z340LTA ..... $ 495
Opt. 00 ..... NC
Opt. 01 ..... NC
Z340P $6,795
Opt. A0 ..... NC
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. ES ..... NC
Opt. EV ..... NC
Opt. L0 ..... $ NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. P1 ..... $595
Opt. P2 ..... $295
Opt. P3 ..... $245
Opt. P4 ..... $895
Opt. S0 ..... $350
Opt. S1 ..... $695
Opt. S2 ..... $1,195
Opt. S3 ..... $1,848
Opt. WR ..... NC
Opt. 00 ..... NC
Opt. 01 ..... NC
Z340ROM $995
Opt. S0 ..... $350
Z340SS $295
Opt. 00 ..... NC
Opt. 01 ..... NC
Z340S1 ..... $695
Z340S2 ..... $1,195
Z340S3 ..... $1,848
Z480FSS $995
Opt. 00 ..... NC
Opt. 01 ..... NC
Z480F32 ..... $2,390
Z480F85 ..... $1,995
Opt. S0 ..... NC
Z480X $14,995
Opt. A1 ..... $ NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. L0 ..... NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. P1 ..... $595
Opt. P2 ..... $295
Opt. S0 ..... $350
Opt. S1 ..... $1,225
Opt. S2 ..... $2,495
Opt. S3 ..... $3,750
Opt. WR ..... NC
Opt. 16 ..... $1,195
Opt. 32 ..... $2,390
Opt. 64 ..... $4,780
Z480XD $19,995
Opt. A0 ..... NC
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. L0 ..... NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Z480XJ $16,995
Opt. P1 ..... $595
Opt. P2 ..... $295
Opt. 16 ..... $1,195
Opt. 32 ..... $2,390
Opt. 64 ..... $4,780
003082500 ..... $7.85
006160300 ..... $120
006160301 ..... $415
006241000 ..... $23
006243200 ..... $305
006243201 ..... $1,045
006283700 ..... $55
006283800 ..... $60
006299000 ..... $37
006671301 ..... $22
006682200 ..... $66
006682400 ..... $77
006682500 ..... $560
006682600 ..... $100
006735000 ..... $300
006782401 ..... $5
010037600 ..... $205
010037700 ..... $250
010037801 ..... $160
010038400 ..... $145
010040901 ..... $485
010041900 ..... $295
010610200 ..... $180
011005701 ..... $55
011006100 ..... $65
011010001 ..... $170
011010200 ..... $38
011010201 ..... $31
011010300 ..... $37
011010301 ..... $31
011010302 ..... $52
011010500 ..... $205
011010600 ..... $255
011010801 ..... $210
011010900 ..... $255
011012800 ..... $88
011012900 ..... $220
011013200 ..... $75
011013400 ..... $33
011015400 ..... $30
011015600 ..... $35
011016000 ..... $125
011016100 ..... $95
011016200 ..... $95
012012400 ..... $795
012121400 ..... $58
012129900 ..... $50
012130100 ..... $55
012130200 ..... $45
012131200 ..... $45
012131300 ..... $45
012139200 ..... $65
012142801 ..... $59
012142900 ..... $79
012143000 ..... $99
012146800 ..... $50
013005200 ..... $19
013005400 ..... $30
013005600 ..... $30
013008500 ..... $16.50
013008501 ..... $17.50
013012600 ..... $27
013014500 ..... $45
013015200 ..... $28
013016900 ..... $370
013019700 ..... $83
013027800 ..... $350
013029100 ..... $29
013029900 ..... $29
015010600 ..... $1,590
015011400 ..... $400
015014900 ..... $980
015020107 ..... $9
015021200 ..... $275
015021300 ..... $275
015021500 ..... $155
015023001 ..... $13
015023100 ..... $50
015026500 ..... $415
015032700 ..... $375
015033900 ..... $65
015035200 ..... $275
016009900 ..... $4.85
016011101 ..... $29
016015602 ..... $23
016035703 ..... $48
016035903 ..... $50
016041400 ..... $13.50
016041402 ..... $13.50
016041405 ..... $13.50

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Products and Price Listing

PRICE INFORMATION

016041406 $13.50	016097400 $14	016117150 $980	016127500 $40	016134900 $49.95
016041409 $41	016097470 $600	016117200 $215	016127550 $600	016134950 $999
016058900 $13.50	016097500 $14	016117220 $215	016127600 $ 40	016135000 $49.95
016058901 $13.50	016097570 $600	016117250 $860	016127700 $95	016135050 $999
016058902 $13.50	016097600 $14	016117300 $125	016127800 $660	016135100 $49.95
016058903 $13.50	016097670 $600	016117350 $500	016127900 $528	016135150 $999
016062202 $45	016097700 $14	016117400 $200	016128000 $504	016135200 $49.95
016063000 $12.50	016097770 $ 600	016117450 $800	016128200 $80	016135250 $499.50
016063300 $5.75	016098300 $35	016117500 $125	016128300 $80	016135300 $49.95
016064202 $270	016098400 $100	016117600 $200	016128701 $195	016135350 $499.50
016070900 $50	016098500 $100	016117700 $110	016128800 $35	016135400 $595
016071000 $65	016098600 $180	016117750 $2,200	016128870 $35	016135900 $39
016071100 $65	016098800 $27	016117800 $110	016129000 $300	016136000 $39
016071200 $50	016099901 $68	016117900 $80	016129200 $300	016136100 $55
016071301 $125	016099950 $620	016117950 $1,600	016129300 $1,120	016136200 $55
016071401 $125	016100801 $68	016118000 $80	016129400 $1,120	016136800 $30
016071501 $125	016102200 $55	016118100 $50	016129600 $75	016136900 $30
016071602 $125	016105800 $10	016118300 $100	016129650 $1,500	017006100 $340
016072500 $27	016105801 $35	016118400 $100	016129700 $75	017007600 $115
016072502 $27	016105802 $35	016118501 $59	016129800 $200	017008800 $110
016072506 $27	016107400 $150	016118601 $59	016129850 $800	017008900 $93
016072509 $70	016107700 $17	016118651 $1,180	016129900 $125	017009000 $295
016073200 $20	016109901 $85	016118800 $140	016129950 $500	017009100 $295
016073300 $8	016110300 $125	016118850 $560	016130000 $125	017009200 $295
016073402 $13	016110400 $125	016119300 $450	016130100 $200	017009300 $240
016073502 $13	016110600 $495	016119400 $50	016130150 $800	017009400 $170
016073602 $13	016111001 $35	016120500 $268	016130200 $245	017052000 $95
016073702 $13	016111200 $495	016120550 $1,072	016130250 $980	020008600 $16
016074200 $5	016111300 $395	016120600 $268	016130300 $185	020008700 $10.25
016074302 $105	016111400 $85	016121100 $225	016130310 $55	020090300 $32
016076504 $130	016111500 $89	016121150 $900	016130350 $740	020162900 $37
016076505 $130	016111700 $55	016121200 $225	016130670 $1,000	020170800 $225
016076604 $130	016111800 $59	016121900 $125	016130700 $29	020171101 $50
016076605 $130	016112100 $50	016122000 $125	016130800 $79	020172400 $47
016077002 $ 40	016112200 $50	016122200 $135	016130900 $79	020183500 $105
016079300 $50	016112300 $129	016122250 $540	016131000 $79	020183600 $65
016079400 $50	016112375 $4,128	016122290 $126	016131600 $755	020190800 $17
016079903 $ 65	016112400 $75	016122300 $30	016131800 $95	020202100 $260
016083601 $130	016112475 $3,300	016122350 $300	016131900 $179	020202200 $210
016083800 $22	016112500 $75	016122400 $30	016132000 $199	020202300 $105
016083901 $13	016112575 $3,300	016123300 $35	016132100 $199	021045700 $355
016084001 $13	016112600 $75	016123900 $1,850	016132200 $199	021046600 $150
016084101 $13	016112675 $3,300	016124100 $1,495	016132300 $595	063003300 $50
016084201 $13	016113000 $42	016124150 $5,980	016132500 $55	063177900 NC
016089100 $68	016113100 $44	016124300 $795	016132600 $55	067051500 $385
016089200 $80	016113700 $25	016124350 $3,180	016133200 $30	067052900 $355
016089202 $80	016113800 $25	016124400 $895	016133300 $65.70	067053600 $70
016089300 $68	016113900 $50	016124450 $3,580	016133320 $10.95	067053700 $130
016089400 $80	016114000 $50	016124500 $835	016133350 $1,314	067053800 $135
016089402 $80	016114100 $62	016124510 $195	016133400 $48	067053900 $195
016089500 $57	016114200 $29	016124550 $3,340	016133420 $8	067054000 $75
016089550 $570	016114300 $29	016124600 $100	016133450 $960	067054100 $115
016089600 $57	016114401 $30	016124650 $400	016133500 $48	067055200 $125
016089800 $150	016114500 $75	016124700 $100	016133520 $8	067055900 $305
016089850 $600	016114901 $55	016124800 $250	016133550 $960	067056200 $105
016090300 $130	016115400 $80	016124850 $1,000	016133600 $48	067057201 $1,190
016090400 $160	016116300 $100	016124900 $250	016133620 $8	067062500 $805
016090601 $145	016116400 $100	016125000 $275	016133650 $960	067075500 $160
016090650 $580	016117000 $190	016125050 $1,100	016134100 $25	067075800 $70
016092000 $105	016117010 $65	016126200 $175	016134600 $19.95	067075900 $60
016095500 $62	016117020 $190	016126210 $70	016134650 $199.50	067076000 $21
016095550 $620	016117050 $760	016126250 $700	016134700 $19.95	067076100 $22
016095600 $62	016117100 $245	016127400 $40	016134800 $49.95	067091600 $6,170
016097300 $20	016117120 $245	016127450 $600	016134850 $999	067093500 $35

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Products and Price Listing

PRICE INFORMATION

067112900 ..... $235
067113099 ..... $25
070582400 ..... $1.25
070655900 ..... $14.95
103015800 ..... $15.50
103016400 ..... $20
103020300 ..... $80
103020900 ..... $ 370
1101A $715
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
1103 ..... $675
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
118AS $6,000
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M1 ..... $495
Opt. M2 ..... $425
Opt. M3 ..... $945
Opt. M7 ..... $260
Opt. M8 ..... $520
Opt. M9 ..... $235
118F01 ..... $1,250
118RC $1,100
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M1 ..... $235
Opt. M2 ..... $170
Opt. M3 ..... $450
Opt. M7 ..... $140
Opt. M8 ..... $280
Opt. M9 ..... $95
11801B $25,000
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 1M $1,200
Opt. 1R $255
Opt. 95 ..... $150
Opt. 96 ..... $50
118771801 ..... $255
118771901 ..... $400
118803500 ..... $300
118866800 ..... $50
118868700 ..... $8
119177501 ..... $150
119177600 ..... $65
119184702 ..... $120
119198001 ..... $390
119198100 ..... $190
1200C01 ..... $750
120046404 ..... $375
120060300 ..... $205
120061400 ..... $245
120110200 ..... $645
122018601 ..... $90
131042800 ..... $20
131042802 ..... $17.75
131276601 ..... $47
131276603 ..... $2.35
131328700 ..... $130
131368501 ..... $4.70
131424400 ..... $115
131435300 ..... $66
131474600 ..... $150
131499701 ..... $6.25
131503000 ..... $66
131503100 ..... $66
132013700 ..... $85
134 ..... $890
1350F01 ..... $3,000
136035202 ..... $50
140E3 ..... $149
140E3A $199
1405 ..... $7,800
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $725
Opt. R2 ..... $260
Opt. 01 ..... $210
Opt. 03 ..... NC
1502B $8,350
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $725
Opt. PB $1,200
Opt. R2 ..... $260
Opt. 03 ..... $260
Opt. 04 ..... $995
Opt. 05 ..... NC
Opt. 07 ..... $1,100
Opt. 95 ..... $150
Opt. 96 ..... $50
1502C $7,350
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $725
Opt. R2 ..... $260
Opt. 03 ..... $260
Opt. 04 ..... $995
Opt. 05 ..... NC
Opt. 95 ..... $150
Opt. 96 ..... $50
1503B $6,300
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $725
Opt. R2 ..... $260
Opt. 03 ..... $260
Opt. 04 ..... $995
Opt. 05 ..... NC
Opt. 06 ..... $360
Opt. 07 ..... $1,100
Opt. 08 ..... $175
Opt. 09 ..... $175
Opt. 10 ..... $365
Opt. 95 ..... $150
Opt. 96 ..... $50
1503C $5,300
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $725
Opt. R2 ..... $260
Opt. 03 ..... $260
Opt. 04 ..... $995
Opt. 05 ..... NC
Opt. 06 ..... $360
Opt. 08 ..... $175
Opt. 09 ..... $175
Opt. 10 ..... $365
Opt. 95 ..... $150
Opt. 96 ..... $50
151031301 ..... $20
1700F00 ..... $70
1700F02 ..... $110
1700F05 ..... $250
1700F06 ..... $60
1700F07 ..... $165
1705A $4,395
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $170
Opt. M3 ..... $530
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. 74 ..... $100
1710B $1,795
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. M2 ..... $95
Opt. M3 ..... $455
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. 74 ..... $100
1710J $1,795
Opt. M1 ..... $285
Opt. M2 ..... $190
Opt. M3 ..... $550
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. M9 ..... $105
1711B $1,795
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $95
Opt. M3 ..... $455
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. 74 ..... $100
1720 ..... $2,495
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. M2 ..... $115
Opt. M3 ..... $475
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. 74 ..... $100
1720SCH $3,400
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $140
Opt. M3 ..... $580
Opt. M7 ..... $220
Opt. M8 ..... $440
Opt. 74 ..... $100
1721 ..... $2,495
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $115
Opt. M3 ..... $475
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. 74 ..... $100
1721SCH $3,400
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $140
Opt. M3 ..... $580
Opt. M7 ..... $220
Opt. M8 ..... $440
Opt. 74 ..... $100
1725 ..... $3,495
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $130
Opt. M3 ..... $770
Opt. M7 ..... $320
Opt. M8 ..... $640
Opt. 74 ..... $100
1730 ..... $2,495
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. M2 ..... $115
Opt. M3 ..... $475
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. 74 ..... $100
1730D $3,695
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M1 ..... $365
Opt. M2 ..... $260
Opt. M3 ..... $700
Opt. M7 ..... $220
Opt. M8 ..... $440
Opt. M9 ..... $145
Opt. 74 ..... $100
1731 ..... $2,495
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $115
Opt. M3 ..... $495
Opt. M7 ..... $190
Opt. M8 ..... $380
Opt. 74 ..... $100
1731D $3,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M1 ..... $365
Opt. M2 ..... $265
Opt. M3 ..... $705
Opt. M7 ..... $220
Opt. M8 ..... $440
Opt. M9 ..... $145
Opt. 74 ..... $100
1735 ..... $2,695
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $130
Opt. M3 ..... $590
Opt. M7 ..... $230
Opt. M8 ..... $460
Opt. 74 ..... $100
1735HD $5,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. M1 ..... $700
Opt. M2 ..... $410
Opt. M3 ..... $1,350
Opt. M7 ..... $470
Opt. M8 ..... $940
Opt. M9 ..... $230
Opt. 74 ..... $100
1740A ..... $ 4,395
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $160
Opt. M3 ..... $680
Opt. M7 ..... $260
Opt. M8 ..... $520
Opt. 02 ..... $100
Opt. 74 ..... $100
174096700 ..... $23
174096800 ..... $26
174096900 ..... $27
174097100 ..... $35
174097200 ..... $40
174097300 ..... $29
174097400 ..... $36
174097500 ..... $23
174097600 ..... $27
174097700 ..... $29
174097800 ..... $33
1741A $4,395
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $160
Opt. M3 ..... $680
Opt. M7 ..... $260
Opt. M8 ..... $520
Opt. 74 ..... $100
174108104 ..... $70
174124100 ..... $300
174138500 ..... $617
174138600 ..... $785
174138700 ..... $449
174138800 ..... $561
174149700 ..... $592
1745A $4,695
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $160
Opt. M3 ..... $680
Opt. M7 ..... $260

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Products and Price Listing

PRICE INFORMATION

Opt. M8 ..... $520
Opt. 74 ..... $100
1750A $5,900
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $185
Opt. M3 ..... $1,005
Opt. M7 ..... $410
Opt. M8 ..... $820
Opt. 02 ..... $100
Opt. 74 ..... $100
175012401 ..... $3.70
175012501 ..... $3.70
175026301 ..... $3.70
175027900 ..... $ 28
175047700 ..... $210
175084802 ..... $3.70
175092500 ..... $7.50
1751A $5,900
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $185
Opt. M3 ..... $1,005
Opt. M7 ..... $ 410
Opt. M8 ..... $820
Opt. 74 ..... $100
175101700 ..... $6.80
175102700 ..... $38
175102701 ..... $79
175183604 ..... $240
1755A $6,200
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $185
Opt. M3 ..... $1,005
Opt. M7 ..... $410
Opt. M8 ..... $820
Opt. 74 ..... $100
1760 ..... $4,900
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $175
Opt. M3 ..... $835
Opt. M7 ..... $330
Opt. M8 ..... $660
Opt. SC $1,500
Opt. 74 ..... $100
1761 ..... $4,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $175
Opt. M3 ..... $835
Opt. M7 ..... $330
Opt. M8 ..... $660
Opt. SC $1,500
Opt. 74 ..... $100
1765 ..... $5,295
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $175
Opt. M3 ..... $835
Opt. M7 ..... $330
Opt. M8 ..... $660
Opt. SC $1,500
Opt. 74 ..... $100
1780F02 ..... $295
1780F05 ..... $100
1780R $10,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. M2 ..... $355
Opt. M3 ..... $1,615
Opt. M7 ..... $630
Opt. M8 ..... $1,260
Opt. 74 ..... $200
1781R $10,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. M2 ..... $340
Opt. M3 ..... $1,740
Opt. M7 ..... $700
Opt. M8 ..... $1,400
Opt. 74 ..... $200
1910 ..... $7,850
Opt. M1 ..... $910
Opt. M2 ..... $415
Opt. M3 ..... $1,775
Opt. M7 ..... $680
Opt. M8 ..... $1,360
Opt. M9 ..... $230
Opt. 01 ..... NC
Opt. 02 ..... NC
Opt. 03 ..... NC
1910F00 ..... $350
195424000 ..... $3.70
195617600 ..... $9.15
196312000 ..... $3.70
196312100 ..... $5.75
196319800 ..... $5.75
196328600 ..... $10.25
196328700 ..... $13
196330200 ..... $17.25
200CART $295
204053201 ..... $42
204054501 ..... $60
204055700 ..... $55
206010400 ..... $1.25
206010500 ..... $2.10
206011400 ..... $5.50
206015304 ..... $175
206018500 ..... $2.25
206019300 ..... $23
206021000 ..... $23
206021201 ..... $23
206021300 ..... $23
206022302 ..... $29
206023003 ..... $40
206023301 ..... $14.75
206026510 ..... $22
206026511 ..... $22
206026512 ..... $22
206026513 ..... $22
206030100 ..... $30
206030200 ..... $33
206031200 ..... $74
206031301 ..... $110
206031400 ..... $115
206031901 ..... $110
206032001 ..... $105
206032200 ..... $115
206032400 ..... $29
206032500 ..... $27
206032800 ..... $30
206033100 ..... $89
206033601 ..... $53
206033701 ..... $47
206033801 ..... $53
206034201 ..... $53
206034900 ..... $89
206035900 ..... $115
206037800 ..... $22
206037900 ..... $83
206038000 ..... $83
206038100 ..... $83
206038200 ..... $89
206038901 ..... $150
206039000 ..... $715
206039800 ..... $240
206039903 ..... $485
206042600 ..... $44
206042700 ..... $68
206043800 ..... $275
206045100 ..... $79
22N50 ..... $ 415
222PS $2,995
224 ..... $2,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. 02 ..... NC
2465B $8,825
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $475
Opt. R2 ..... $160
Opt. 05 ..... $1,045
Opt. 06 ..... $1,395
Opt. 1R $405
Opt. 10 ..... $995
Opt. 11 ..... $225
Opt. 22 ..... $ 450
Opt. 46 ..... $1,390
Opt. 95 ..... $150
Opt. 96 ..... $50
2467B $16,820
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 05 ..... $1,045
Opt. 06 ..... $1,395
Opt. 1R ..... $ 405
Opt. 10 ..... $995
Opt. 11 ..... $225
Opt. 5H $1,595
Opt. 95 ..... $150
Opt. 96 ..... $50
26N50 ..... $1,240
262099801 ..... $40
2704 ..... $1,135
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $275
Opt. R2 ..... $60
2705 ..... $335
Opt. C5 ..... $275
Opt. R2 ..... $60
2706 ..... $4,835
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $475
Opt. R2 ..... $160
2707 ..... $4,300
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $475
Opt. R2 ..... $160
Opt. 01 ..... NC
2711 ..... $9,100
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 02 ..... $845
Opt. 03 ..... $815
Opt. 04 ..... $3,245
Opt. 05 ..... $4,070
Opt. 07 ..... $1,395
Opt. 08 ..... $815
Opt. 10 ..... $670
Opt. 15 ..... $290
Opt. 20 ..... *1
Opt. 21 ..... $4,380
Opt. 30 ..... $260
Opt. 33 ..... $105
Opt. 34 ..... $610
2712 ..... $12,310
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 04 ..... $3,245
Opt. 05 ..... $4,070
Opt. 07 ..... $1,395
Opt. 08 ..... NC
Opt. 10 ..... $670
Opt. 12 ..... $1,525
Opt. 14 ..... $620
Opt. 15 ..... $290
Opt. 20 ..... $ 3,390
Opt. 21 ..... $4,380
Opt. 30 ..... $260
Opt. 33 ..... $105
Opt. 34 ..... $610
27120 ..... $25,200
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. 05 ..... $4,070
Opt. 10 ..... $670
Opt. 11 ..... –$3,385
Opt. 16 ..... –$2,955
Opt. 17 ..... –$4,835
2714 ..... $13,950
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. R2 ..... $ 400
Opt. 03 ..... NC
Opt. 05 ..... $4,070
Opt. 07 ..... $1,395
Opt. 08 ..... NC
Opt. 15 ..... $290
Opt. 30 ..... $260
Opt. 33 ..... $105
Opt. 34 ..... $610
2715 ..... $15,900
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,050
Opt. R2 ..... $400
Opt. 03 ..... NC
Opt. 05 ..... $4,070
Opt. 07 ..... $1,395
Opt. 08 ..... NC
Opt. 15 ..... $290
Opt. 30 ..... $260
Opt. 33 ..... $105
Opt. 34 ..... $610
2721A $7,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. M2 ..... $215
Opt. M3 ..... $1,315
Opt. M7 ..... $550
Opt. M8 ..... $1,100
2722A $8,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. M2 ..... $300
Opt. M3 ..... $1,260
Opt. M7 ..... $480
Opt. M8 ..... $960
Opt. 01 ..... $995
2784 ..... $59,640
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. B1 ..... $260
Opt. B2 ..... $365
Opt. R2 ..... $1,130
Opt. 04 ..... $2,575
Opt. 16 ..... NC

*1 *Contact your local Tektronix representative for price information.*

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Products and Price Listing

PRICE INFORMATION

Opt. 18 ..... $14,550
Opt. 19 ..... $23,560
Opt. 30 ..... $545

30C02 ..... $850

30DA01 ..... $650

30DM04 ..... $1,500
Opt. 1D ..... –$300
Opt. 1S ..... NC

30DM06 ..... $1,500
Opt. 1D ..... –$300
Opt. 1S $500
Opt. 2S $400
Opt. 3S $500

30DM07 ..... $1,000
Opt. 1D ..... –$300
Opt. 2D ..... –$150

30DM08 ..... $1,500
Opt. 1D ..... $ –300
Opt. 1S $500
Opt. 2S $400
Opt. 3S $500

30DM09A $2,000
Opt. 1D ..... –$500

30DM10 ..... $2,000
Opt. 1D ..... –$500
Opt. 1S ..... NC
Opt. 3S $225

30DM101 ..... $2,000
Opt. 1D ..... –$300

30DM27 ..... $1,500
Opt. 1D ..... –$300
Opt. 1S ..... NC
Opt. 2S ..... NC
Opt. 3S $800
Opt. 4S $500

30DM31 ..... $2,000
Opt. 1D ..... –$500

30DM33 ..... $2,000
Opt. 1D ..... –$500

30DM41 ..... $1,000
Opt. 1D ..... –$200
Opt. 1S ..... NC

30DM41F $1,500

30DM91 ..... $1,500
Opt. 1D ..... –$300
Opt. 2D ..... –$150

30DM92 ..... $1,500
Opt. 1D ..... –$300

30DM93 ..... $2,000
Opt. 1D ..... $ -500

30DM993 ..... $2,000
Opt. 1D ..... –$600

30DSM $6,500
Opt. R2 ..... $260
Opt. 95 ..... $150
Opt. 96 ..... $50

30F01 ..... $2,000

30F02A $800
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC

30F03 ..... $250

30F04 ..... $750

30F06 ..... $2,500

30F08 ..... $250

30F30 ..... $50
Opt. 1A $750

30F40 ..... $950

30HSM $6,500
Opt. R2 ..... $260
Opt. 1L $1,000
Opt. 2A $750
Opt. 4L $1,200
Opt. 5L $2,400
Opt. 95 ..... $150
Opt. 96 ..... $50

30MPX $6,500
Opt. R2 ..... $260
Opt. 1A $650
Opt. 1F $450
Opt. 1H $1,000
Opt. 1L $500
Opt. 95 ..... $150
Opt. 96 ..... $50

30RP2 ..... $2,500
Opt. 01 ..... $350
Opt. 02 ..... $350

3001GPX $8,995
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $400
Opt. 1A $650
Opt. 1B $75
Opt. 1C $750
Opt. 1D ..... –$1,000
Opt. 1K $500
Opt. 1M $840
Opt. 1R ..... NC
Opt. 1S $2,000
Opt. 1Z $995
Opt. 2C $850
Opt. 2D ..... –$2,000
Opt. 3D ..... –$3,000
Opt. 4D ..... –$4,000
Opt. 95 ..... $150
Opt. 96 ..... $50

3001HSM $9,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $ 400
Opt. 1B $75
Opt. 1C $750
Opt. 1K $500
Opt. 1L $1,000
Opt. 1M $840
Opt. 2A $750
Opt. 4L $1,200
Opt. 5L $2,400
Opt. 95 ..... $150
Opt. 96 ..... $50

3001MPX $7,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $260
Opt. 1A $650
Opt. 1B $75
Opt. 1C $750
Opt. 1F $450
Opt. 1H $1,000
Opt. 1K $500
Opt. 1L $500
Opt. 1M $840
Opt. 95 ..... $150
Opt. 96 ..... $50

3002C $6,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $260
Opt. 04 ..... $1,500
Opt. 1B $75
Opt. 1C $750
Opt. 1R ..... NC
Opt. 2C $850
Opt. 2D ..... –$400
Opt. 95 ..... $150
Opt. 96 ..... $50

3002CG $14,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $ 400
Opt. 04 ..... $1,500
Opt. 1B $75
Opt. 1C $750
Opt. 1S $2,000
Opt. 2C $850
Opt. 2S $700
Opt. 95 ..... $150
Opt. 96 ..... $50

3002CGD $21,000
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $590
Opt. 04 ..... $1,500
Opt. 1B $75
Opt. 1C $750
Opt. 1S $2,000
Opt. 2C $850
Opt. 2S $700
Opt. 95 ..... $150
Opt. 96 ..... $50

3002CGG $22,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $590
Opt. 04 ..... $1,500
Opt. 1B $75
Opt. 1C $750
Opt. 1D ..... –$1,000
Opt. 1S $4,000
Opt. 2C $850
Opt. 2D ..... –$2,000
Opt. 2S $700
Opt. 3D ..... –$3,000
Opt. 95 ..... $150
Opt. 96 ..... $50

3002CGH $21,000
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $590
Opt. 04 ..... $1,500
Opt. 1B $75
Opt. 1C $750
Opt. 1S $2,000
Opt. 2A $750
Opt. 2C $850
Opt. 2L $1,000
Opt. 2S $700
Opt. 4L $1,200
Opt. 5L $2,400
Opt. 95 ..... $150
Opt. 96 ..... $50

3002CH $11,000
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $400
Opt. 04 ..... $1,500
Opt. 1B $75
Opt. 1C $750
Opt. 2A $750
Opt. 2C $850
Opt. 2L $1,000
Opt. 2S $700
Opt. 4L $1,200
Opt. 5L $2,400
Opt. 95 ..... $150
Opt. 96 ..... $ 50

3002CHD $17,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $400
Opt. 04 ..... $1,500
Opt. 1B $75
Opt. 1C $750
Opt. 2A $750
Opt. 2C $850
Opt. 2L $1,000
Opt. 2S $700
Opt. 4L $1,200
Opt. 5L $2,400
Opt. 95 ..... $ 150
Opt. 96 ..... $ 50

3002CHH $17,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $400
Opt. 04 ..... $1,500
Opt. 1B ..... $ 75
Opt. 1C $750
Opt. 2A $750
Opt. 2C $850
Opt. 2L $1,000
Opt. 2S $700
Opt. 3A $1,500
Opt. 3L $2,000
Opt. 4L $1,200
Opt. 5L $2,400
Opt. 6L $4,800
Opt. 95 ..... $150
Opt. 96 ..... $50

3002CX $11,000
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $400
Opt. 04 ..... $1,500
Opt. 1B $75
Opt. 1C $750
Opt. 1F $450
Opt. 1H $1,000
Opt. 1L $500
Opt. 2C $850
Opt. 2S $700
Opt. 95 ..... $150
Opt. 96 ..... $50

3002CXD $17,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $ 400
Opt. 04 ..... $1,500
Opt. 1B $75
Opt. 1C $750
Opt. 1F ..... $ 450
Opt. 1H $1,000
Opt. 1L $500
Opt. 2C $850
Opt. 2S $700
Opt. 95 ..... $150
Opt. 96 ..... $50

3002CXH $17,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $400
Opt. 04 ..... $1,500
Opt. 1B $75
Opt. 1C $750
Opt. 1F ..... $ 450
Opt. 1H $1,000
Opt. 1L $500
Opt. 2A $750
Opt. 2C $850
Opt. 2L $1,000
Opt. 2S $700
Opt. 4L $1,200
Opt. 5L $2,400
Opt. 95 ..... $150
Opt. 96 ..... $50

3002CXX $17,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $ 400
Opt. 04 ..... $1,500
Opt. 1B ..... $ 75
Opt. 1C $750
Opt. 1F $450
Opt. 1H $1,000
Opt. 1L $500
Opt. 2C $850
Opt. 2F $900
Opt. 2H $2,000
Opt. 2L $1,000
Opt. 2S $700
Opt. 95 ..... $150
Opt. 96 ..... $50

3002E $2,000
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC

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Products and Price Listing

PRICE INFORMATION

Opt. A5 ..... NC
Opt. R2 ..... $100
Opt. 95 ..... $150
Opt. 96 ..... $50
3002ED $8,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $260
Opt. 01 ..... $6,500
Opt. 02 ..... $6,500
Opt. 03 ..... $8,500
Opt. 95 ..... $150
Opt. 96 ..... $50
3002P $7,200
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. R2 ..... $260
Opt. 1B $75
Opt. 1C $750
Opt. 2B $100
Opt. 2C $850
Opt. 95 ..... $150
Opt. 96 ..... $50
305XF18 ..... $2,575
3052F02 ..... $3,295
3052F06 ..... $9,950
Opt. 01 ..... NC
Opt. 02 ..... NC
Opt. 03 ..... NC
3052F07 ..... $5,495
Opt. 01 ..... NC
Opt. 02 ..... NC
3052F10 ..... $10,765
Opt. S0 ..... $350
3052F11 ..... $1,650
Opt. 01 ..... NC
Opt. 02 ..... NC
3052F13 ..... $9,550
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. S0 ..... $280
3052F14 ..... $2,745
3052F15 ..... $1,100
3052F16 ..... $2,095
3052F28 ..... $2,745
3052F31 ..... $3,295
3052F96 ..... $1,200
3052F97 ..... $2,500
3052F98 ..... $2,500
3052F99 ..... $5,000
Opt. S0 ..... $590
32DM02 ..... $1,000
Opt. 1D ..... –$550
32DM04 ..... $1,500
Opt. 1D ..... –$650
32DM06 ..... $ 1,500
Opt. 1D ..... $ -650
Opt. 1S ..... NC
32DM07 ..... $1,000
Opt. 1D ..... –$550
32DM08 ..... $1,500
Opt. 1D ..... –$650
Opt. 1S ..... NC
32DM09 ..... $2,000
Opt. 1D ..... –$750
Opt. 1S ..... NC
32DM10 ..... $2,000
Opt. 1D ..... $ -750
32DM101 ..... $2,000
Opt. 1D ..... –$750
Opt. 1S ..... NC
Opt. 2S ..... NC
Opt. 3S ..... NC
32DM11 ..... $3,000
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. 1D ..... –$750
32DM12A $2,000
Opt. 01 ..... $175
Opt. 1D ..... $ -750
32DM122 ..... $1,500
Opt. 1D ..... –$650
Opt. 1S ..... NC
32DM123 ..... $2,000
Opt. 1D ..... –$750
Opt. 1S ..... NC
32DM13A ..... $ 4,000
Opt. 1D ..... –$1,500
32DM14 ..... $ 4,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. 01 ..... $1,200
Opt. 1D ..... –$1,500
Opt. 1S $1,500
32DM21 ..... $1,000
Opt. 1D ..... –$550
32DM24 ..... $1,000
Opt. 1D ..... –$550
32DM27 ..... $1,500
Opt. 1D ..... –$650
Opt. 1S ..... NC
Opt. 2S ..... NC
Opt. 3S ..... NC
32DM31 ..... $2,000
Opt. 1D ..... –$750
Opt. 1S ..... NC
Opt. 2S ..... NC
32DM33 ..... $2,000
Opt. 1D ..... –$750
Opt. 1S ..... NC
32DM34 ..... $2,000
Opt. 1D ..... –$750
32DM36 ..... $4,500
Opt. 1D ..... –$750
32DM41 ..... $1,000
Opt. 1D ..... –$550
32DM55 ..... $2,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. 1D ..... –$1,500
32DM81 ..... $1,500
Opt. 1D ..... –$650
Opt. 1S ..... NC
32DM91 ..... $1,000
Opt. 1D ..... –$550
32DM92 ..... $1,500
Opt. 1D ..... –$650
Opt. 1S ..... NC
32DM921 ..... $2,700
Opt. 1D ..... –$1,950
32DM923 ..... $2,700
Opt. 1D ..... –$1,950
32DM924 ..... $545
Opt. 1D ..... –$295
32DM925 ..... $1,500
Opt. 1D ..... –$750
Opt. 1S ..... NC
32DM926 ..... $1,000
Opt. 1D ..... –$750
32DM927 ..... $1,000
Opt. 1D ..... –$750
32DM93A $2,000
Opt. 1A $750
Opt. 1D ..... –$750
Opt. 1S ..... NC
32DM930 ..... $7,950
Opt. 1D ..... –$7,700
32DM94 ..... $3,000
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. 1D ..... –$1,500
32DM96 ..... $1,500
Opt. 1D ..... –$650
32GPD $10,500
Opt. M0 ..... $195
Opt. Q0 ..... $495
Opt. R2 ..... $ 400
Opt. 1A $650
Opt. 1D ..... –$1,000
Opt. 2D ..... –$2,000
Opt. 2W $35
Opt. 3D ..... $ -3,000
Opt. 4D ..... –$4,000
Opt. 40 ..... $3,075
Opt. 41 ..... $3,000
Opt. 42 ..... $500
Opt. 43 ..... NC
Opt. 44 ..... $575
Opt. 95 ..... $150
Opt. 96 ..... $50
32GPX $8,500
Opt. M0 ..... $195
Opt. Q0 ..... $495
Opt. R2 ..... $260
Opt. 1A $650
Opt. 1D ..... –$1,000
Opt. 1R ..... NC
Opt. 2D ..... –$2,000
Opt. 2W $95
Opt. 3D ..... –$3,000
Opt. 40 ..... $3,075
Opt. 41 ..... $3,000
Opt. 42 ..... $500
Opt. 43 ..... NC
Opt. 44 ..... $575
Opt. 95 ..... $150
Opt. 96 ..... $50
32PA $1,500
344004600 ..... $3.50
344042200 ..... $240
370A $24,595
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,225
Opt. R2 ..... $590
Opt. 1R $595
371 ..... $25,000
371A $28,395
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. C5 ..... $1,225
Opt. R2 ..... $590
426204104 ..... $270
436017201 ..... $60
436020301 ..... $21
436020402 ..... $99
436020502 ..... $99
436020900 ..... $350
436022202 ..... $150
436022401 ..... $125
436023600 ..... $295
436023700 ..... $295
436025500 ..... $99
436025600 ..... $99
436026100 ..... $99
436026200 ..... $99
436027100 ..... $195
436027200 ..... $195
436027300 ..... $99
436027400 ..... $99
436027500 ..... $99
436027600 ..... $99
436027800 ..... $125
436027900 ..... $99
436028000 ..... $99
436028200 ..... $125
436028300 ..... $125
436028400 ..... $125
436028500 ..... $125
436028600 ..... $ 49
436028800 ..... $125
436028900 ..... $125
436029201 ..... $95
436029301 ..... $95
436029402 ..... $195
436029900 ..... $15
436030100 ..... $95
436030201 ..... $95
436031400 ..... $125
4540 ..... $1,695
Opt. A0 ..... NC
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. E3 ..... $149
Opt. S1 ..... $119
Opt. S2 ..... $225
Opt. S3 ..... $325
Opt. WR ..... NC
46ABAC $1,392
46AS1 ..... $995
46AS2 ..... $2,065
46AS3 ..... $3,040
46BBAC $900
46BS1 ..... $645
46BS2 ..... $1,335
46BS3 ..... $1,965
46CBAC $696
46CE3 ..... $495
46CS1 ..... $495
46CS2 ..... $1,035
46CS3 ..... $1,520
46DBAC $444
46DS1 ..... $315
46DS2 ..... $660
46DS3 ..... $975
46EBAC $156
46ES1 ..... $110
46ES2 ..... $230
46ES3 ..... $345
46S0 ..... $350
46S02 ..... $550
46YBAC $1,692
46YS1 ..... $1,225
46YS2 ..... $2,495
46YS3 ..... $3,750
4676 ..... $6,695
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. BZ ..... NC
Opt. DD ..... NC
Opt. D0 ..... NC
Opt. D1 ..... $475
Opt. D2 ..... $895
Opt. D3 ..... $1,285
Opt. L0 ..... NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. P0 ..... NC
Opt. P1 ..... $595
Opt. P2 ..... $295
Opt. P3 ..... $245
Opt. P4 ..... $895
Opt. S0 ..... $350
Opt. S1 ..... $1,100
Opt. S2 ..... $1,995
Opt. S3 ..... $2,950
Opt. WR ..... NC
Opt. 16 ..... $1,195
Opt. 32 ..... $2,390
4676A $6,695
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. BZ ..... NC
Opt. DD ..... NC
Opt. D0 ..... NC
Opt. L0 ..... NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. P0 ..... NC
Opt. P1 ..... $595
Opt. P2 ..... $295
Opt. P3 ..... $245
Opt. P4 ..... $895

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Products and Price Listing

PRICE INFORMATION

Opt. 16 ..... $1,195
Opt. 32 ..... $2,390
4676CB $9,995
4676DB $12,775
4676FP1 ..... $595
4676FP2 ..... $295
4676FP3 ..... $245
4676FP4 ..... $895
4676FSS $799
Opt. 00 ..... NC
Opt. 01 ..... NC
4676FS1 ..... $2,300
Opt. 00 ..... NC
Opt. 01 ..... NC
4676FS2 ..... $2,300
Opt. 00 ..... NC
Opt. 01 ..... NC
4676FTA $595
Opt. 00 ..... NC
Opt. 01 ..... NC
4676J $8,420
Opt. DD ..... NC
Opt. D0 ..... NC
Opt. P0 ..... NC
Opt. P1 ..... $595
Opt. P2 ..... $295
Opt. P3 ..... $245
Opt. P4 ..... $895
Opt. 16 ..... $1,195
Opt. 32 ..... $2,390
4676ROM $395
4680FP1 ..... $595
4680FP2 ..... $295
4680FSS ..... $ 295
Opt. 00 ..... NC
Opt. 01 ..... $295
4680F02 ..... $595
Opt. S0 ..... $350
4681FSS $195
Opt. 00 ..... NC
Opt. 01 ..... NC
4681FTA ..... $ 495
Opt. 00 ..... NC
Opt. 01 ..... NC
4681FXI $2,300
Opt. S0 ..... $350
4681F1F $195
Opt. S0 ..... $350
4681F20 ..... $1,595
Opt. S0 ..... NC
Opt. 01 ..... $1,405
4681F8M $645
4685 ..... $7,995
Opt. A0 ..... NC
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. DD ..... NC
Opt. D0 ..... NC
Opt. L0 ..... NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. MX ..... NC
Opt. P1 ..... $595
Opt. P2 ..... $295
Opt. S0 ..... $350
Opt. S1 ..... $645
Opt. S2 ..... $1,335
Opt. S3 ..... $1,965
Opt. WR ..... NC
Opt. 00 ..... NC
Opt. 01 ..... NC
Opt. 16 ..... $1,195
Opt. 32 ..... $2,390
Opt. 48 ..... $3,585
4685FSS $395
Opt. 00 ..... NC
Opt. 01 ..... NC
4685FTA $495
Opt. 00 ..... NC
Opt. 01 ..... NC
4685F16 ..... $1,195
Opt. S0 ..... $350
4685J $9,995
Opt. P1 ..... $595
Opt. P2 ..... $295
Opt. 00 ..... NC
Opt. 01 ..... NC
Opt. 16 ..... $1,195
Opt. 32 ..... $2,390
Opt. 48 ..... $3,585
4686 ..... $1,395
Opt. AC ..... NC
Opt. DD ..... NC
Opt. E3 ..... $149
Opt. L0 ..... NC
Opt. L1 ..... NC
Opt. L4 ..... NC
4686A $1,395
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. DD ..... NC
Opt. L0 ..... NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
4686FP1 ..... $295
4686FSS $195
Opt. 00 ..... NC
Opt. 01 ..... NC
4686J $1,655
469CART $395
469LAM $995
Opt. A0 ..... NC
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. A6 ..... NC
Opt. JP ..... NC
Opt. S1 ..... $110
Opt. S2 ..... $230
Opt. S3 ..... $345
Opt. WR ..... NC
Opt. 01 ..... $100
Opt. 02 ..... $100
4690FXI $295
Opt. S0 ..... $350
Opt. 01 ..... $10
4690F20 ..... $495
Opt. S0 ..... $350
4690F27 ..... $995
4690F29 ..... $995
4690F4M $345
Opt. S0 ..... $350
4690F41 ..... $495
Opt. UP ..... –$300
Opt. 00 ..... NC
Opt. 01 ..... NC
4694F1F $595
4697F20 ..... $69
4697F21 ..... $39.95
4698CRT $695
4698FXI $1,995
Opt. S0 ..... NC
Opt. S1 ..... $995
Opt. WR ..... NC
Opt. 00 ..... NC
Opt. 01 ..... NC
4698F01 ..... $395
4698J $8,500
Opt. DD ..... NC
Opt. 00 ..... NC
Opt. 01 ..... $395
Opt. 02 ..... $695
Opt. 04 ..... $395
Opt. 08 ..... $690
Opt. 12 ..... $1,035
4698PXI $6,995
Opt. AC ..... NC
Opt. A0 ..... NC
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. DD ..... NC
Opt. L0 ..... NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. S0 ..... $350
Opt. S1 ..... $995
Opt. S2 ..... $2,065
Opt. S3 ..... $3,040
Opt. WR ..... NC
Opt. 00 ..... NC
Opt. 01 ..... $395
Opt. 02 ..... $595
Opt. 04 ..... $345
Opt. 08 ..... $690
Opt. 12 ..... $1,035
4699FSS ..... $ 495
Opt. 00 ..... NC
Opt. 01 ..... $ 495
4699J $11,500
Opt. DD ..... NC
Opt. D0 ..... NC
Opt. P1 ..... $595
Opt. P2 ..... $295
Opt. 01 ..... $395
Opt. 04 ..... $345
Opt. 08 ..... $690
4699PXI $9,995
Opt. AC ..... NC
Opt. A0 ..... NC
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. DD ..... NC
Opt. D0 ..... NC
Opt. L0 ..... NC
Opt. L1 ..... NC
Opt. L2 ..... NC
Opt. L3 ..... NC
Opt. L4 ..... NC
Opt. P1 ..... $595
Opt. P2 ..... $295
Opt. S0 ..... $350
Opt. S1 ..... $995
Opt. S2 ..... $2,065
Opt. S3 ..... $3,040
Opt. WR ..... NC
Opt. 00 ..... NC
Opt. 01 ..... $395
Opt. 04 ..... $345
Opt. 08 ..... $690
Opt. 12 ..... $1,035
4699RX $7,995
Opt. AC ..... NC
Opt. A0 ..... NC
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. S0 ..... $350
Opt. S1 ..... $995
Opt. S2 ..... $2,065
Opt. S3 ..... $3,040
Opt. WR ..... NC
Opt. 00 ..... NC
Opt. 01 ..... $395
540BACD $576
540BACS $1,320
540D1 ..... $475
540D2 ..... $895
540D3 ..... $1,285
540S1 ..... $1,100
540S2 ..... $1,995
540S3 ..... $2,950
64BPIX $2,540
6502 ..... $6,285
650330200 ..... $1,660
650330300 ..... $4,330
650335600 ..... $4,265
650335700 ..... $985
670972611 ..... $205
671063400 ..... $560
7B15 ..... $4,050
728D $3,200
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. M1 ..... $400
Opt. M2 ..... $220
Opt. M3 ..... $780
Opt. M7 ..... $280
Opt. M8 ..... $560
Opt. M9 ..... $120
Opt. 01 ..... NC
Opt. 02 ..... NC
728E $8,000
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. M1 ..... $550
Opt. M2 ..... $340
Opt. M3 ..... $1,060
Opt. M7 ..... $360
Opt. M8 ..... $720
Opt. M9 ..... $190
Opt. 01 ..... –$2,500
Opt. 02 ..... –$4,800
Opt. 03 ..... $1,200
728F03 ..... $1,200
728M $3,200
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. M1 ..... $400
Opt. M2 ..... $220
Opt. M3 ..... $780
Opt. M7 ..... $280
Opt. M8 ..... $560
Opt. M9 ..... $120
Opt. 03 ..... $1,200
73A270 ..... $3,390
Opt. X1 ..... $205
Opt. X2 ..... $340
Opt. X3 ..... $405
73A308 ..... $1,700
Opt. X1 ..... $100
Opt. X2 ..... $170
Opt. X3 ..... $205
73A425 ..... $ 4,450
Opt. X1 ..... $265
Opt. X2 ..... $445
Opt. X3 ..... $535
73A426 ..... $4,450
Opt. X1 ..... $265
Opt. X2 ..... $445
Opt. X3 ..... $535
73A451 ..... $1,130
Opt. 01 ..... $75
Opt. 02 ..... $75
Opt. 20 ..... $145
73A452 ..... $725
Opt. 01 ..... $75
Opt. 02 ..... $75
73A453 ..... $3,500
Opt. X1 ..... $210
Opt. X2 ..... $350
Opt. X3 ..... $420
73A455 ..... $6,450
Opt. X1 ..... $385
Opt. X2 ..... $645
Opt. X3 ..... $775
Opt. 2N $790
73A541 ..... $2,270
Opt. X1 ..... $135
Opt. X2 ..... $225
Opt. X3 ..... $270
Opt. 96 ..... $50
73A642 ..... $257
73A734 ..... $187
73A850 ..... $645
73A851 ..... $1,240
Opt. X1 ..... $75
Opt. X2 ..... $125
Opt. X3 ..... $150
Opt. 01 ..... $135
Opt. 02 ..... $140
760A $2,500
Opt. A1 ..... NC
Opt. A2 ..... NC

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Products and Price Listing

PRICE INFORMATION

Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. M1 ..... $310
Opt. M2 ..... $235
Opt. M3 ..... $595
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. M9 ..... $130
Opt. 74 ..... $100

760D $2,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. M1 ..... $310
Opt. M2 ..... $235
Opt. M3 ..... $595
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. M9 ..... $130
Opt. 74 ..... $100

760N $2,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. M1 ..... $310
Opt. M2 ..... $235
Opt. M3 ..... $595
Opt. M7 ..... $180
Opt. M8 ..... $360
Opt. M9 ..... $130
Opt. 74 ..... $100

764 ..... $4,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC

92A96UD $35,950
Opt. K1 ..... $ 415
Opt. K2 ..... $830
Opt. K3 ..... $1,245
Opt. Q0 ..... $150
Opt. 1D ..... –$3,500
Opt. 1P $600
Opt. 2D ..... –$1,000
Opt. 4S $2,000
Opt. 95 ..... $150
Opt. 96 ..... $50

92C02 ..... $2,100
Opt. 96 ..... $50

92C96 ..... $14,300
Opt. K1 ..... $320
Opt. K2 ..... $640
Opt. K3 ..... $960
Opt. Q0 ..... $150
Opt. 1D ..... –$3,600
Opt. 1P $600
Opt. 2D ..... –$1,050
Opt. 4S $2,000
Opt. 95 ..... $150
Opt. 96 ..... $50

92C96D $18,400
Opt. K1 ..... $320
Opt. K2 ..... $640
Opt. K3 ..... $960
Opt. Q0 ..... $150
Opt. 1D ..... –$3,600
Opt. 1P $600
Opt. 2D ..... –$1,050
Opt. 4S $2,000
Opt. 95 ..... $150
Opt. 96 ..... $50

92C96SD $26,600
Opt. K1 ..... $320
Opt. K2 ..... $640
Opt. K3 ..... $960
Opt. Q0 ..... $150
Opt. 1D ..... –$3,600
Opt. 1P $600
Opt. 2D ..... –$1,050
Opt. 4S $2,000
Opt. 95 ..... $150
Opt. 96 ..... $50

92C96XD $22,500
Opt. K1 ..... $320
Opt. K2 ..... $640
Opt. K3 ..... $960
Opt. Q0 ..... $150
Opt. 1D ..... –$3,600
Opt. 1P $600
Opt. 2D ..... –$1,050
Opt. 4S ..... $ 2,000
Opt. 95 ..... $150
Opt. 96 ..... $50

92DM04A $2,500
Opt. 1D ..... –$650

92DM06A $2,500
Opt. 1D ..... –$650
Opt. 1S ..... NC

92DM08A $2,500
Opt. 1D ..... –$650
Opt. 1S ..... NC

92DM09B $3,950
Opt. 1D ..... –$750
Opt. 1S ..... NC

92DM10A $3,950
Opt. 1D ..... –$750

92DM11 ..... $3,950
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. 1D ..... –$750

92DM12A $4,950
Opt. 01 ..... $175
Opt. 1D ..... –$750

92DM13A $6,000
Opt. 1D ..... –$1,500

92DM14 ..... $6,000
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. 01 ..... $1,200
Opt. 1D ..... –$1,500
Opt. 1S $1,500

92DM16 ..... $ 4,950

92DM17 ..... $4,950
Opt. 1D ..... –$750
Opt. 2S ..... NC

92DM31B $3,950
Opt. 1D ..... –$750
Opt. 1S ..... NC
Opt. 2S ..... NC

92DM33B $3,950
Opt. 1D ..... –$750
Opt. 1S ..... NC

92DM34A $4,950
Opt. 1D ..... –$750

92DM35A $4,950
Opt. 04 ..... $1,900
Opt. 1D ..... –$1,950

92DM36 ..... $6,000
Opt. 1D ..... –$750

92DM55 ..... $3,500
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. 1D ..... –$1,500

92DM56 ..... $4,950
Opt. 1D ..... –$750

92DM72A $4,950
Opt. 1D ..... –$750

92DM74 ..... $4,950
Opt. 1D ..... –$750
Opt. 2S ..... NC

92DM75A ..... $ 4,950
Opt. 1D ..... –$750
Opt. 2S $250

92DM77A ..... $ 4,950
Opt. 1D ..... –$750

92DM81 ..... $3,500
Opt. 1D ..... $ -650
Opt. 2S ..... NC

92DM901 ..... $2,500
Opt. 1D ..... –$550

92DM902 ..... $2,500
Opt. 1D ..... –$200

92DM911 ..... $12,000
Opt. 1D ..... –$8,000

92DM912 ..... $3,500
Opt. 1D ..... –$650
Opt. 2S ..... NC
Opt. 3S ..... NC

92DM913 ..... $2,500
Opt. 1D ..... –$550

92DM914 ..... $3,500
Opt. 1D ..... –$750

92DM916 ..... $3,500
Opt. 1D ..... –$750

92DM920 ..... $3,500
Opt. 1D ..... –$750
Opt. 2S ..... NC

92DM921 ..... $3,500
Opt. 1D ..... –$1,950

92DM923 ..... $3,500
Opt. 1D ..... –$1,950

92DM925 ..... $3,500
Opt. 1D ..... –$750
Opt. 2S ..... NC

92DM926 ..... $1,000
Opt. 1D ..... –$750

92DM927 ..... $1,000
Opt. 1D ..... –$750

92DM93A $3,500
Opt. 1A $750
Opt. 1D ..... –$750
Opt. 2S ..... NC

92DM930 ..... $8,200
Opt. 1D ..... $ -7,700

92DM94 ..... $4,950
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A5 ..... NC
Opt. 1D ..... –$1,500

92FMPA $250

92FM04A $250

92FM06A $250

92FM08A $250

92FM09A $250

92FM10 ..... $250

92FM12 ..... $250

92FM12A $250

92FM13A $250

92FM14 ..... $250

92FM17 ..... $250

92FM31A $250

92FM33A $250

92FM34A $250

92FM35A $250

92FM55 ..... $250

92FM72A $250

92FM74 ..... $250

92FM75A $250

92FM77A $250

92FM81 ..... $250

92FM901 ..... $250

92FM902 ..... $250

92FM911 ..... $250

92FM912 ..... $250

92FM913 ..... $250

92FM914 ..... $250

92FM916 ..... $250

92FM920 ..... $250

92FM921 ..... $250

92FM923 ..... $250

92FM925 ..... $250

92FM926 ..... $250

92FM93A $250

92FM930 ..... $250

92FM94 ..... $250

92FXNET $12,260
Opt. Q0 ..... $700
Opt. 1E ..... NC
Opt. 18 ..... $360
Opt. 4X $1,860
Opt. 95 ..... $150
Opt. 96 ..... $50

92FXSE $9,790
Opt. Q0 ..... $600
Opt. 1E ..... NC
Opt. 18 ..... $360
Opt. 4X $1,860
Opt. 95 ..... $150
Opt. 96 ..... $50

92F1B $3,450

92F11 ..... $ 400
Opt. Q0 ..... $300

92F19 ..... $475

92LANP $1,500

92LANSE $980
Opt. Q0 ..... $225
Opt. 01 ..... $1,500
Opt. 96 ..... $50

92PA $2,500

92PORT $975

92QTURN $5,000

92SIMLK $1,000

92SSR $750

92SSU $1,500

92SWU $1,250
Opt. 01 ..... NC

92SX109 ..... $10,200
Opt. K1 ..... $320
Opt. K2 ..... $640
Opt. K3 ..... $960
Opt. Q0 ..... $520
Opt. 09 ..... $2,600
Opt. 11 ..... $950
Opt. 95 ..... $150
Opt. 96 ..... $50

92SX118 ..... $13,500
Opt. K1 ..... $320
Opt. K2 ..... $640
Opt. K3 ..... $960
Opt. Q0 ..... $565
Opt. 09 ..... $5,200
Opt. 95 ..... $150
Opt. 96 ..... $50

92S16 ..... $7,550
Opt. K1 ..... $320
Opt. K2 ..... $640
Opt. K3 ..... $960
Opt. Q0 ..... $150
Opt. Q6 ..... $665
Opt. 1D ..... –$1,550
Opt. 2S $3,600
Opt. 95 ..... $ 150
Opt. 96 ..... $50

92S32 ..... $9,750
Opt. K1 ..... $320
Opt. K2 ..... $640
Opt. K3 ..... $960
Opt. Q0 ..... $150
Opt. 1D ..... –$3,100
Opt. 1S $1,800
Opt. 2S $3,600
Opt. 95 ..... $150
Opt. 96 ..... $50

92XTERM $3,050

9206XT $2,800
Opt. A1 ..... NC
Opt. A2 ..... NC
Opt. A3 ..... NC
Opt. A4 ..... NC
Opt. A5 ..... NC
Opt. K1 ..... $200
Opt. K2 ..... $400
Opt. K3 ..... $600
Opt. Q0 ..... $200
Opt. 1X $3,050
Opt. 4C $980
Opt. 4X $1,860

9617H3 ..... $3,000

9617K3 ..... $2,100

9617R3 ..... $3,500

9617S3 ..... $3,100

All prices, specifications and characteristics set forth in this catalog are subject to change without notice. Prices current at the time an order is accepted by Tektronix will apply. Check with your local Tektronix representative for current price and specification information.

49A-10733-0

ISO Certification

ISO 9001
ACCREDITED BY THE DUTCH COUNCIL FOR CERTIFICATION

Tektronix Measurement products are manufactured in ISO registered facilities.

ISO CERTIFICATION

Tektronix has chosen to become ISO9001 certified in order to demonstrate to our customers our commitment to being a quality vendor. By passing the audit, Tektronix assures that behind our quality products and services is a well-defined, systematic approach to quality-design to delivery. This certificate reinforces Tektronix' status as a deliverer of technology and quality in products.

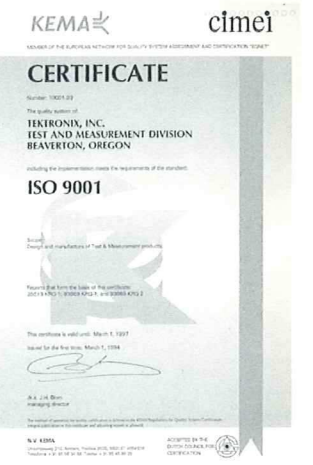
To achieve, ISO 9001 certification you need to prove to a third party, known as the quality system registrars, that you meet three requirements:

1. Leadership
2. Involvement
3. Quality in Line Organizations and Quality System Infrastructure

The ISO 9001 standard establishes a minimum requirement for the above and starts transitioning the company from a traditional inspection-oriented quality system to one based on partnership for continuous improvement. This concept is key in that Tektronix no longer focuses on inspection but on individual processes.

Tektronix' quality management system are based on three objectives:

1. Customer oriented quality–the aim is to improve customer satisfaction.
2. Quality is determined by people–the aim is to improve the internal organization and cooperation between staff members.
3. Quality is continuous improvement–the aim is to continuously improve the internal organization and the competitive position.


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TEST AND MEASUREMENT DIVISION
BEAVERTON, OREGON
ISO 9001


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